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"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

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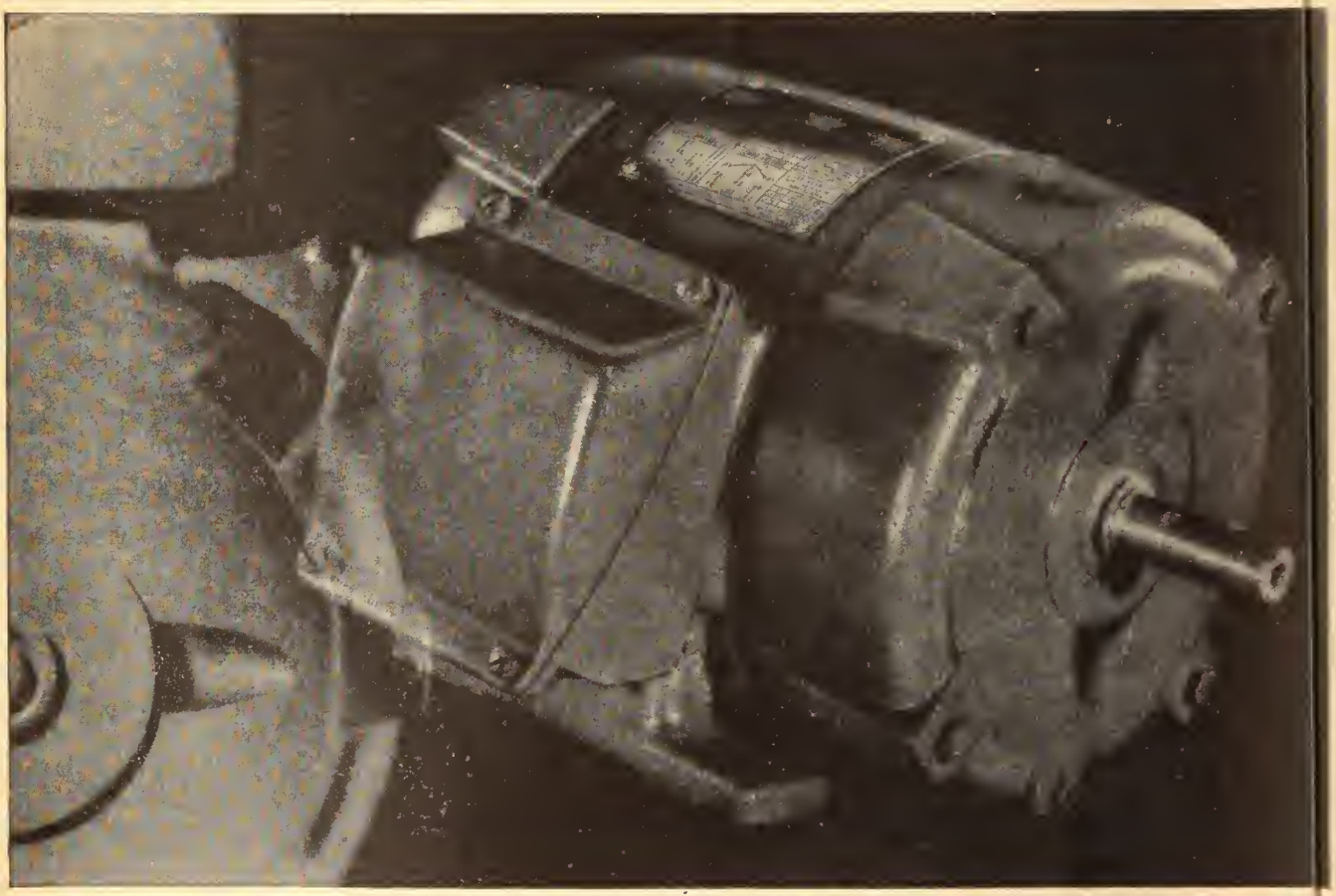

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Polythene, Its Development, Manufacture and Use

A paper presented before the Edmonton Branch of the Engineering Institute of Canada, February 10, 1954.

by

J. W. Suthren, M.E.I.C.

Assistant Works Manager, Edmonton Works, Canadian Industries (1954) Ltd., Edmonton, Alta.

Polythene, the transparent 'wonder plastic' that helped to make wartime radar possible, has now 'gone commercial'. By 1956 the U.S. market alone is expected to absorb half a billion pounds yearly. Canada's requirements can now be supplied by a recently opened Canadian Industries 1954 Limited plant at Edmonton, using ethane extracted from natural gas. In this paper the production process, properties and uses of polythene are described.

Early in 1931 Imperial Chemical Industries of Great Britain (I.C.I.), decided to investigate the affect on chemical reactions of pressures varying between 1,000 and 12,000 atmospheres. This decision, taken during a period of industrial depression when research might have been thought by some to be a luxury, set in motion a research project for which even the equipment to be used presented an appreciable problem.

Although high pressure physics at 1,000 atmospheres was being studied by Bridgeman in the United States, the first continuous compressor to work above 1,000 atmospheres was designed and constructed in Holland. It was sometime after the decision was made to embark on the project that suitable equipment was obtained and a start made.

The overall project to study chemical reactions at high pressures was broken down into several sections, one covered reactions with unsaturated hydrocarbons such as ethylene. Among the reactions studied in this group was that between benzaldehyde and ethylene, carried out in 1933 by two men Gibson and Fawcett. Gibson, in his notebook for 27th March 1933, made an entry which read — "white waxy solid in reaction tube".

The experiment was repeated, but an explosion took place. It required several unsuccessful attempts before the experimenters were able to obtain a reaction with the gas supply available which, when the bomb was opened, gave them 8 grams of the snow white material we now know as polythene.

Early Uses

For many months the polymer was a scientific curiosity, and it was not until several evaluation tests had been carried out that its true potential began to appear. Requests for larger quantities to be used for further evaluation purposes resulted in a pilot plant being constructed by I.C.I. Initial production from this pilot plant occurred in 1938, and a new plastic had been launched

Early evaluation indicated that polythene, used as an electrical insulating material, combined several of the most desirable properties in a manner then unique. It had a high dielectric strength, it has a very low dielectric loss factor even at centimetric wave lengths, it was moisture repellant, it could be moulded or extruded, it was tough, it remained flexible even at extremely low temperatures, and it was light, in fact the lightest plastic known.

One of the first applications tried was in submarine cable, where it proved singularly effective replacing the formerly used Gutta Percha. Its properties when applied to radar were recognized by Sir Robert Watson Watt, sometimes referred to as "Mr. Radar," who stated that polythene had greatly simplified installation and maintenance problems of airborne radar.

Wartime Production

The evaluation tests permitted by the material from the I.C.I. pilot plant soon indicated a potential demand for commercial production of polythene. To this end a plant was designed and constructed by I.C.I. which started production the day that Hitler invaded Poland in September, 1939. However, the entire output from this plant was immediately commandeered for military purposes, and construction of a second and larger plant was started to augment the supply.

From discussions with the engineer responsible for design and equipment procurement of the second plant, who received an O.B.E. for his efforts, it is evident that in blitzed, struggling Britain of the early forties, obtaining the necessary high pressure equipment, special alloy fittings and piping, etc., made today's construction and procurement problems appear paltry. Nevertheless the second I.C.I. plant started operations in 1942 and is still running, producing good polythene.

During the war, the utilization of all output for military purposes had the immediate effect of accelerating I.C.I.'s production, but the long term effect was reverse. Polythene could not be spared for development of civilian applications which have expanded so spectacularly since 1946. It was not until 1951 that I.C.I.'s third and much larger polythene plant came into production in England.

Because of polythene's military value part of the British early wartime production was made available for U.S. and Canadian service needs through the Allied High Command.

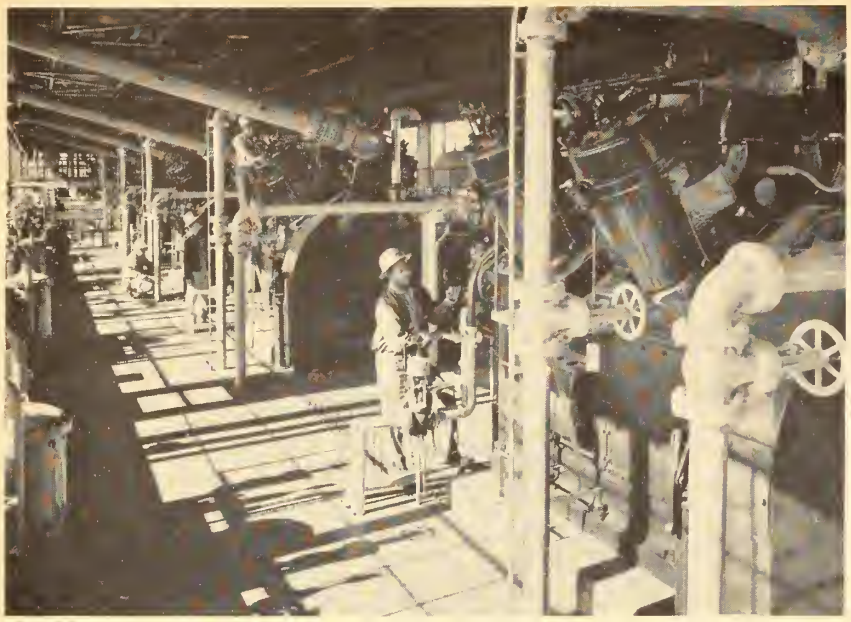


Fig. 1. In this row of gas compressors, natural gas and its derivatives are compressed at various stages in the first step of polythene manufacture.

Meanwhile in the United States, both duPont and the Carbide and Carbon Chemicals Corporation developed processes for polythene production, based on the I.C.I. patents, which they were able to get into production in 1943.

Postwar Market

After the war much greater attention could be devoted to non-military uses of polythene. Only then was it fully realized that polythene's unique combination of properties could be used in many applications. From 5,000,000 lbs. at the end of World War II, annual world consumption has already risen to over 200,000,000 lbs. By 1956 U.S. demand alone is expected to reach 500,000,000 lbs. per year if not more. There are currently two U.S. producers of polythene; six more are under construction.

Canada's requirements during the post war period were supplied by imports. The polythene process operates at pressures higher than any other known commercial operation. This requires massive high grade alloy equipment and much precision workmanship. In consequence — the investment required for a plant is very large, a small plant is uneconomical. Until Canada's consumption reached a substantial level it remained in everyone's best interest to continue importing from larger plants elsewhere.

Canadian Plant at Edmonton

By 1951 market studies indicated that the Canadian demand for polythene would reach a reasonable level by about 1954, and Canadian Industries Limited decided to construct a plant at Edmonton. Most users of bulk polythene are located in Ontario and Quebec, but this site was chosen because of the availability of favourable raw materials.

Ethylene, from which polythene is made, is cracked from ethane. At Edmonton there is a virtually inexhaustible supply of natural gas rich in ethane. Furthermore, the advantage in raw material and fuel costs offsets the freight charge for sending the finished product to the East.

The production of polythene at Edmonton started last October — 18 months after the first sod was turned in April 1951. The plant is now producing quality polythene in quantity. The production is divided into two basic stages. The first stage is the production of pure ethylene from natural gas, and the second is the polymerization of ethylene to polythene.

The production of ethylene is achieved in an ethylene unit designed by the Lummus Co. of New York. Ethylene plants are much the same but local conditions, raw materials etc., vary enough to give each plant its own peculiar problems and modifications. In this the Edmonton unit is not an exception.

The starting material of the ethylene unit is a dry residue gas. Formerly this gas, consisting of approximately 75 per cent methane, 20 per cent ethane and 5 per cent propane, was delivered directly to the City of Edmonton. Because of its high heat content, it had to be diluted before distribution for use by the average householder. Now, gas is diverted to our plant where the ethane is extracted, fuel needed for plant use is consumed, and the residue fed back into the main. A rigid control is maintained over the gas returned

Fig. 2. A close-up of the ethylene distillation towers where ethylene gas is purified to a high degree before the polymerization process.

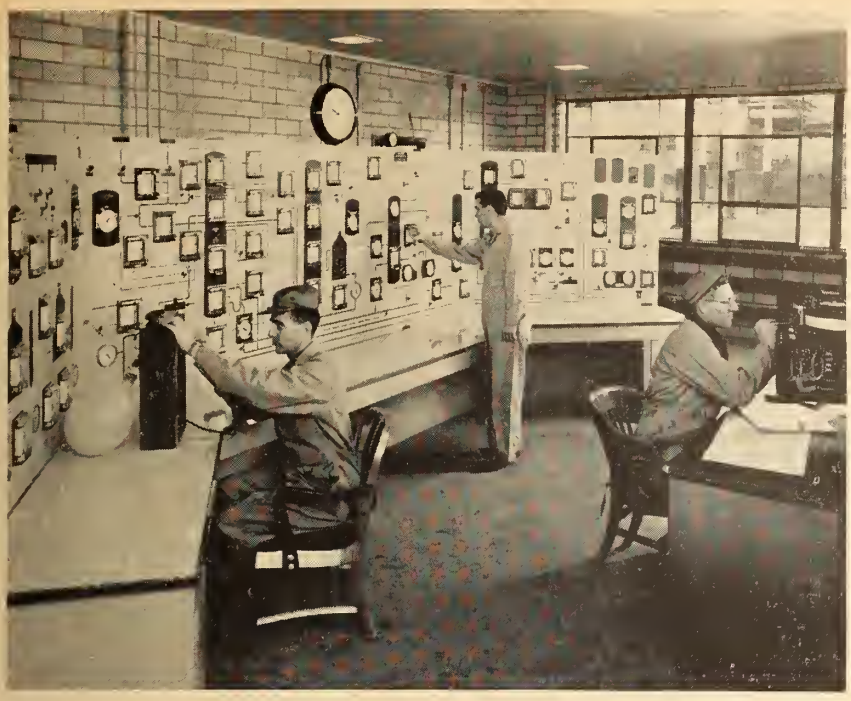


Fig. 3. A control room—one of several from which the manufacturing operations are controlled and checked.

to the main, to ensure that the B.T.U. content is satisfactory.

Similar to Oil Refinery

An ethylene unit is similar to an oil refinery unit, looks a bit like one, and in process could be considered as an extension to an oil refinery. Conventional liquid phase cracking, as carried out in an oil refinery, depends basically upon the breaking down of large hydrocarbon molecules under heat treatment into smaller molecules.

Ethane and propane cracking as developed on a large scale is an extension of the thermal cracking processes of the oil industry. However, it aims at producing high yields of ethylene by very high temperature pyrolysis of ethane and propane in the gas phase.

The basic chemical reaction in the ethylene plant is the high temperature gas phase dehydrogenation of ethane (C_2H_6) to ethylene (C_2H_4) in a cracking heater, where the gas stream, consisting of roughly 92 per cent ethane and 8 per cent propane, attains a temperature of 1,500°F. Like all cracking processes the length of time spent in the cracking zone of the heater tubes is a critical factor. If the contact time is too long the ethylene formed by the initial reaction will polymerize to higher hydrocarbons. These in turn will be decomposed to carbon and hydrogen.

This contact time is limited to give an optimum conversion with minimum side reactions. It should be emphasized that current optimum conversion still leaves an appreciable amount of ethane unconverted — in the order of 50 per cent. This must be separated from the other constituents of the heater effluent and recycled back to the cracking heaters. The separation is achieved in the "heater effluent absorber".

Plant Operation

To obtain the primary ethane charge for the cracking heaters it is necessary to separate the ethane from the methane of the incoming natural gas, or, as it is termed, fresh gas feed to the plant. This separation is performed in the "fresh feed absorber".

In both absorption units, the heater effluent absorber and the fresh feed absorber, advantage is taken of the fact that when a mixture of hydrocarbons is brought into intimate contact with a relatively heavy oil in which the various constituents are soluble, there is a definite tendency towards a transfer of these constituents between gas and oil. Therefore, the gas is passed through suitably constructed towers countercurrent to a flow of lean oil consisting of predominantly hexanes and heptanes (akin to gasoline) admitted near the top of the tower.

Conditions of operation, pressure, temperature, rates of oil to gas, etc., are chosen to ensure that substantially all of the ethane and ethylene in the gas streams is picked up and retained in the oil. The lighter constituents comprising methane and hydrogen leave the top of the tower as gases. The rich oil is drawn off at the bottom of each tower.

As the plant operates, the rich oil stream from the bottom of the fresh feed absorber (containing dissolved ethane from the fresh feed gas) flows, with additional lean oil, into the top of the heater effluent absorber tower. On its downward journey it absorbs ethane and ethylene from the heater effluent, flowing upwards. This permits the methane and hydrogen to pass out of the top as gas.

The rich oil from the bottom of the heater effluent absorber contains the combined ethane and ethylene picked up in both absorbing towers. This rich oil is passed through a distillation tower, where the ethane and ethylene are vaporized from the absorbing oil and subsequently condensed and fed to a fractionating tower for separation. The ethane separated in the fractionating tower is fed to the cracking heaters. The

Fig. 4. As polythene is manufactured it is extruded from the reactors in the form of a continuous ribbon. Here the ribbon has left the reactors, passed through a water cooling bath and is being inspected on its way up to the floor above where it is chopped, blended and bagged.

ethylene, after scrubbing, is discharged to storage tanks as a liquid or fed directly to the polythene stage.

Heating and Cooling

This covers briefly the salient features of ethylene production but it must not be overlooked that pressures and temperatures play an important part in the process. The need for maintaining widely divergent temperatures in the many unit operations concerned, as well as the necessity of exercising economy in the heating and cooling phases of the process, results in the extensive use of equipment for heat transfer purposes.

Generally, the heat exchangers employed are of the shell and tube design. The pressure requirements of the process are met through the use of large gas engine driven compressors, commencing with the fresh feed gas compressors which boost the incoming gas pressure to around 550 lbs. per sq. in. and terminating in the ethylene compressors which deliver ethylene to the product line at approximately the same pressure.

Refrigeration is a major item in a unit such as this, and the basic load is carried by a circulating cooling water system. Current demands for plant cooling water are in the order of 9000 g.p.m. Additional refrigeration, where necessary, is obtained from a freon unit, utilizing a 4 stage centrifugal compressor rated at 900 tons of refrigeration and driven at approximately 5000 r.p.m. by a 1,300 h.p. turbine.

Process Confidential

The pure ethylene produced by the ethylene unit is fed to the polythene unit at a pressure in the order of 550 lbs. per sq. in. The polythene process is confidential, and it is not possible to go into details of equipment or process. Since it is a relatively simple process, basically a high pressure polymerization of pure ethylene in the presence of a catalyst, it may be stated that the ethylene is compressed to a pressure of over 20,000 lb. per sq. in. and fed to a reaction vessel where the polymerization takes place.

The compressors are custom units of rather massive construction, requiring drives of over 600 h.p. each. They operate quite efficiently and give relatively little trouble. Valves, fittings, packings, etc. present problems at times, but since they were designed for the service they also operate without too much trouble. They are rather different from the standard types most of us are accustomed to, but so is the service.

Ribbon Discharge Cooled and Diced

Pipe lines used are extremely heavy walled, and made of special alloys, but this again is understandable when it is realized that they are operating under continuous pressure akin to the pressure encountered in a rifle barrel, after cartridge powder ignition and prior to the bullet leaving the muzzle.

The compressed gas is fed to a reaction vessel at a constant rate and under controlled conditions of pressure and temperature. Polymerization, once started in the vessel, goes forward at a constant rate forming liquid polythene, which is bled off also at a constant rate. Gas entrapped with the liquid polythene is separated and recycled to the system and the polythene, maintained liquid by close temperature control, is extruded through a nozzle in the form of a ribbon. The ribbon on cooling is fed to a dicing machine where it is cut into cubes and transferred into large hoppers. From the hoppers it is bagged into 50 lb. bags on a standard bagging machine, and is then ready for shipment.

Properties of Polythene

Polythene, is not a trade mark, but the generic name for those polymers of ethylene suitable for application as plastics. It is a thermoplastic resin produced by polymerizing ethylene under high pressure and elevated temperatures to form long, essentially saturated, hydrocarbon chains. By controlling the conditions of polymerization the length of these chains may be varied to yield polymers of different molecular weights, but the molecular weights of all useful grades produced are in the thousands.

Uncompounded polythene is a waxy, white, translucent material, tasteless, odourless, and non toxic. It has more properties rated as very good than any other synthetic resin. Like nylon it is relatively strong, and can be cold-drawn to produce an irreversible elongation with an increase in tensile strength. In thin sections it is very flexible, although it lacks the limp rubbery quality that characterizes most non-rigid plastics. In thick sections polythene exhibits sufficient stiffness to be classed among the more rigid plastics. It is the lightest solid plastic, with a density less than that of water.

Polythene is tough, possessing a high impact strength and shock resistance. It is flexible even at low temperatures, with grades of highest molecular weight being flexible at temperatures below −70°C. It has a high softening point and heat distortion temperature.

It possesses excellent resistance to chemical attack, even by hot concentrated acids and alkalis. It is not dissolved by any solvent at room temperatures, is grease-proof, non-corrosive, and has a very high resistance to the permeation of water vapour. It is resistant to bacteria and fungi and will not support mold growth.

Electrically, polythene possesses a high dielectric strength, a low dielectric constant, a very low power factor, and dielectric stability over wide frequency and temperature ranges. This of course was demonstrated by its original use in radar.

Many Commercial Applications

The foregoing properties, coupled with the fact that polythene can be extruded, moulded and heat-sealed, has led to its application in many fields. In fact the demand resulting from trial applications has increased so phenomenally that, as was mentioned before, at least six new large plants are being constructed concurrently in the United States.

The uses of polythene can in general be broken down into 4 categories: packaging; electrical applications; consumer goods; and industrial uses.

Packaging

Generally speaking polythene can be used for packaging in two ways, – by itself or in combination with other materials. Polythene, by itself, is used in such forms as film, bags made from film, and as bottles or vials both large and small. In combination with other materials it appears as a coating for paper, cardboard, fabric, foil, etc.

It can be blown or injection moulded into bottles, which, because of the material's flexibility and flex strength, lend themselves to squeeze type applications — the familiar squeeze bottle. Because of its chemical inertness similar or larger bottles may be used as unbreakable containers for liquid chemicals such as hydrofluoric acid, battery acid, as well as other wet and dry reagents. The lightness of polythene produces a container which in many cases is much easier to handle and results in large savings in freight.

The potential for polythene film in the packaging field is enormous. The products that can be successfully packaged to advantage in polythene film, either by itself, or as a liner for rigid or flexible outer containers are innumerable. Food stuffs, soap, shrubs, cosmetics, tools,

Fig. 5. Polythene film is used mainly for food packaging. Industrial uses are as coatings for multi-wall craft bags, liners for chemical drums as shown here.

Fig. 6. Polythene housewares.

chemicals, precision equipment, automobiles for overseas shipments, even polythene itself.

In combination with other materials for example — as a film applied to paper — polythene imparts more strength, chemical and moisture resistance, and widens the uses to which paper may be put. The familiar multiwall paper bag for packaging fertilizers, cement and other materials — becomes not only moisture proof but considerably stronger through the use of polythene coated paper.

Those who are associated in any way with concrete work will realize the value of cement packed in moisture proof and stronger multiwall paper bags. Coated on foil, polythene imparts crease and puncture resistance and reduces the tendency to contaminate contents. It also serves as a heat seal medium, thus simplifying the package closing procedure. Truly, polythene can revolutionize the packaging industry, since rare indeed is the packaged material that will not benefit from its application.

Electrical

Polythene's early development was based almost entirely on its many electrical applications. Because of its excellent water resistance one of its first commercial uses was in the insulation of submarine cable. Subsequently, and as an outgrowth of its wartime application to radar, it has developed into what could be considered the most useful high frequency dielectric for such uses as coaxial cable, twin cable such as the TV lead-in, twisted pair and multi-circuit TV transmission line.

In the construction of multi-conductor telephone cable a sheath of polythene successfully replaces the formerly used lead with the distinct advantage of a considerable reduction in weight. It is interesting to note that the first polythene insulated H.F. cable commercially produced in North America was manufactured in Canada, using British polythene. Polythene used as a storage battery case gives excellent service and, of course, has the advantage of producing an unbreakable case.

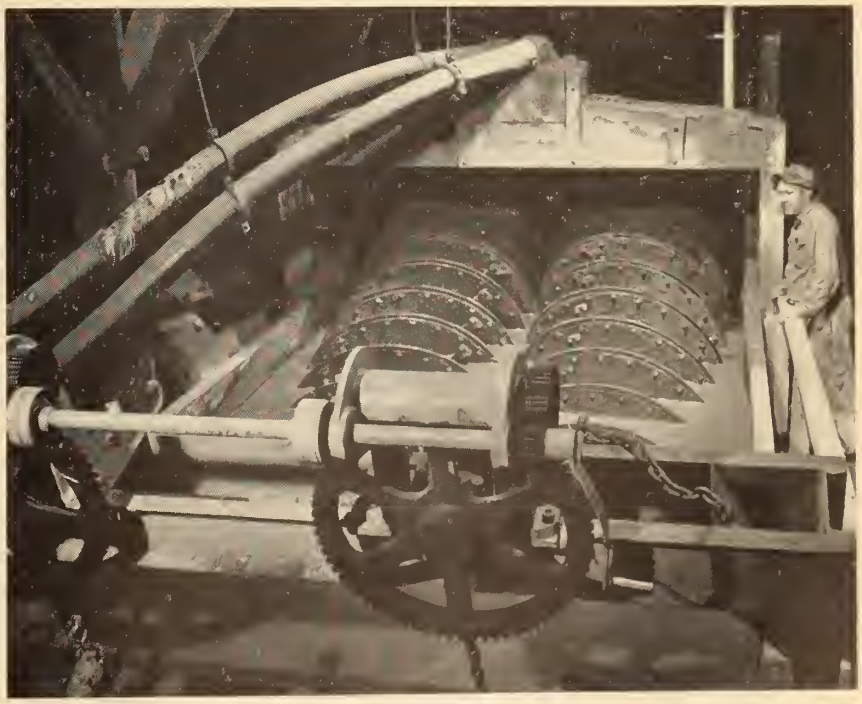


Fig. 7. Six-inch polythene pipe in use at Giant Yellowknife Gold Mines in N.W.T. Used to carry slurry (60% solid).

Consumer Goods

The non-toxic and waterproof properties of polythene, plus its inertness and lack of taste and smell, make it ideal for use in food containers. Coupled with its unique properties of flexibility and toughness these properties give polythene a natural usefulness in household items such as tumblers, ice cube trays, soap dishes, food storage bowls, toys, etc.

The very fact that a toy fabricated from polythene is unbreakable, washable or cleanable with solvent, non-toxic, and floats, makes it attractive to children and parents. Regarding polythene ice cube trays, the fact that the trays are flexible and that ice does not stick to the polythene makes it a simple matter to pop the ice cubes out when required.

Around the house and farm one of the better applications of polythene is in cold water piping. Extruded polythene pipe can be obtained in lengths of hundreds of feet, and owing to its lightness can be handled by one man. A 300 ft. coil of one inch diameter flexible pipe weighs only 54 lbs. In addition its characteristic of expanding with freezing water, and returning to normal on thawing makes it unnecessary to lay a pipe line more than a few inches below the ground surface. In fact lines can be laid on the surface of the ground and moved at will.

A few years ago in Dunnville, Ont., the public utilities manager was asked to provide water service to three new houses located 1,600 ft. from the nearest main. The economy-minded official elected to try the new polythene pipe available and in less than 4 hours, with three men and a trencher, had completed the laying and back filling for the entire job.

Other uses of polythene which have particular application in Alberta — are the utilization of polythene film in the form of tarpaulins for the protection of grain and of farm implements and automotive equipment. There are many Edmontonians lacking garages who could employ a polythene envelope to effectively protect their vehicle from rain, snow, dust, etc. Being light the cover is relatively easy for one person to handle.

Industrial

The industrial uses of polythene are many, and stem primarily from its inertness. This property, coupled with its other characteristics, make polythene desirable for a wide range of uses in mining, chemical manufacture, pulp and paper, brewing and food processing. In addition to its use in piping and other forms, polythene is used for tank linings where sheet polythene may be used or the lining sprayed on.

Polythene possesses one characteristic which results in its achieving remarkable results in the air filtration field. Shredded polythene, where subjected to a continuous air stream, becomes electrostatically charged and continues to renew its charge as long as the air stream blows over it. Since the charge is opposite to that carried by dust particles in the air stream the polythene filter becomes in effect a self-generating electrostatic precipitator.

Tests carried out on pullman cars and elsewhere to date have shown remarkable results in comparison with other filter packs now in use, particularly since the polythene filters can be cleaned and reused. An extension of this use to forced air systems in industry and homes should prove particularly effective on the prairies where, during certain times of the year, dust presents an appreciable problem.

There are many other actual and potential uses of polythene that could be mentioned. Some of these, because of the shortage of polythene in Canada, have not as yet been firmly established commercially. As the supply of polythene becomes greater, so will its use expand.

Fig. 8. Aerial view of the plant.

Fig. 1. Aerial view of ore transfer facilities.

Ore Handling Facilities at Seven Islands

by

D. H. Sharp, M.E.I.C.

C. D. Howe Company Ltd., Montreal

Handling ten million tons of iron ore in eight months is not to be done with shovel and wheelbarrow; this was the problem of the Iron Ore Company of Canada at its Seven Islands shipping point. This article tells how it was solved by the use of the most modern types of unloading, conveying, storing, reclaiming and loading equipment. The installation is notable for the many safety features which have been built into it.

Iron ore is mined by open cut methods from various deposits near Knob Lake for about five and a half months of the year. This ore is of different types and varies in its characteristics. It may be lump ore, like coarse sand, like soft mud, or a mixture. It weighs 135 to 150 lb. per cu. ft.

The ore, crushed to 5 in. at the mines, is shipped in cars of 90 long tons capacity in trains of about 115 cars. In general, about seven trains make the 360-mile trip from the mines to the terminal in each 24 hours. They finish their runs in the classification yard of the terminal, seen in the right background of Fig. 1. The terminal is located on the flat, sandy, coastal plain two or three miles from Seven Islands.

Ore handling facilities are fed from the classification yard and are capable of handling 8,000 long tons of iron ore per hour into ships, or 3,000 long tons per hour to storage piles. The shipping season is about eight months.

Ore Grading

The ore graders arrange for the delivery of cars to the various tracks of the classification yard according to the grade of the ore. Diesel electric pusher locomotives deliver these cars, one or two at a time, to the inert retarder at the foot of the barney slope under the instructions

Fig. 2. Pusher locomotive used for drawing cars to insulated section of barney track; dumper house in background.

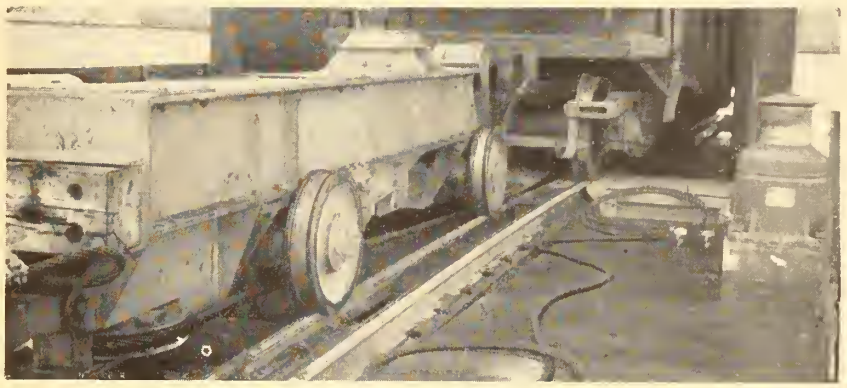


Fig. 3. Barney mule at top of travel pushing car into rotary dumper.

of the ore grading staff (Fig. 2). It is at this point that the ore handling facilities, as described in this paper take over.

The car or cars in the inert retarder are pushed up the 11 per cent incline 220 feet to the tandem car dumper by the barney mule or "pig" (Fig. 3), which is a heavy chassis on wheels, pulled up by two 1⅝-in. steel wire ropes and back to its original position by one 1¼-in. tail rope. This mule operates on two sets of tracks so arranged that it uses the outer when pushing cars and the inner when returning to its starting point. Switches at the ends of the travel slide the wheels in and out on their axles. The mule returns to rest at the bottom of the incline by travelling on the inner track under the next two cars waiting in the inert retarder and rapid rise of these inner tracks enables the mule to engage the rear coupler of the cars to be pushed up the incline. This operation is under the control of the operator in the dumper house and is protected by various safety devices.

When the pusher locomotives deliver the cars to the retarder, they leave them on a section of insulated track and themselves must actuate a limit switch to ensure this. Unless the cars are entirely on the insulated track, the 5-volt current which it carries is shorted by them; also when the mule returns to its starting position it must actuate a limit switch at the end of its travel. Unless these conditions are met and all the switches actuated, the electrical circuit of the barney haulage is not complete and the dumper operator cannot move the mule. In this way it is assured that the mule is at its starting point and that the cars are in the correct position to be engaged properly at the coupler by the mule at the beginning of its cycle.

Should a short occur at the insulated track, the equipment "fails safe" and cannot be moved. Beside these devices, one of the staff sits where he can observe the contact between mule and car and operate an emergency stop button if it is necessary. The mule cannot complete its cycle and deliver the cars into the rotary dumper unless the dumper has actuated a switch by returning to the upright position; a maximum travel switch is also provided to limit the travel of the mule at the upper end of its cycle.

The barney haulage operation is completely automatic, being run by a nut limit switch which has a zero speed switch on it to cut off the

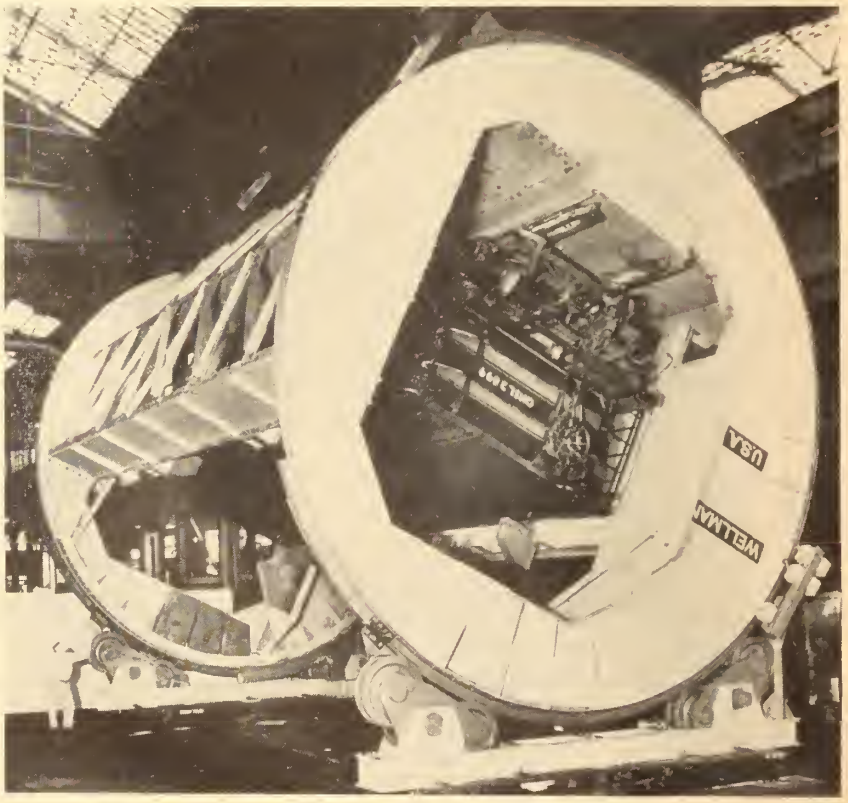


Fig. 4. One half section of dumper set up in manufacturer's shop.

power should the nut limit switch stop for any reason.

The barney haulage pushes cars up the incline at 600/ft. min., engages them with the empty ones already in the dumper at 200 ft/min., then accelerates to 300 ft./min. before coming to a stop at the end of its travel. It is then returned to its original position at 1200 ft./min. Forty-five cycles are made per hour.

The Barney Hoist

The barney hoist consists of a single, parallel-face, welded drum about 7′-0″ in diameter by 9′-9½″ long, grooved for the three cables mentioned. It is driven by two 350 hp., shunt-wound, d.c. motors through gear flex couplings and herringbone pinions to a ring gear mounted on the hoist drum. The large gear dips in oil and oil is pumped to the pinions. The hoist is mounted on antifriction bearings and the motors are provided with solenoid brakes on their double ended shafts. Power is supplied through a 700 hp. motor generator set.

The hoist building is located below the barney slope, so that the wire ropes are in line with the drum. This building is divided into two parts and the one housing the electrical apparatus is pressurized to protect the equipment from dust.

The dumper operator stops the two full cars delivered by the barney mule by using two air operated retarders, one in each half of the tandem dumper. Fig. 4 shows one half section of the dumper. Air for the retarders is provided by a 260 c.f.m. air-cooled compressor. Delivery is through an aftercooler and a long length of hose to allow for the rotation of the dumper. A spare compressor is installed.

The arrival of the two full ore cars pushes the two empty cars out of the dumper and these return by gravity to the empty car yard. Should the full cars not have been stopped in quite the correct position in the dumper by the operator they are "pinched" along by lever or pulled in either direction by either of two 10 hp. vertical spindle car pullers provided for the purpose.

The operator rotates the dumper toward him through about 180° and so can see the inside of the cars. The rotation of the dumper automatically actuates, by counter weights, the clamps which hold the ore cars to the rails. These clamps have been designed so that vibrators can be mounted on them to assist in clean dumping of the ore should this be necessary. As has been intimated, the dumper is made up of two separate units, each mounted on two circular rails, each of which rides on eight double-flanged equalizer wheels. Each half of the dumper has its own drive and the drive shafts are connected by a quick disconnect coupling, so that each unit may be operated separately if required. The drive pinions engage cast segmental ring gears which encircle the dumper structure. A selector switch is provided, so that the operator may dump either one or two cars. End thrust, due to the stopping of full cars, is taken by rollers and transmitted to the building at the discharge end.

Duplicate Facilities

The dumper house provides duplicate facilities; beside the tandem dumper with its two units coupled together there are two separate 38° grizzlys, two crushers, two hoppers, two feeders and two reversible belts below the feeders. (Fig. 5.) The track level in the car dumpers, 20 ft. above ground, is such that empty cars run by gravity to the empty car yard from the dumper and the lowest basement floor is about 30 ft. below ground water and 20 ft. below mean low tide. The building is 500 ft. from the shore.

There is a possibility that ore will freeze in the cars during the 16-hour run from Knob Lake, or in the storage piles, and that frozen lumps may

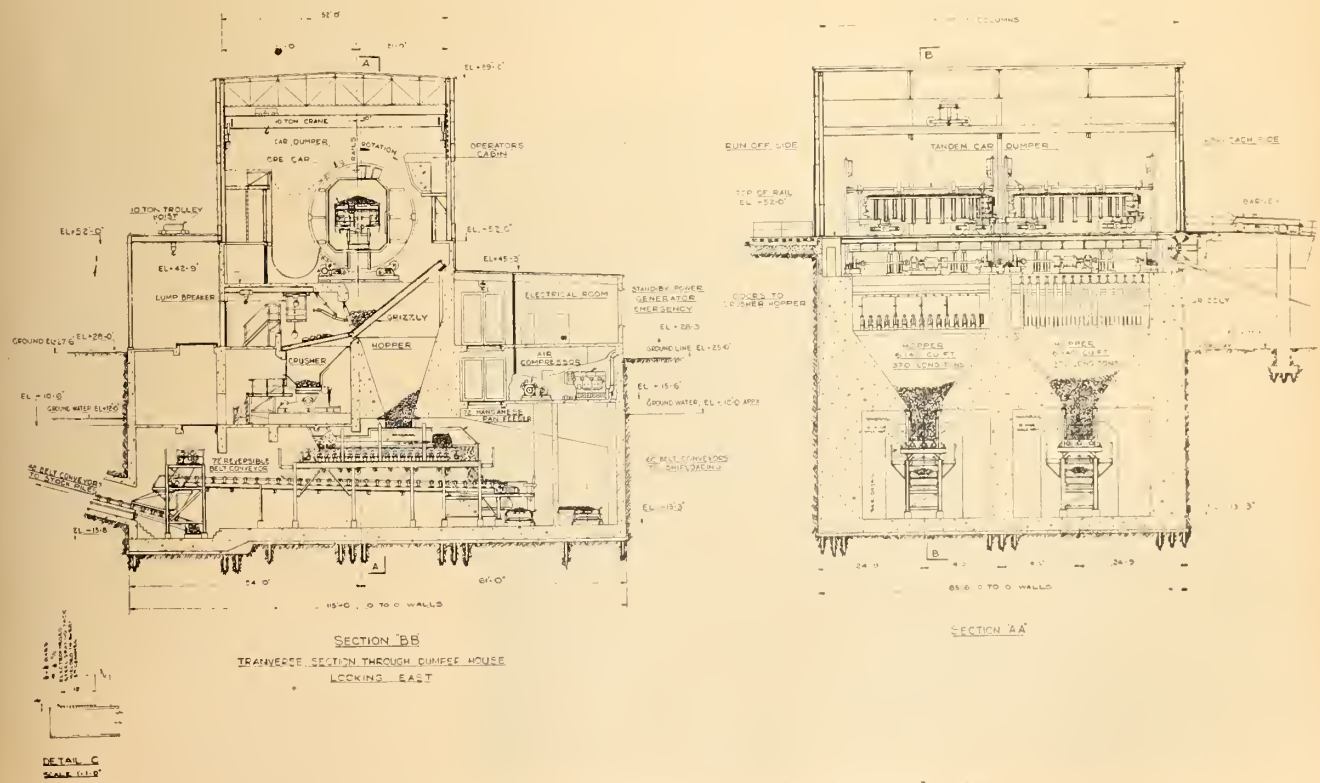


Fig. 5. Longitudinal and cross sections of dumper house.

be in the cars when they are dumped. For this reason the grizzlys, which are 28 ft. long by 26 ft. wide measured on the slope, discharge oversize lumps for crushing to two 36 by 60 in. reversible crushers, which can be set to discharge the size required. It is possible to isolate the crushers and crusher hoppers by hinged doors at the foot of the main grizzlys. Provision is made to break up lumps too large to enter the crushers.

All ore passing through the main grizzlys, i.e., 5-in. and under, falls into two concrete hoppers holding 360 long tons each. Valley angles are at least 60°. Each hopper is emptied by a four-speed, 72-in., manganese steel, pan feeder which discharges ore at 1,000, 2,000, 3,000 or 4,000 tons per hour onto the 72-in. reversible belt below it. The maximum depth of ore stream is 4 ft. and the maximum delivery rate to storage piles is 3,000 tons/hr. When running south these belts feed the shiploading system and when running north they feed the storage system, their speed being 378 ft./min. Their direction is selected by the dumper operator.

Fig. 7. The "Hawaiian" at the loading dock, July 31, 1951.

Dumper House to Ships

Ore for ships leaves the dumper house on 60-in. belt conveyors 154 ft. long, running at 600 ft./min. All this equipment is on the same floor level as the lowest floor of the dumper house and is housed in a waterproofed concrete tunnel about 24 ft. wide and in the drive house, which has a high roof over the lifting apparatus and an exit to the surface.

At this drive house ore is transferred to two 60-in. conveyors, 3A and 3B, inclined at 12°, which discharge into two 1,000-ton concrete mixing bins (see cover) 38-ft. 8-in. outside diameter, built as a monolithic structure on the loading dock. The top floor of these bins is 60 ft. above the dock pavement.

Conveyors 3A and 3B are driven on the return side about half way down. The drives are dual each using one 500 hp. and one 175 hp. totally enclosed squirrel cage motor. The take up is by gravity. Protection is provided to belts 3A and 3B by an electric eye in each bin which warns the dumper operator when the ore reaches a predetermined height, so that he may either stop dumping, or stop the feeders below the dumper house hoppers, and in this way stop the feeds to the bins. Mixing is attained in these bins by operating as much as possible with them about half full.

Ore is withdrawn from the mixing bins by two 72-in. manganese steel pan feeders of infinitely variable speed, which discharge to two 60-in. belt conveyors traversing the length of the 800 ft. loading dock seen in Fig. 6. These feed two shiploaders through trippers. The drives are at the head ends of the conveyors.

The shiploaders are mounted on rails 70 ft. apart and consist of a truss of U-shaped cross section. Inside this truss is another which carries the shuttle belt. This latter truss is hinged at the centre, may be advanced and retracted and the half next to the ship raised about 60° above or lowered 15° below the horizontal. The shiploaders can travel along the dock at 80 ft./min. while loading and can operate at 48 ft. centres. The shuttle belt on its truss can be moved back and forth during loading at 50 ft. per min. The capacity of each shiploader is 4,000 long tons per hour. Limit switches govern the total travel of these units and their proximity to each other. Spring stops are provided at the ends of their travel. The size of the ships which may be loaded ranges from 2,000 to 27,000 tons. Fig. 7 shows the first vessel loaded about ready to depart. A shiploader is at the right.

Fig. 6. Belts 4A and 4D on dock as seen from the top of one of the 1,000 ton bins.

Shiploader's Power Supply

Power is supplied to the shiploaders at 550 volts from the sub-

station in drive house 4A-4D through aluminum conductor rails and is picked up by sliding shoes.

A somewhat similar arrangement is used to provide power to the shuttle belt and boom elevating apparatus. The eight bridge traversing motors are supplied with 230 volt d.c. current from a five-unit motor-generator set mounted on a rigid frame suspended from the bottom of the main truss.

The bridge is kept in proper alignment on the rails by the use of two electrical devices mounted on the landward leg of the shiploaders about 15 ft. apart. These envelop the head of the rail, but are clear of it. Any misalignment of the bridge causes a variation in this clearance, with a consequent variation in inductance. This variation is used to actuate a selsyn control, which slows or speeds up the drive motors on either rail supporting the shiploader. Thus the end ahead is slowed down and the lagging end is speeded up.

With this equipment the shiploader operator can traverse in any of four directions in the horizontal plane besides moving the boom up or down while loading. He can start, stop or slow down the feed, as he has control of the feeders below the mix bins and he can start and stop his conveyors, all this in accordance with instructions given from the deck of the ship being loaded or elsewhere by radio. The capacity of each shiploader is increased 12 per cent or 500 tons/hr. when traversing the bridge toward the load while operating.

The Iron Ore Co. of Canada has built 1,600 ft. of dock dredged to 37 ft. below mean low tide, 800 ft. for mooring and 800 ft. for loading. The Federal Government has constructed a further 600 ft. at the north end, dredged to 27 ft., the whole making one continuous dock.

Conveyors to Storage

Ore may be sent to storage at the rate of 3,000 tons per hour by running one reversible belt towards the north, in which case it feeds conveyor 2A, 48 in. wide. This belt rises in its tunnel and reloads at right angles onto conveyor 2L, a short belt which, in turn, feeds conveyor 2C, 48 in. wide and 2,226 ft. long, and running at 558 ft./min. This belt feeds the stacker (Fig. 8) and is driven by a dual drive using one 300 hp. and one 125 hp. motor in drive house 2C at the head end of the conveyor. Provision has been made to extend this conveyor by 500 ft. to increase storage if required. There is a gravity take up beyond the drive house.

Forty-eight-inch conveyor 2C feeds 54-in. conveyor 2D, which elevates the load from the tripper on 2C up to the double-arm stacker, where the ore may be discharged up either 100-ft. arm on 54-in. belts to form storage piles of 500,000 tons. These piles will be 87 ft. high. Total storage capacity is expandable to 2 million tons. The stacker may be traversed in either direction while discharging, at 62½ ft./min. toward the load and at 125 ft./min. away from it. The high-torque, high-slip propelling motors may be plugged or reversed to provide braking action. Thrustor brakes are provided for holding only. Dual controls allow the operator to face the direction in which he is moving.

Ore is reclaimed from the storage piles by electric shovels with 7 cu. yd. dippers; these place the ore in the ore cars, which are again passed through the classification yard and so enter the system a second time.

All conveyor belts run on ball-bearing live shaft-troughing and return rolls and can be started and stopped under full load. They are interlocked so that a load cannot be placed on a belt unless it is running at full speed, centrifugal switches

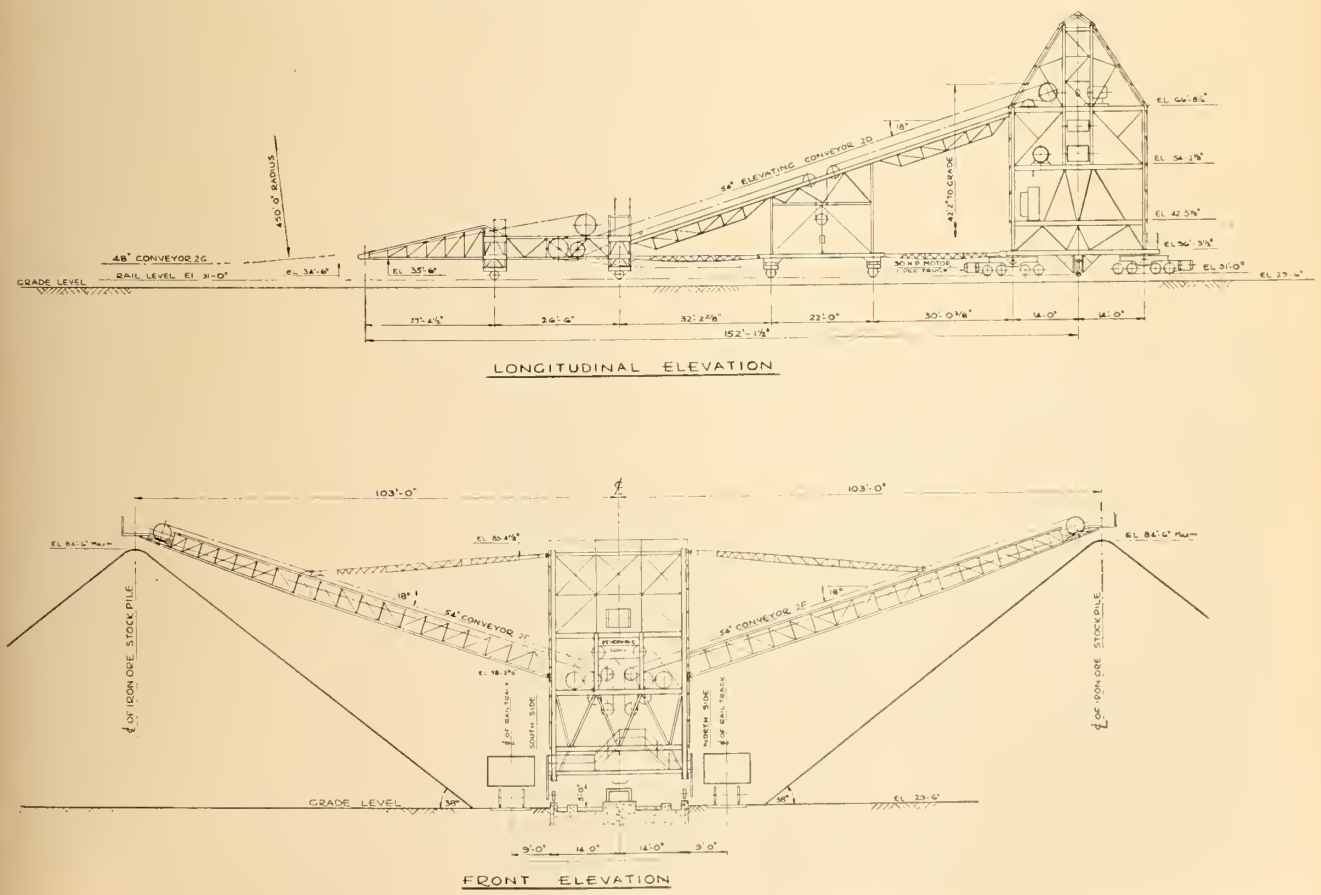


Fig. 8. General arrangement of stacker.

being used. Warning horns are sounded before conveyors are started and emergency pull cords actuating stop switches are run on each side of belts which cannot be seen from the motor. Motor switches have "automatic", "hand operation" and "off" positions. Thus they may run within the interlock system or by hand individually for test.

Warning of high winds is given shiploader and stacker operators by two anemometers, one on the stacker and one on a shiploader which warn of winds of 35 miles per hour. If this velocity is reached operations are stopped and the brakes set.

Electrical Equipment

Power is supplied to the main substation for this area at 44,000 volts, and stepped down to 4,160 volts in three 2,000 kva single-phase transformers. One spare transformer is provided. The main switchroom is in the dumper house and distribution is made here to five 1,000 kva. and one 600 kva. three-phase transformer, 4,160/550 volts. These unit substations are located in the various buildings in pressurized rooms.

All motors are totally enclosed and fancooled and some have outside forced ventilation.

In basements, sump pumps are provided, of the open impellor type capable of pumping ore up to $^3/_8$ in., which may be hosed off the floor. These pumps discharge into cribs without floors sunk flush with the ground. As this ground is all sand, the water drains off and the ore is periodically cleaned out.

Overhead lifting apparatus is provided in all buildings to facilitate rapid repairs and replacements.

Fluid drives of the scoop type are used on all drives of 125 hp. and over. These permit the use of standard squirrel cage motors, since the motors attain 90 per cent of full load speed before the fluid drive starts to apply the load. Starting current is thus lowered and starting equipment simplified. The fluid drives are designed to limit the torque to 140 per cent, as required by the belt manufacturers and to give uniform acceleration. They will stall under overload, in which case the motors are cut out by the thermal overload relay. Conveyors may be "inched" along for repairs or run at slow speeds for inspection by starting the motors and partially engaging the scoops by hand.

The contract for the mooring dock was let in September, 1951; for the loading dock in February, 1952 and for the ore handling facilities in May, 1952. The terminus was officially opened on July 31, 1954. During the tune-up period since then about 1,800,000 tons have been shipped. The design capacity, which will be reached after all phases of the project are fully operating, is 10 million long tons per year.

The design and construction of these docks and ore handling facilities was the responsibility of the C. D. Howe Company, Limited, of Montreal. The writer was project engineer. √

The Thermal Barrier

The men who engineer and plot advanced theory for tomorrow's aircraft disagreed on whether the speed limit to man's flight was already in sight.

They agreed, though, that research on the effects of high-speed, high-altitude flight lagged behind the design of aircraft to fly in the thermal barrier.

The thermal barrier applies to the high temperature met by aircraft beyond Mach 2 (twice the velocity of sound).

Nine technical papers on thermal flight problems were delivered at the annual meeting of the American Society of Mechanical Engineers in the Hotel Statler. Nuclear-powered aircraft, pilotless aircraft, and the effect of thermal flights on man, equipment, and aircraft structure were among the subjects covered.

"Startling" problems are presented by supersonic heating, the scientists said. For example, they pointed out, at Mach 5 aluminum melts, and at Mach 6 steel melts.

Dr. George Gerard, assistant director of the Research Division of the New York University College of Engineering, and George T. Hayes of Stanford Research Institute stated in a published summary of the nine papers that there are optimistic and pessimistic views of thermal barrier effects on aircraft performance.

Optimists, they said, believe that aircraft without radical design changes, following carefully prescribed flight paths, can weather thermal flight conditions. A suitable designed plane or missile, say the optimists, "may fly very fast at extreme altitude where the density of air is practically zero and then proceed at reduced speed while passing through lower altitudes."

The more pessimistic contend that the damaging effect of heating during thermal flight can be prevented for only short periods. "Sooner or later," says this group, "the aircraft engineer will have to face the task of designing the aircraft to carry loads while hot"—that is, while the aircraft body and equipment are at temperatures of anywhere from 200 to 1,600 degrees F. or more.

In pilotless aircraft—missiles, rockets, etc.—heat effects might be alleviated by allowing certain parts of the missile to melt, Charles H. McLellan of the National Advisory Committee for Aeronautics pointed out. The melting process would be similar in nature to that of meteorites that fall to earth. Melting in meteorites occurs at the surface; the interior remains relatively cool.

Describing results of research in NYU's Engineering Research Division on structural aspects of thermal flight, Dr. Gerard foresaw a possible upper limit, with present engineering materials, of about Mach 3.5 speed for any sustained period of time.

At this speed, the increased weight necessary to make the plane structurally sound in the face of 800 degrees F., for example, would render the aircraft impractical, he stated. A Mach 3.5 fighter might weigh as much as current heavy bombers.

There are two approaches to design of high-speed piloted aircraft, said Harold W. Adams of Douglas Aircraft. One is to design the aircraft to endure the high temperatures. The other is to keep the airplane cool so that conventional designs may be used.

The first course "presents almost insurmountable problems at the present time," even at moderately high Mach numbers, he said. Possibilities for the second course include cooling by air-cycle systems, water-evaporation systems, and fuel cooling (the latter only in chemically fueled aircraft).

GROUT CURTAIN

FOR A

ROCKY MOUNTAIN DAM FOUNDATION

by

E. Parrag, M.E.I.C.

Chief Designing Engineer
Power Corporation of Canada Limited,
Montreal, Quebec

This paper deals with the problem of assuring a tight foundation for a concrete dam by means of a grout curtain, and shows how the drilling and grouting for it was carried out.

The East Kootenay Power Company's Aberfeldie Plant on the Bull River 12 miles north of Wardner, B.C. was built some 33 years ago. It consisted of a concrete dam, a wood-stave pipe of 7-foot diameter, a mile and a half in length with a wood-stave surge tank, and a steel penstock leading to the power house. The powerhouse contains two 3,600 hp. turbines which operate under a gross head of 278 feet.

The wood-stave pipe had deteriorated to a point where immediate replacement was urgent. The old dam leaked considerably and showed disintegration. It was decided early in 1952 to build a new dam with maximum height of 87 feet, about three quarters of a mile above the power house and below the old dam, together with a new stave pipeline 3,333 feet long on the original location, and to submerge the old dam and collapse the balance of the old pipeline.

The proposed site for the new dam was at a narrow point in a deep ravine. A geological report based on 10 diamond drill test holes had indicated that the foundation rock was solid and satisfactory. However, it was realized a grout curtain would probably be needed in order to assure a firm impervious foundation and to avoid waste of water.

The Bull River is a mountain stream having a drainage area above the site of some 610 square miles. The natural flow in the fall and winter averages 250 to 300 c.f.s. The maximum flood, recorded in 1918, was 13,000 c.f.s. At the new site, the dam (Fig. 1) is some 445 feet long at El. 2846. It is designed with a spillway section 196 feet in length, with crest at El. 2832, capable of discharging 36,000 c.f.s. without overtopping the bulkhead; and with a trash sluice 14 feet with sill at El. 2826, closed by stoplogs and operated by an electric hoist on a travelling gantry, which also can lift the trashracks. The steel headgate at the pipe inlet is operated by a separate electrically operated hoist.

Geology

Most unweathered rocks possess sufficient strength to support dams of usual height. However, special consideration is called for with rocks in which seams or faults, and weathered or crushed zones, have resulted in separated or partly separated foundation blocks which

Fig. 1. The new dam; some 445 feet long at El. 2846.

might move slightly under the load of the dam.

The Bull River, over the years, has carved its way through the glacial debris into the underlying precambrian sediment, to establish the present river bed about 40 feet below the preglacial grade on the right bank. On the left bank, the rock was found to extend upwards well above the crest of the new dam, with little overburden. On the right bank the rock levels off some 30 feet below the crest, passing under glacial deposits, gravel and silt.

The rock is thinly bedded, and consists of limestone and siliceous shales and slates. Here and there quartz veins are visible which appear to have occurred before the latest folding. All the rock is partly metamorphosed. The limestone beds vary from a few inches to three feet in thickness. The slate beds are characteristically thin, varying from a fraction of an inch to a few inches in thickness.

The major structure is a syncline, plunging in an upstream direction and highly deformed. There is also a small secondary anticlinal fold. Because of the thinly bedded nature of the rock and the great deformation it has undergone, it is all highly fractured. Strike and tension joints are prevalent. There is practically no bond between any of the bedding planes, and some slippage occurred on nearly every plane during the folding process.

On the right bank the rock dips at about 60 degrees towards the river. In the riverbed it is characterized by the secondary fold, and dips about 10 degrees downstream. On the left bank it dips gently about 20° into the bank and slightly upstream.

The limestone layers are highly resistant. The argillaceous shales were examined for possible deterioration if continuously submerged in water, in view of the many troubles caused in the area due to the unreliable nature of the layers. From a test on a piece of the rock under saturated steam at 295 p.s.i. by an inspection company, it was reported that . . . "Apart from the weakening in the joints, deterioration of the material when immersed in water is not anticipated".

Drilling and Grouting Required

Though preparatory work such as setting up camps and plant, cofferdams and stockpiling of aggregates was started in the late summer of 1952, placing of concrete was not started until October, with a temporary mixer setup. By March 1953, a permanent mixer plant, and later a cableway, was set up, and placing of the 22,500 cubic yards of concrete was continuous until completion late in December.

The drilling was started in December 1952, with one diamond drill. In January 1953, a further inspection at the site disclosed that the rock in the sub-foundation was cracked and broken to a far greater extent than the original geological report had indicated. There were also many more argillaceous shale and slate layers throughout the limestone.

It was therefore decided to revise and extend the program of drilling and grouting, and to provide a grout curtain, by drilling along a line four feet downstream from the face of the dam, to a depth of 55 feet into the rock in the riverbed and with holes on either bank, drilled deeper through the rock, to the same elevation as those in the riverbed. This was confirmed by the Harza Engineering Corporation of Chicago, who were called in as consultants and who also made an inspection of the site.

Normally these holes would be vertical, or drilled at right angles to the 60 degree pitch of the rock on the right bank but in a vertical plane. Holes were to be drilled at 6 foot centres to start with, intermediate holes being added where adjacent holes were found to take an excessive amount of grout or where geological conditions indicated the need. On completion the average distance between holes was about 3 feet.

Besides this grout curtain on the upstream face, it was decided that "consolidation" grouting would be required at the toe of the dam, to cement together the loose layers and transfer the load to the subfoundation. These holes, 25 feet deep in the rock, would be set 16 to 20 feet apart.

Drilling

The drilling had been commenced in the riverbed with a gas driven portable type diamond drill, using an AXT bit giving a hole 1-7/8 inches in diameter. During the summer high-water period, drilling was continued on the right bank, moving back to the riverbed when high water subsided to drill intermediate holes. The left bank was left till the last so as not to interfere with construction. Here springs were intersected by the drilling, indicating the probability of seepage with the pond filled. In September 1953, a second drill of the same type was added. During most of the time, operation was for one shift, but during the last 3 months of 1953, two drills worked continuously in three shifts.

Core recovery ranged generally between 75 and 97 per cent, though in the limestone layers recovery was close to 100 per cent, reducing somewhat where many argyllite layers were encountered. Required depth of drilling was determined by the geological profile across the riverbed as disclosed by the drillholes.

Some of the holes had to be drilled through between twenty and fifty feet of the concrete already placed, so as not to interfere with the placing of concrete. Some holes were drilled from the upstream face of the dam, on a dip of about 80 degrees for the same reason. In such cases, additional holes were found necessary to close the gaps between different curtain planes.

Every hole was carefully examined and recorded so that a complete geological profile could be drawn. The loss of drillwater was noted at the various elevations. Each hole was washed out after drilling under 20 to 60 p.s.i. pressure, depending on the depth. In all some 222 holes were drilled, with a total footage of 15,300 feet; 74 per cent of which was through rock and 26 per cent through concrete already placed. The use of 254 diamond drill bits, or one for each 60 feet of hole drilled, indicated the hardness of the limestone.

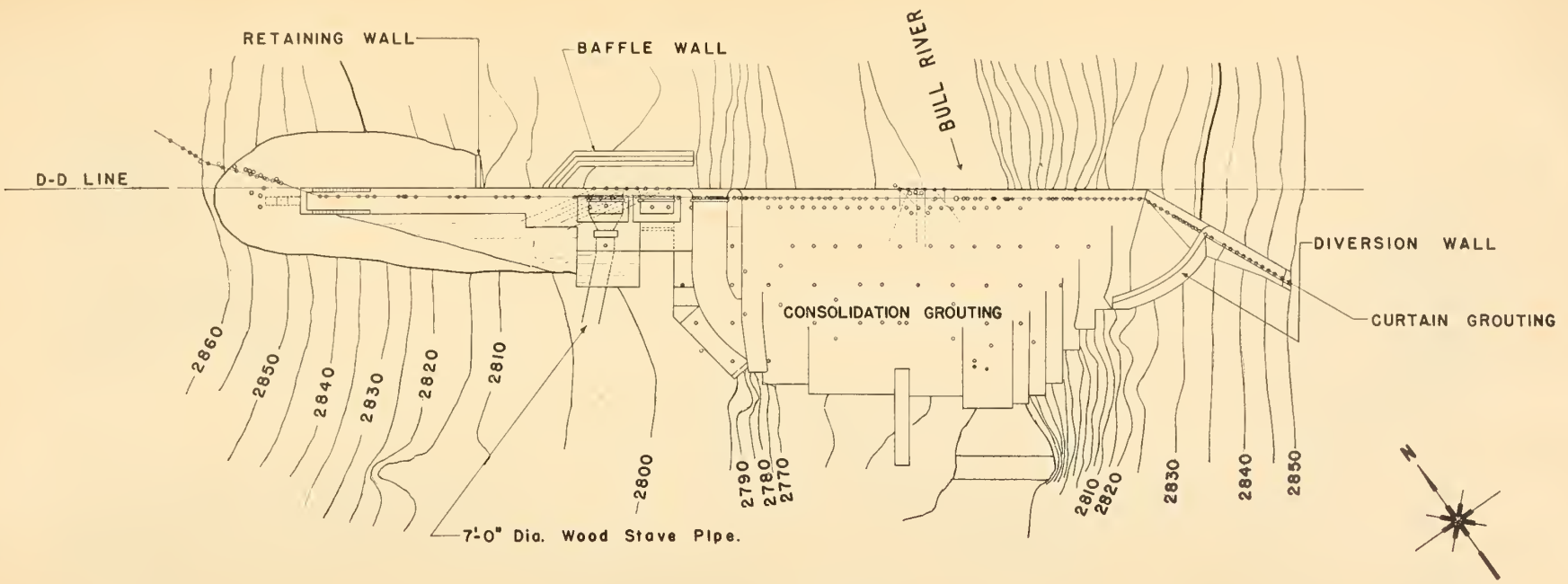
The sequence and spacing of the holes along the upstream face was planned in the first instance at some 18 feet apart, in order that the grout should not reach the adjacent holes. After the grout had set intermediate holes were drilled. Seldom was grout found to travel more than 15 or 20 feet from one hole to another, although at the start there were occasions where it was found to travel up to 60 feet or more through a wide seam. The "consolidation" drill holes at the toe of the dam were drilled about 25 feet in the rock, spaced at 16 to 20 feet centres, with the object of leaving gaps in the grout to permit some seepage and thus lessen the uplift.

Grouting

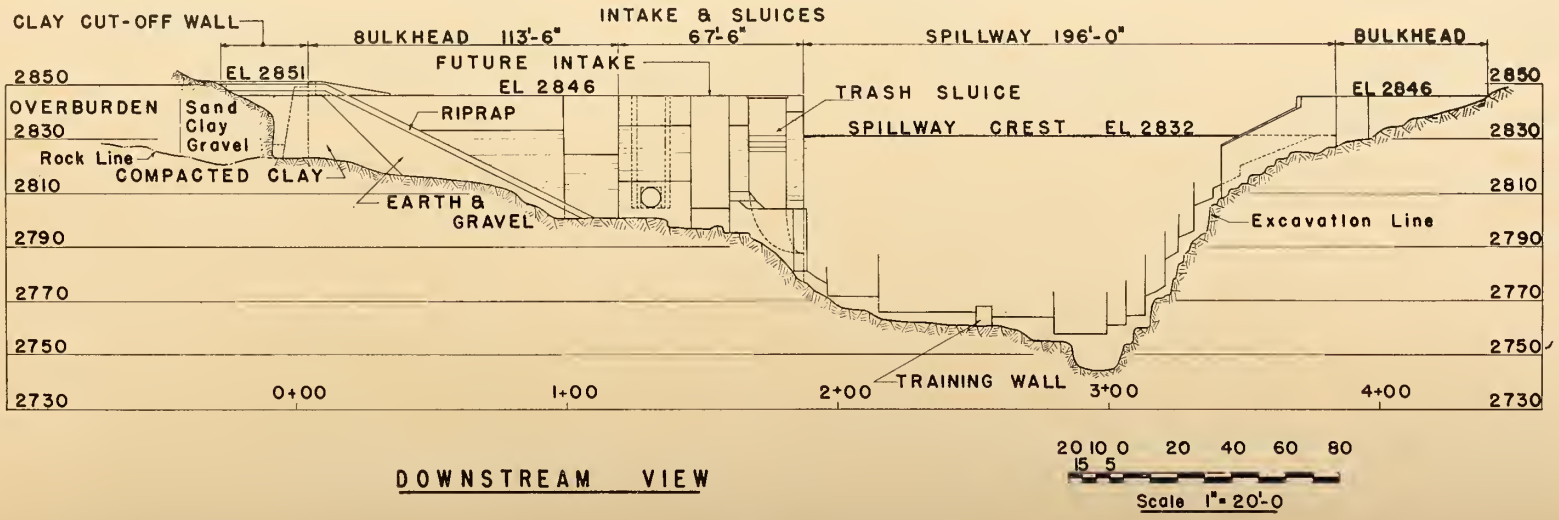
Pressures to be used in grouting were set as a general rule according to the formula:

$$P = h + 1.33\,h\left(\frac{h}{900} + \frac{\sqrt{h}}{20}\right)$$

where h is the depth below the surface. These resulting pressures were varied however, depending on what



PLAN



DOWNSTREAM VIEW

Fig. 2. Downstream view.

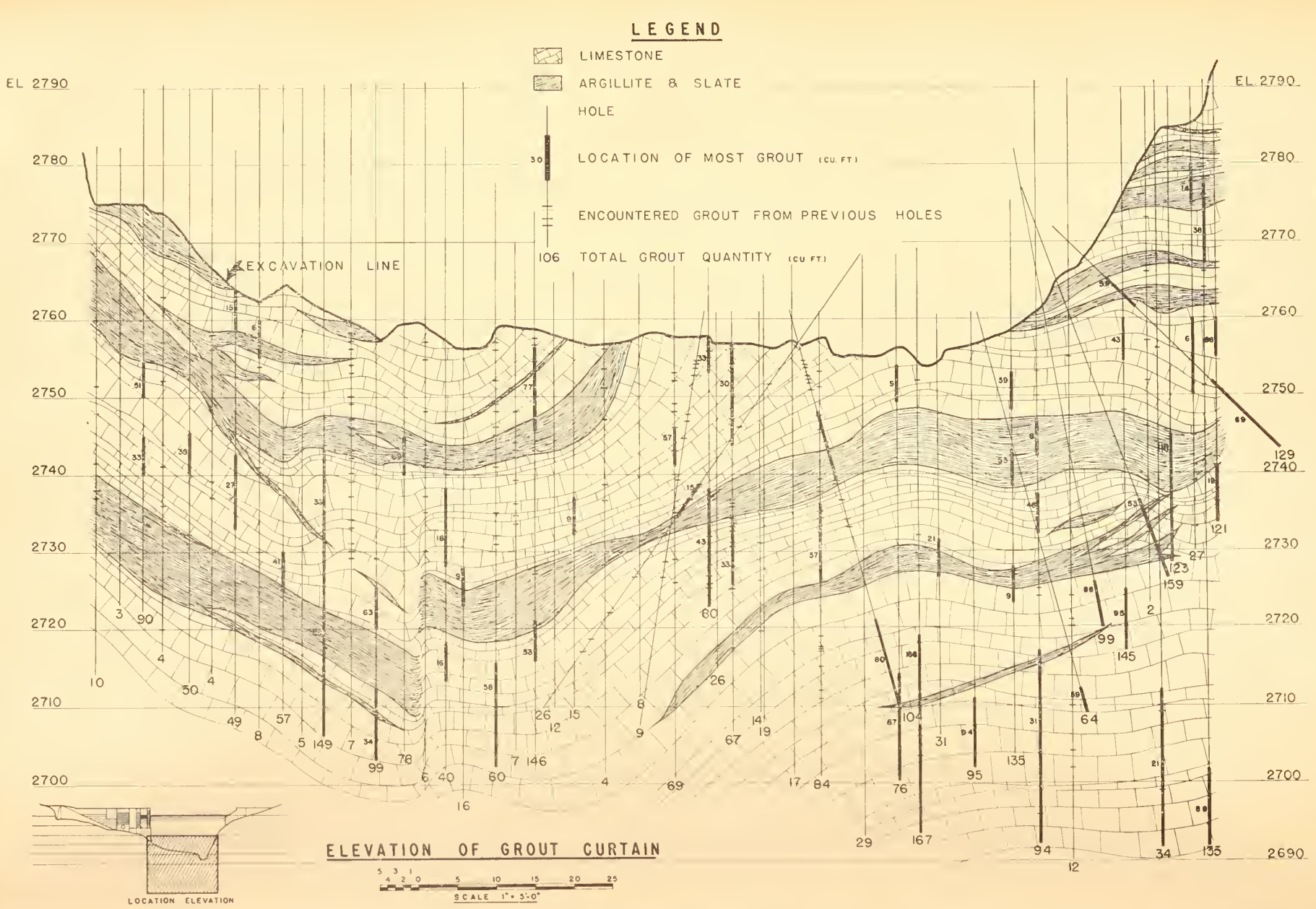


Fig. 3. Elevation of grout curtain.

had been disclosed in the log of the hole. Where part of the hole was through superimposed concrete about 2 feet was added to *h* for every foot of concrete drilled.

Grout was placed in five-foot lifts, using the customary rubber seals at the top of each lift to hold the pressure. In each hole grouting was started with a mixture of 4 parts water to one part cement, measured in volume, then progressively thickened to 3:1, then 2:1, then 1:1. Where pressures could not be maintained, even with the thicker one-to-one mix, two handfuls of fine sawdust, added for every cubic foot of grout, was usually found effective in holding the pressure.

Many of the holes took as much as 100 to 200 cubic feet of grout. The maximum pressure was 175 p.s.i. The amount of grout taken was recorded in every hole and at every lift. Very little grout was observed to leak out beyond the upstream limit of the foundation.

Figures 2 and 3 show in plan and elevation respectively the grout holes. At each hole is noted the amount of grout placed. Short horizontal lines indicate places where drills encountered seams of grout from neighbouring holes already filled. A total of 11,260 cubic feet of grout was placed, using 5,187 bags of cement.

Generally, the most grout was placed in holes where the core recovery was the best. Though apparently a paradox, this is explained by the fact that only the limestone layers, where recovery was easy, show fissure voids. The argyllite layers, though showing a poor core recovery, were mostly watertight. The limestone is full of fissures. The carbon dioxide in the rain water dissolves the lime during its passage downward between the layers. Thus it washes out narrow cavities, averaging considerably less than an inch in width but extending over a wide area. Only once was a cavity traversed by drilling that was 1½ inches thick.

Generally, and especially on the left bank, the deeper the holes below the riverbed the more grout they took at the bottom due to the larger and more extended fissure voids between the limestone layers at the lower elevations. The curtain wall was carried to a horizontal plane about 55 feet below the riverbed and it was considered that below this depth there would be no continuous voids between the limestone layers which would drain the water from the headpond to points downstream from the structure. This was based on the fact of encountering many watertight clay argillaceous layers and many dislocations intersecting the continuity of the voids.

In badly fractured rock such as found here, every hole is different and must be treated accordingly. Core recovery is important, both to see the width of the seams and to enable plotting a geological profile. Experience and judgment are needed to decide what pressure should be used at each elevation, as well as the consistency of the grout.

Too little pressure means more holes are needed to seal a given area. Too much pressure carries the risk of uplift on parts of the foundation and adjacent parts of the structure. Thin grout travels further but sets more slowly. Thicker grout sets faster but will not spread as far.

It was never possible to predict how much grout a hole would take by comparing the amount taken by adjacent holes. Some holes would absorb from 20 to 100 bags of cement, though grout placed earlier in holes only three feet away at either side had taken very little. Yet in drilling the hole taking the large volume of grout, many grout seams, sometimes 10-16, had been encountered.

The overburden on the right bank extended to a depth of some 24 feet below the maximum elevation of water in the pond, and consisted of layers of gravel, fine sand, and dry clay a few inches thick. This was also grouted to prevent seepage. Three-inch casing was sunk to rock. The spacing of the holes was at 2½ ft. centres. The diamond drill was used in the casing in some of the holes to cut through gravel and sand layers cemented to solid concrete by grout from adjacent holes. These holes were then grouted in the usual way. Grout used here averaged 2 cubic feet per foot of hole, with some holes taking up to 300 cubic feet of 4 to 1 and 1 to 1 mixtures.

Curtain Expensive But Warranted

The purpose of this extensive, and at the same time intensive, grouting operation was to consolidate the joints between the rock layers and to stop seepage as far as possible. Every drop of water is precious, for during the winter months the flow of the river is considerably below that necessary to support full load on the turbines.

The grouting program proved a more costly operation than had been expected, both in time and in dollars. Almost 5 per cent of the cement consumption for the dam went into the grouting, while the cost of the "grout curtain" comprised almost 7 per cent of the entire outlay for the new dam.

That the operation was successful, and therefore warranted, is evidenced by the fact that the resulting leakage at the dam has been measured over a weir placed 400 feet downstream from the new dam, and has been found to be negligible. Even with the head pond filled, the greatest deflection recorded on crest of the spillway was 1/8 of an inch. This shows that at the toe of the dam the rock foundation had practically no settlement and also that the consolidation grouting was effective.

The design and construction of the project, including the grout curtain wall, was carried out by Power Corporation of Canada, Limited, Montreal, with C. E. Popham as field superintendent. Lloyd Anderson, engineer for the East Kootenay Power Company, supervised the grouting operation as resident engineer. √

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An Experiment in Teaching Design

by

W. Czerwinski, M.E.I.C.
A. V. Roe Canada Limited.
Toronto, Ontario.

and

B. S. Shenstone
British European Airways.
London, England.

The first part of this paper describes an experiment in the teaching of design to engineering students. Though the object of this problem was a sailplane, the method would seem to be of fairly general application. The authors' experiences and conclusions should be of interest to all engineering teachers, bearing as they do on a matter of real national importance. The second part—the appendix—is the description of the aircraft which was designed and built.

Original Design in Canada

For a country with wide industrial activity, Canada produces little original design for industry. For the most part, we have copied the designs of other countries, using them under licence or adopting them because it is easier to copy than to create. We had manufacture thrust upon us before we were ready to originate. People with money have come from the United States and from Great Britain to set up manufacture to their own designs for us and for others. Our background has been the factory and not the design office. Now that we are in big business we must take a look at the design side, be it for electrical equipment, engines, stoves, heaters, plastics or boathooks. In the short run it is cheaper to borrow designs, but in the long run it is more expensive, for it guarantees that we remain at least one step behind our competitors. We cannot lead from behind.

Remarks like these have often been made since the war and much interest has been shown lately in design problems, apart from arts and crafts, which are outside the scope of this paper. The activities of the Industrial Design Committee and of the National Gallery of Canada have accomplished a great deal. As a result, we are beginning to realise that even if we are not as big industrially as the United Kingdom and the United States, there is no reason why we should not be competitive with countries, such as Switzerland and Sweden. We have found that, although the size and spread of internal markets may not be critical factors, the necessity to be competitive is indeed critical. Without trained designers it is impossible to be either original or competitive. With these thoughts in mind, the authors set out in 1946 to see whether and to what extent the techniques of design could be taught in an engineering school without completely changing its present curriculum. Being aircraft engineers themselves, the authors wanted to try a design experiment in the field which they knew best. The lack of experienced designers in Canada is especially acute in the aircraft field, because the Canadian aircraft industry was developed only during the late war and the original design of new types of aircraft was started even later, if one ignores the simple and not very original prewar bush planes. The ability to produce a good, original and reliable new type of aircraft depends mostly on experience and technical tradition, built up through many years of design work and development.

Sources of New Designers

Very few among us are born with the ability to originate. To be effective as designers in industry, even gifted people must be trained. The untrained genius is more trouble than the untrained clod. On the other hand, there are never enough geniuses to go round and other gifted people must also be trained. At present there is design teaching in art schools, in schools of architecture, in the engineering faculties of universities and in technical schools. But only in art and in architecture is a really serious attempt made to cherish creative impulses in design.

No very great attempt to teach design is being made in the Aeronautical Engineering Department of the University of Toronto, the only place in Canada where aircraft engineers are being educated. Today's requirements demand from an aircraft engineer so much theoretical preparation that, within the present scope of study, there is not much time left for training in design. The result is that Toronto's graduates are filling the stress offices and aerodynamic departments of Canadian aircraft factories, only few of them being occupied in actual design work. These few are obtaining their design training by apprenticeship, an old method indeed, but far from satisfactory today. The "apprentice" may well be getting his instruction from people who, not necessarily being well grounded, lack the proper approach, and mostly not graduates, are afraid of competition from the educated newcomer.

Efforts should be made to teach students design at the universities, where they may obtain instruction from first-class sources, from

teachers carefully picked from industry who have proved by their professional achievements that they are competent designers. This is what is being done in European universities.

Only a small percentage of people who are taught design will ever become creative designers. In other words, out of an engineering class of one hundred, possibly only ten may be interested in original work and, out of these, only a few may show the necessary talent. However, without a positive effort to bring out such talent, it will likely remain dormant. Is such a small percentage return worth while? Yes, it is, because the knowledge of design is essential to any engineer. If every engineering student cannot acquire the ability to design, he should at least become familiar with the methods used in design, through which structures are created which will function reliably and be economical and safe. It should finally be noted that a comparatively small number of creative designers can keep a large industry flourishing technically. A few is all we need and it is worth while to find and to educate them. Although these few are needed, the greater need is for larger numbers of less talented, but well trained, designers. Thus, even if only a few students show originality, the rest will have had some grounding in design techniques and thus will become more valuable to their industry.

Rather than theorize and express grief over the lack of aircraft designers in Canada, the authors felt they should try to expand the existing curriculum of the Aeronautical Engineering Faculty at the University of Toronto by adding a few hours a week devoted to teaching design. Fortunately, Professor T. R. Loudon, M.E.I.C., the head of the department, realised fully the importance of this problem and was willing to let them try. The results of this experiment follow.

Philosophy of Teaching Design

It is not possible to train a design engineer completely by university education only, but the student should obtain a sound basic knowledge of engineering design there. Teaching should be done through all four years of study (mostly five in Europe) by using carefully selected subjects and exercises. Teachers should be individuals who are notable designers themselves, and who know how to teach and how much should be taught. Mechanical and aeronautical design differ basically from general industrial design, where the designer has to be no more than a sort of artisan or artist and does not need any deep knowledge of science or technology. His only great talent is the ability to shape things or to make arrangements because of his inborn ability to think in three dimensions, developed and improved by many years' work and experience.

But an aircraft designer must be able to cope with much more difficult and complicated problems than the industrial designer. He has to produce, in whole or in part, a complicated and specialized piece of machinery, which is, as a rule, a product of a compromise between many contradictory requirements, using to the utmost all his "heavy theoretical tool kit", as Sir Robert Southwell called it, which he got at the university by four years of hard work. The product of his design ability has to be safe, reliable, economical and light in weight, which last in itself might be considered as requiring highly specialized knowledge on account of the high complexity of the problem. As the design work done by aircraft engineers is often a completely original effort—pure pioneering—knowledge of everything which has been done to date is not enough. There is plenty of research and development required in the aircraft industry which are quite inseparable from pure design. In many cases, the aircraft designer must do his own research. It needs no proof that this state of affairs offers the highest technical challenge to the aircraft designer today. He not only has to possess an inborn talent for design, but has to be able to utilize and apply all his theoretical and technological knowledge. He should be considered as a sort of cross-breed: 25 per cent artisan and 75 per cent scientist and technologist, armed with the modern knowledge which allows him to be more productive and objective than the last generation.

The tasks facing aircraft designers and engineers today require from them a special ability to work in groups, rather than single-handed. Creative design in a group is a special sort of ability which should and could be taught as early as possible.

Realising and summarising all this, one may try to answer the question, "How do you teach aircraft design?" A concise answer might be that aircraft design should be taught by:—

a. A properly chosen and selected curriculum to develop in the student the proper type of three-dimensional frame of mind, very essential for his future work.

b. Showing him how useful and basic is his theoretical knowledge acquired at the university and teaching him how to use it successfully. How the proper shaping of parts and components depends on practical application of logic, theory and technology has to be shown by many examples. All this should be demonstrated by original projects, however simple, because only an original design will force the student, and the teacher as well, to do their best creatively. It will also allow the teacher to show how a professional designer works.

c. Pointing out to the student how important is the exclusion of his knowledge and education in the field of technology, which is usually not completely covered by the university curriculum. It should be impressed on him that he should keep himself abreast with the latest achievements in the fields of metallurgy, machining, foundry and forging techniques and other manufacturing processes. No designer's education is complete without knowing how his creations can be manufactured in the most economical way.

d. Starting to develop in him the proper sort of engineering judgment which is characteristic of any kind of engineering activity. This implies the ability to synthesize and to criticise his own work, as well as the work of others. After many years of practising design, it develops into helpful technical intuition, by means of which he can guide himself through difficulties.

e. Trying to develop in the student the understanding and the ability to work not only single-handed, but in groups. This requires the special talent of recognising the need for help or advice from other co-workers, who happen to be specialists in their own fields, as well as for keeping close contact with others, in order to fit one's own part into a harmonious whole. It requires the development of a special sort of group feeling, through which each member gets satisfaction from working with his colleagues and considers himself co-responsible for the success of the whole project.

What to Design

In order to inspire enough interest in students and to give them

some idea and experience in design along their line of study, a glider was chosen as the subject. The choice was fortunate. A glider, though a flying machine in its simplest form, requires from a designer skill and knowledge in aerodynamics, performance, stability and control, aeroelasticity, stressing, etc. The extent to which this knowledge should be exercised during design depends entirely upon the intentions and the knowledge of the teachers. The only aspect left out completely is the power plant and related problems, which are usually handled by specialists in aircraft design offices. All the problems in glider design, when properly set out, are simple and on a small enough scale to be covered as separate reports in one year's term work, when handled by one or two students.

To add more importance and interest to the students' work, it was decided at the start that the glider would be built at the university, using university facilities. This condition, of course, put additional responsibility and work on the shoulders of the teachers, who on top of their class work had to supervise construction and material supply. However, it was well worth while, as it emphasized the very valuable element of adventure, which is always present wherever something new is created. This is especially true in the case of a flying machine.

Initial Approach and Problems

The design of such a glider is a long-term job. It was planned to spread it over a number of years, but it was subdivided into parts or groups, so that the students could attack and complete certain of them each year. It was hoped that the continuity and the aim towards a clear-cut result would make the job interesting. The more usual problems, which are repeated year after year, resulting only in marks on paper depicting nothing worth building, are devoid of interest.

Design office practice was followed. A specification was written before the class started and copies were given to each student. This specification gave general requirements for performance and dimensional limitations, and indicated the standard of strength required.

The ten students in their final (fourth) year in aeronautical engineering were initially given their heads in a couple of groups to sketch general layouts and to work out the performance of the more promising schemes. As might have been expected, ideas were scarce and the layouts pedestrian, showing the lack of experience of the group. The schemes were all conservative and unwieldy, except one which was far too complicated and rather flamboyant. This scheme was made by a student who later took a serious interest in design. A synthesis of the layouts put forward was made and a compromise scheme chosen. A weight and a performance estimate of this scheme completed the first year's effort. Even allowing for the restricted time of three hours a week, the result was not promising and the interest aroused was disappointing.

Final Scheme

During the summer vacation of 1946 the authors modified the scheme, refining it considerably, and wrote a resumé of the problem for the next group of students. This enabled them to be fully acquainted with the problem and to know what was expected of them.

Techniques Employed with Students

The second (1947) and later years were spent rather differently from the first. The job was broken down and those interested in calculations were allowed to make them under supervision of Prof. B. Etkin. Others, more interested in detail design, had enough to do. Students were allocated specific jobs and given a clear idea of what they involved. The instructor worked individually with students on the drawing board, encouraging them to express themselves. As might be expected, they were unable to make any start whatever and rough freehand sketches of possible schemes had to be made for them. In order to give further indication of what the shape of things might become, sets of drawings for other gliders were made available, but without citing them as good models. This had its disadvantages, since it led to easy copy-solutions, but was necessary, there being too little background from which to work. This utter lack of experience after three years of study of engineering was disappointing, but was to be expected, considering the curriculum covered by the students in previous years. The authors fully realise that teaching design should start with fundamental ideas two years earlier.

Some other interesting aspects of lack of experience came to light. In this design experiment, there was an obvious necessity for close collaboration between groups, because their work interlocked, as it does as a rule in a real design office. The obviousness of this necessity often did not occur to the students, who tended to forget they were part of the whole. The interlocking jobs did not mesh, resulting in waste and frustration. Again and again collaboration had to be forced. This tendency to form watertight groups may be natural and avoidable only by the introduction of interlocking projects in the earlier student years. Another aspect of inexperience was the commission of gross errors both in calculations and in drawings. In run of the mill problems, such gross errors are easily avoidable because the general size and quantities involved can be guessed. But here, breaking into new territory, the student often forgot to make the proper checks and, not realising how parts should be proportioned, there was no automatic warning for him that he had left off a zero or slipped a decimal. This was the first time that the students had made drawings to be followed by serious construction. The lack of accuracy was particularly noticeable in the working lofts. As much work as possible was lofted full scale from drawings and calculations on white painted Masonite and the lofts used as jigs for manufacture. This gave excellent practice in the principles of accuracy and checking.

This is probably the most appropriate place to discuss the efficiency of student work. In order to understand it fully, it should be mentioned that all the work was done on Saturday mornings from nine to twelve. Assuming an effective average of 45 minutes for each hour "worked", the net working time was only two and a quarter hours. Taking into account that there are only twenty or twenty-one working Saturdays in each academic year, it made altogether about forty

Table 1: Number of Aeronautical Students

School Year	1947/1948	1948/1949	1949/1950	1950/1951
Number of fourth-year aeronautical engineering students:	23	54	52	30

effective hours on the average per year, which is a short time indeed. The lapse of a week between sessions and the fact that the work was done on Saturdays, which as a working day is not popular with the students, slowed the work considerably. There is still another factor which influenced the efficiency of the work, namely, that there were too many students in the years 1948-1950. To give some idea what it meant to the instructors, the figures in Table 1 are quoted. (See page 20.)

Adding to that the fact that one of the authors left Toronto for England in 1948, it is quite evident that the two instructors left could never have coped efficiently with such large groups. However, the amount of work done by students through all the years from 1946 to 1950 is really impressive. The short summary of their work is as follows:

1. A complete set of prototype drawings for the Loudon glider was prepared.
2. A revised set of drawings, worked out as so-called "production" drawings, approximately 80 sheets, was made and finally approved by the Department of Transport (DOT).
3. A complete set of loft-jigs for all components of the wing, fuselage and tailplane and rudder was made.
4. A complete type-record, consisting of about 30 reports dealing with aerodynamic and stress calculations was written; this was the basis for DOT approval.

As the authors have had many years' experience in the aircraft industry and know well what to expect from an average drawing office staff consisting of professional draftsmen and technicians, it can be said that the result achieved at the University of Toronto is good.

It might be asked whether, despite the success of the design, the experiment was of value to the university. As to the choice of a project for teaching, the authors think that it would have been difficult indeed to find one of more intrinsic interest to aeronautical engineering students, possibly excepting a jet racing aircraft. The design of a powered aircraft is so much more complicated than that of a glider that it would have been impossible. The glider gave practice in all design problems outside the power plant. To the students the greatest value was definitely this: For the first time in their engineering study, they had the opportunity to see how they could use the technical knowledge acquired at the university in practical application.

The hope was that those engaged on the design would show sufficient interest in the translation of their work into reality to assist in the job of building. Experience of similar projects in Europe was that the actual building bred enthusiasm and a great deal of activity. In this case, nobody, except for a couple of students for a short period, helped to build the glider. The reasons are not known, so the authors have made some guesses. They feel that general social conditions may give the answer. In Europe the students were always very poor. They did not attend the university as an expected right; they were lucky to get there. Having little or no money to spend, wine, women and movies were very special treats, and they were thrown back on activities which cost them nothing. To improve their chances, to add to their experience and to use their spare time all at once were opportunities not to be missed. Our students are not poor enough and the temptations of other less improving amusements need not be resisted.

Conclusions

This experiment resulted in a successful design (see Appendix), but that was not the main purpose of the experiment. May we conclude that something about design can be taught in the way we have tried it? If so, should this scheme be continued and, if so, in what way?

It is obvious that the basic difficulty in coming to a positive conclusion is that the effects of the experiment are not yet fully known. It is true that the experiment did not result in an upsurge of enthusiasm or of talent. Early in this paper it was pointed out that talents are rare and only a few high-class designers are needed. But the worst weakness in our design offices today is not the lack of designers in leading positions. It is the intermediate grades which are very urgently needed in large numbers. The whole success in design of the German aircraft industry during the last war was only because Germany had, and still has, an intermediate class of designers, perfectly educated and prepared for their professional work. In Germany and in Switzerland, in all sorts of technical schools, great effort is directed towards teaching design and discovering talent. The same is being done in Russia on a nation-wide scale. The Russian leaders realise clearly that without a great number of well-educated engineers, they cannot beat the western world.

We know that we cannot teach anyone how to design in three hours on Saturdays during a fourth year of study. To teach design seriously, a much more extensive study is required, which should be started two years earlier. What we hoped to achieve was to develop those with talent and to give some knowledge of design to the rest, so that on taking a job in a design office the graduate would not feel as helpless as he feels today. Although our desire was to recognize those with talent, it must be realised that this can be no more than a byproduct of the job of turning out graduate engineers, who have had a chance to learn something about designing. It is obvious to everyone that because engineering undertakings today are tending toward greater size, higher cost and more complicated structures, the number of engineers involved has to be larger. The aircraft firms today are craving for experienced design engineers. They do not ask for geniuses at all; they ask merely for good designers having sound engineering background.

So far, we have only tried to bring to the surface the student interested in design. What do we do when he shows himself? Should the university provide him with the possibility of further study? We think that the answer should be "Yes". After all, the university is the only place where one may obtain higher special education. In several countries in Europe, machine and aircraft design is being taught successfully. Why should it not be done here?

Throughout this paper the authors have held forth on the necessity for teaching design and indicated how they tried it. How close were the results to the hopes? To what extent must the ideal be tempered to the possible? The authors cannot answer fully because it is still too early. But it is possible to say that the immediate reaction of the students was not as good as had been hoped. Later reaction has been better, as the teaching has had time to sink in. The authors are convinced that the technique of teaching design by doing is correct. Indeed, the senior author has been continuing the work on a new design for the past few years. If gradually this sort of teaching becomes recognized it will become more effective, because students will want to take such courses. If this occurs, the product will

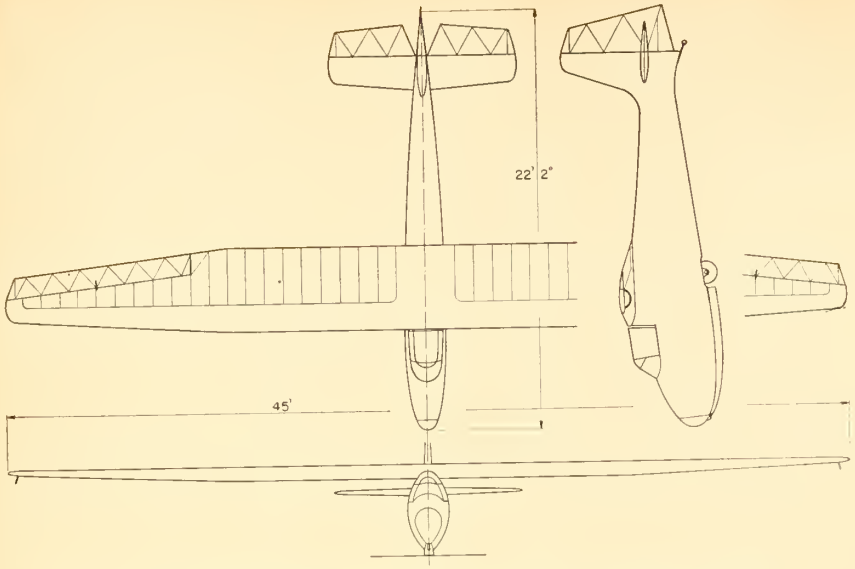

Fig. 1. General drawing of University of Toronto Loudon glider.

Fig. 2. Glider in flight.

neighbourhood of the cockpit. The parts were, as far as possible, made from the lofts by drilling them and applying suitable locating blocks where required after backing with half-inch multiply.

Metal fittings were a problem. The design details were as simple as possible and only aireraft quality mild steel was used, exeept for some details in dural. However, sueh work as maehining the main wing root fittings was outside the experience of the shop at the university. Enquiries outside were not encouraging and when estimates were given, they were far too high to be contemplated. Finally, the fittings were in fact made in the university maehine shop and made very well indeed. The welder was speeially approved by the DOT for this job. Progressive inspeetion was made of the glider as a whole, aceording to DOT requirements.

Technical Description of Loudon Sailplane

The University of Toronto Loudon is an advanced training sailplane. The prototype first flew in November, 1949, and since that time has obtained several successes.

The total time flown up to the end of 1953 was over 200 hours.

The Loudon (Figs. 1 and 2) was designed to fulfil modern requirements for an advanced trainer and proved to be much superior in performanee and handling qualities to prewar parallel types, such as the British Cadet and the German

improve, for nothing succeeds like suecess.

APPENDIX

Building the Glider

A basement room, well heated, was made available for building the sailplane, and a mechanic was employed to build it.

As indicated above, the method of manufacture was based on lofts drawn on white painted Masonite with a very hard peneil. When completed the lofts were eoated with clear varnish to prevent smudging and to make them easy to keep clean. As many as possible of the shapes were drawn from ealculations and the old-fashioned job of eut and try fairing was almost eliminated. The wing taper being linear, sections interpolated between root and tip were easily calculated. Fuselage frame shapes were nearly all made up of circular ares and the only detailed fairing neeessary was in the

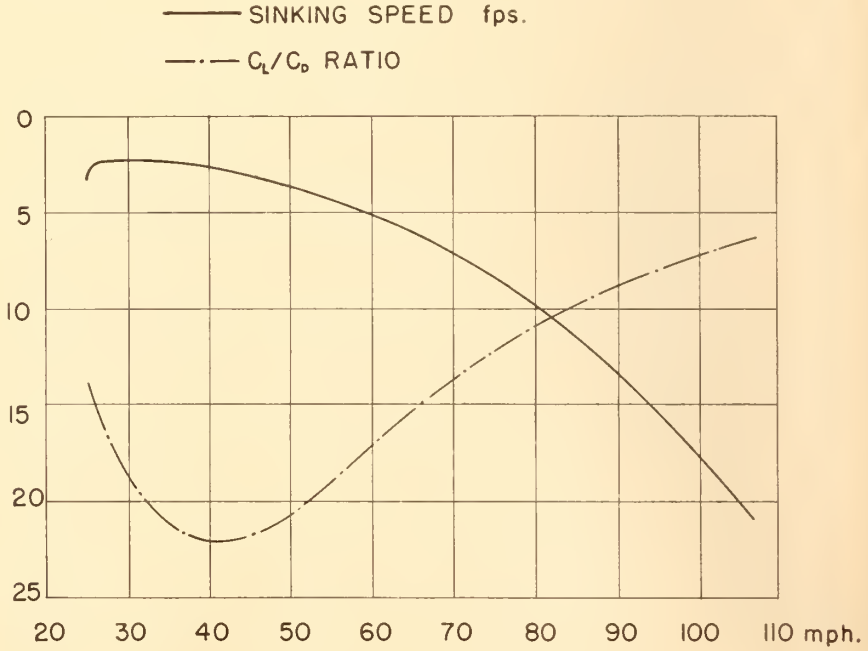

Fig. 3. Performance curves.

Grunau Baby. (Fig. 3). A good advanced trainer to-day should combine fairly good cross-country flight performance with good low speed characteristics, permitting the less experienced pilot to stay in the air sufficiently long in average weather conditions. It should be especially suitable to cover the performance required to obtain the Silver "C" certificate.

The structure should be sturdy enough to withstand many landings and short distance transport and simple enough to guarantee a reasonably low production price. It should be restricted to standard material and simple production methods, in case someone wants to build it at home or in a private workshop. As might be expected, in view of the required performance, the Loudon's wing has the moderate span of 45 ft. and an aspect ratio of 11.6. The airfoil section used is NACA 4416 over the rectangular portion of the wing, with a linear transition to NACA 6412 at the tip. The geomctric washout at the root is 4° which assures a good overall low drag wing characteristic. The wing plan form, consisting of a rectangular central part and moderately tapered tips, gives a close approximation to the eliptical shape required for obtaining a good aspect ratio efficiency, although, of course, the twist has also an important influence on the effective aspect ratio.

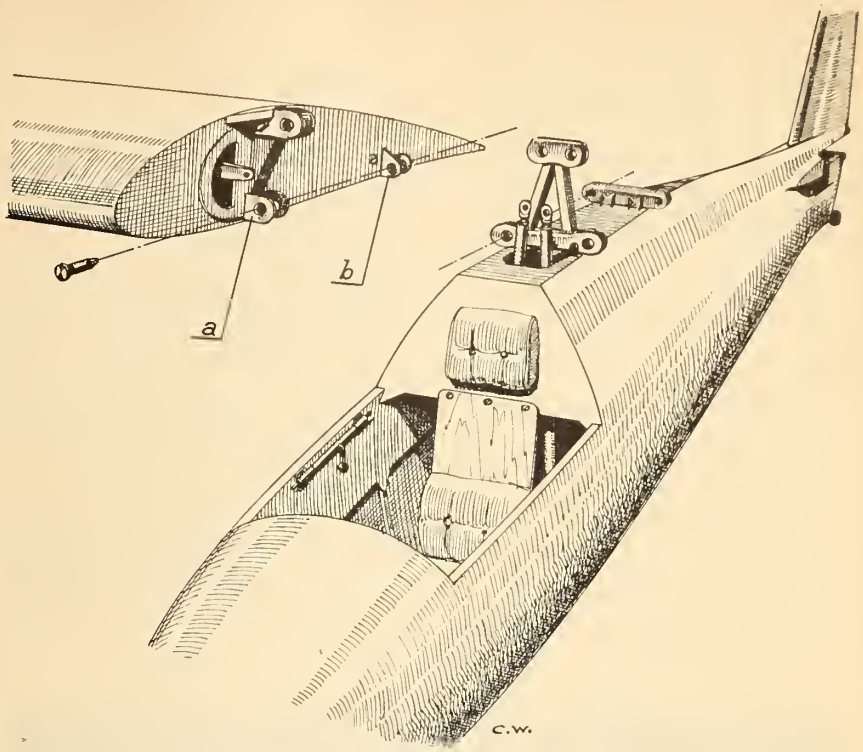

Fig. 4. Fuselage—wing joint.

Fig. 5. Wing structure.

The Wing Structure.

The wings are connected by a transport joint at the fuselage. Fig. 4 shows that joint. It consists of an inverted V-shaped welded fitting bolted permanently to the fuselage main bulkhead, to which the wing spar-root fittings are pinned, plus a simple attachment fitting bolted to the rear fuselage bulkhead. The wing spars are attached to the V-shaped fitting by four pins, two on each side, which take the whole bending moment. The two pins aft of the spar, in combination with the lower forward pins, take all loads and moments acting in the plane of the wing. For the sake of simplicity and stiffness, all the forces acting in the plane of the wing, plus torsion, are taken by a welded steel tube tripod bolted to the spar, which has a D nose type leading edge. Thus, a simple scheme was devised which was easy to manufacture, design and stress. The D nose leading edge structure (Fig. 5) consists of simple ribs covered with diagonal birch plywood in order to obtain the maximum torsional rigidity. The nose ribs, of semi-triangular design, are spaced 6 in. apart. The portion of the wing aft of the main spar is fabric, covered over the ribs, spaced 12 in. apart. The dive brakes are located a few inches aft of the main spar and consist of metal plates operating on the upper surface of the wing only, hinged to steel brackets and actuated by cables.

The ailerons are of conventional diagonal rib design, operated by

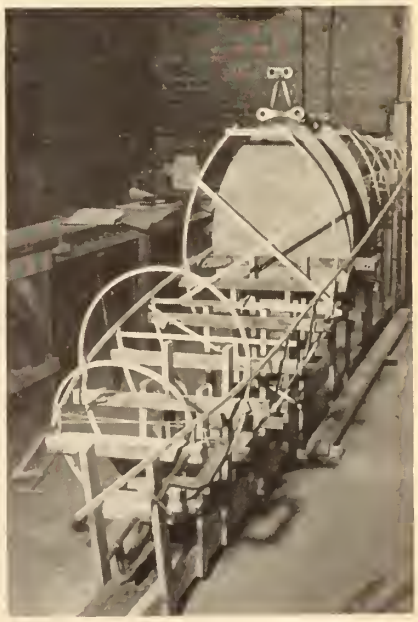

Fig. 6. Internal fuselage structure.

cables connected to an independent bellcrank system in each wing. The ailerons have differential, deflecting 30° up and 15° down. The wing tips are equipped with small steel tube skids, which protect the wing tips when operating the glider from paved runways and provide convenient handles for ground crews.

Fuselage.

The fuselage is built entirely of wood. Spruce and birch are used for frames and other structural members and birch plywood for skin and webs. The fuselage is of conventional semi-monocoque design, having a load carrying skin with longerons, frames and stringers. Fig. 6 shows the internal structure of the fuselage on the mounting jig. A special method of covering the fuselage frames with plywood was developed, in which the fuselage skin was scarf-jointed into long strips to cover almost the full length of one quadrant of fuselage. Before final gluing, the front portion of these strips was preformed to suit the greater double curvature of fuselage in the cockpit region. Thus, an almost perfectly smooth shell was obtained, which took little working time to assemble (Fig. 7).

The plywood covering has the grain arranged at 45° to the fuselage axis, in order to ensure the greatest possible torsional stiffness. The pilot's seat and the single wheel undercarriage axle are supported on two beams arranged between frames or bulkheads. The cockpit floor is removable.

The tail unit attachment is shown in Fig. 8; it consists of a horizontal slot in the fuselage, into which the stabilizer is inserted and held firmly by two bolts, joining the upper fin post with the lower portion through the tubular fittings attached to the rear face of the stabilizer spar. This sort of attachment is simple and sturdy. The front short spar of the stabilizer is clamped between wooden blocks arranged on top and bottom in the fuselage slot.

The undercarriage consists of a wheel located behind the main bulkhead and the skid mounted underneath the pilot's seat. The skid is elastically supported by an air-inflated rubber tube, enclosed between two fabric strips permanently attached to the fuselage and to the skid. The tow hook is of the Ottfur type, arranged right in the nose of the fuselage. The tail skid is of steel, and is fitted with a small wheel for easy operating on paved runways.

Fig. 7. Nearly completed fuselage showing strips of plywood covering.

Tail Unit.

The tail unit structure was designed along conventional lines, except for the horizontal tail fuselage attachment, already described. The elevators, of diagonal rib design, are joined by means of a short piece of steel tube, to which a control horn is attached. The rudder has a light alloy control horn, having the main spar recessed to accommodate the elevator axis, and is hinged to the fin post by two fittings. The stabilizer and fin are plywood covered; the elevators and rudder are covered with fabric.

Controls.

The elevators and ailerons are operated from a control unit consisting of a horizontal tube mounted underneath the pilot's seat, to which a control stick and V-shaped aileron bellcrank are attached. The control stick is directly connected by means of cables to a bellcrank in the rear portion of the fuselage, from which the elevators are operated direct by a push-pull rod. The ailerons have a completely separate control circuit in each wing, which, by means of two push rods, are connected with the V-shaped bellcrank in the fuselage. The differential aileron movements of two to one ratio are obtained by the geometry of the V bellcrank and the push rod system.

The rudder is operated by a conventional pedal and cable system. The airbrakes, arranged only on the upper surface of each wing, are connected by means of cables with an operating lever mounted on the left side of the pilot's seat.

Flight Testing and Performance.

The Loudon prototype has full approval of the Canadian Department of Transport as a Class II glider, according to U.S.A. C.A.R.-05 requirements. This makes it fit

for any sort of flying and manoeuvres within the specified speed range and weight limits, except cloud flying. Initially, it was intended to design it as a Class I glider, but, unfortunately, almost at the end of the design work, the requirements for the Class I glider were changed and it was too late to modify the design. However, the few spots and dimensions which required strengthening under the latest C.A.R.-05 specification were modified on the production drawings, so that it should not be difficult to change the classification in the future.

The prototype was approved for a C.G. range from 30.2 to 36.4 per cent of the mean wing chord at 585 lb. all-up weight. The above range accommodates pilots weighing from 130 to 200 lb.

A very extensive flight test programme was proposed to DOT by the Toronto Gliding Club, and was later carried out by experienced pilots. The test programme covered such flight cases and characteristics as take-off and aero-tow, landing, maximum speed test, controllability and manoeuvrability, balance and stability, spinning, flutter and vibrations, as well as ground characteristics.

The Loudon was flown for the first time on November 5th, 1949, at Oshawa Airport, Ontario, on which day five flights were made, as a result of which the sailplane was accepted as airworthy for the continuation of the already approved test programme.

During the initial test period of test flying, some minor troubles began to show up, which were gradually corrected. It was evident, for instance, that the control stick forces were too high at slow speeds. This was corrected by adding a trim tab on the elevator, and on future models by changing the tailplane incidence. The spoilers were not as effective as desired, and a high frequency buzz started at 60 mph. It was found that the spring retaining mechanism was not stiff enough. This was cured, as well as the low effectiveness of spoilers, by reducing the gap between the spoiler plate and the upper wing surface.

A mild tail shudder and rather poor slip characteristics were cured by adding a rounded fillet between the fuselage and the fin. Before the fillet was added, the air flow was breaking away over the fin and rudder with the rudder actually stalling, thus making it difficult to keep the machine in a sideslip. All these minor changes took place during the first few months of test flying.

The performance in straight flight as calculated, is given in Fig. 3. The performance obtained in test flight shows a little improved minimum sinking speed and a slightly higher sink in the region of higher speeds. The estimated minimum sink was 2.1 ft./sec., as compared with the calculated 2.25 ft./sec. The best gliding angle proved to be almost the same as calculated.

The Loudon does not show any tendency to fall off to one side when flown in steady partial stall with the stick fully back and normal rudder. When reducing the speed in straight flight, the glider can be flown as slow as 22 mph. and, although the sinking speed is two or three times the minimum, steady flight can be maintained.

The glider does not show any tendency to spin or spiral dive. Several attempts were made to spin it in either direction without success. The glider can be made to stall and lift a wing into a spin, but it recovers in a spiral dive in about a quarter turn without moving the controls from the cross control position.

The low stalling speed obviates any tendency to stall in tow and adequate control can be maintained at all times. Great care was exercised when testing the glider at high speeds. In order to get the speed readings correctly, two trailing static bombs were used for two speed ranges, one covering speeds from 30 to 50 mph., the other from 60 to 100 mph. The design gliding speed of Loudon is 100.5 mph., and the glider was flown up to 103 mph., which adequately covers the corresponding C.A.R.-05.2 requirement.

A similar test was repeated with extended spoilers, in which case, however, the maximum speed should not exceed 1.67 times stalling speed. As the stalling speed with spoilers fully extended is about 35 mph., the maximum test speed should be $35 \times 1.68 = 58.6$ mph. The glider was in this case flown up to 71 mph. which well covers requirements. In all high speed flights, a high control stick force and a forward stick position is required to maintain a steady flight condition. It is particularly noticeable at the maximum speed at full range of C.G. positions.

The glider is fully manoeuvrable and controllable at all speeds between stall and maximum certificated speed, and forward and aft C.G. locations. The glider has been looped at speeds from 75 to 95 mph.,

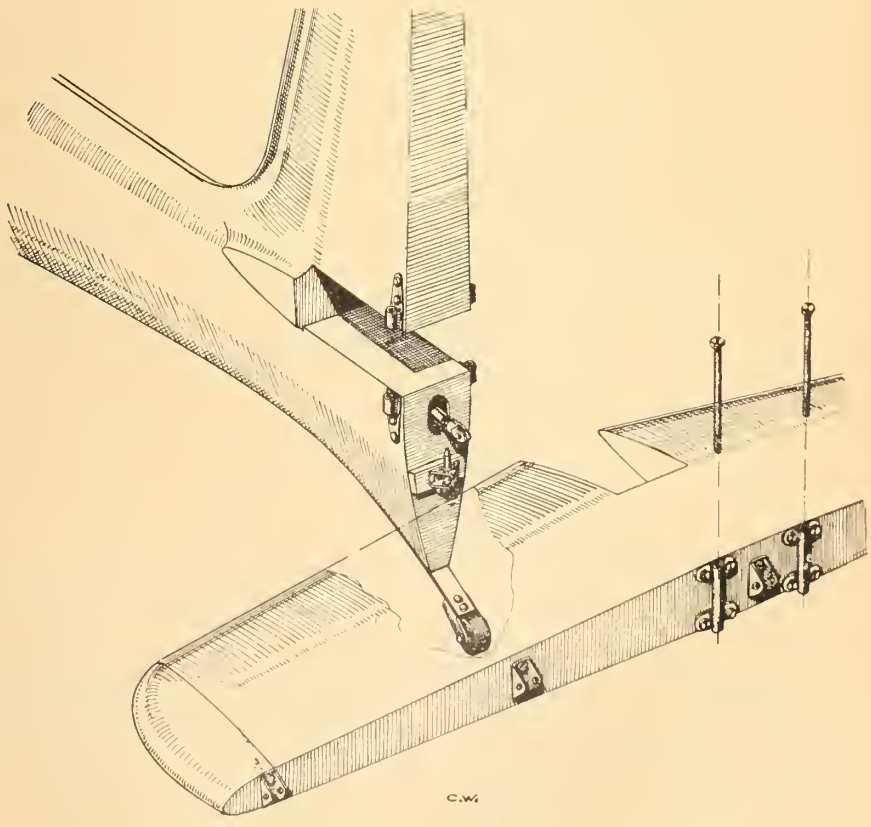

Fig. 8. Tail unit attachment.

stall turned entering at a wide range of speeds and landed from a high speed climbing turn entered at 90 mph. at 20 ft. altitude. The spoilers have been used at varying amounts up to full travel at speeds from stall to 71 mph. in free flight and in tow, both in turns and in straight flight. No difficulty was experienced in maintaining full control at all times, and no buffeting was noticed.

The glider is statically and dynamically stable about all three axes. The dynamic stability was checked by sharply moving the control stick or rudder in steady flight and observing the path and speed of recovery to normal flight condition. In each case, a high damping effect was evident with oscillations levelling out very fast. It is particularly noticeable in roll.

After finding the cause of the vibration of spoilers and the shudder of the fin and of the rear portion of the fuselage and correcting them by proper modifications, no further trouble with vibration or flutter has ever occurred at any speed range during any test flights.

On the basis of all tests in flight, the following placard speeds were approved by DOT.:

Placard maximum speed, 90 mph.

Placard maximum auto-winch speed, 65 mph.

Placard maximum aero tow speed, 90 mph.

Placard maximum speed for operation spoilers, 65 mph.

Stressing and Structural Testing.

One of the main documents, on the basis of which the DOT approval was granted, was a very thoroughly prepared record, consisting of aerodynamic and stressing calculations. For this, the numerous aerodynamic and stress reports prepared by students during their university work were revised and edited before final presentation to DOT. This was a good opportunity indeed to check how reliable a student's work could be. It was found generally that the average quality of work was not too bad, except for a few cases where the reports had to be completely rewritten. Also, some other reports had to be added, in order to cover the whole structure more thoroughly.

One special case is worth mentioning, namely, the stressing of the front portion of the fuselage in the region of the cockpit. The main loading cases for that portion of fuselage are the down, up and sideways loads applied at the tow hook

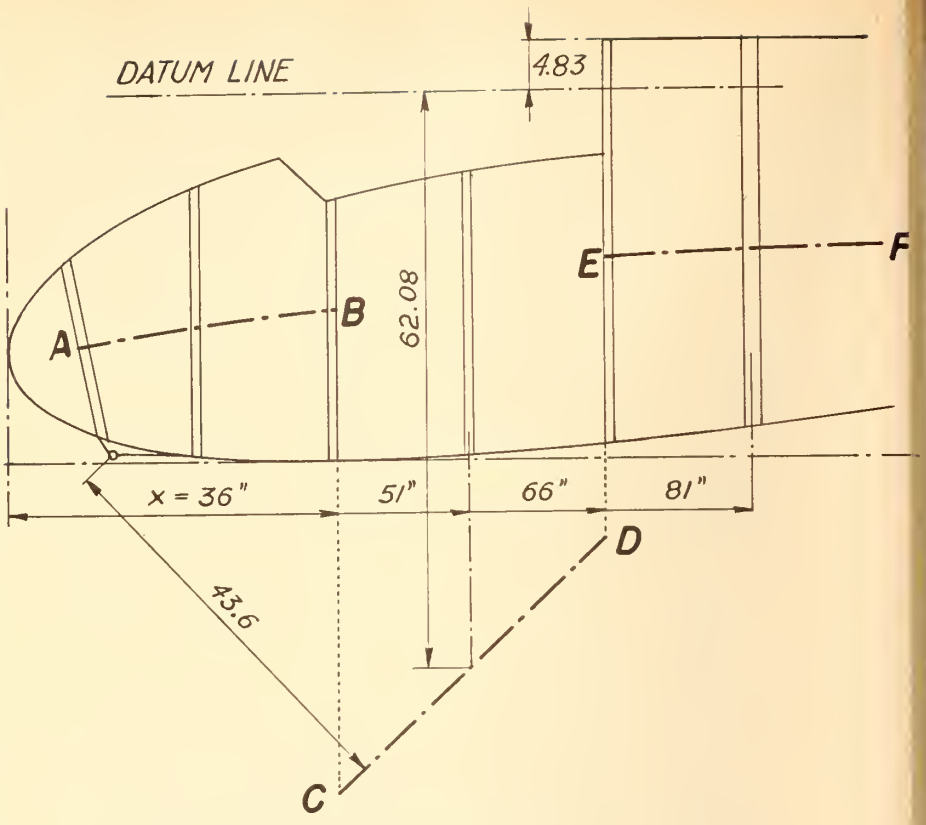

Fig. 9. Shear centre line location; fuselage front portion.

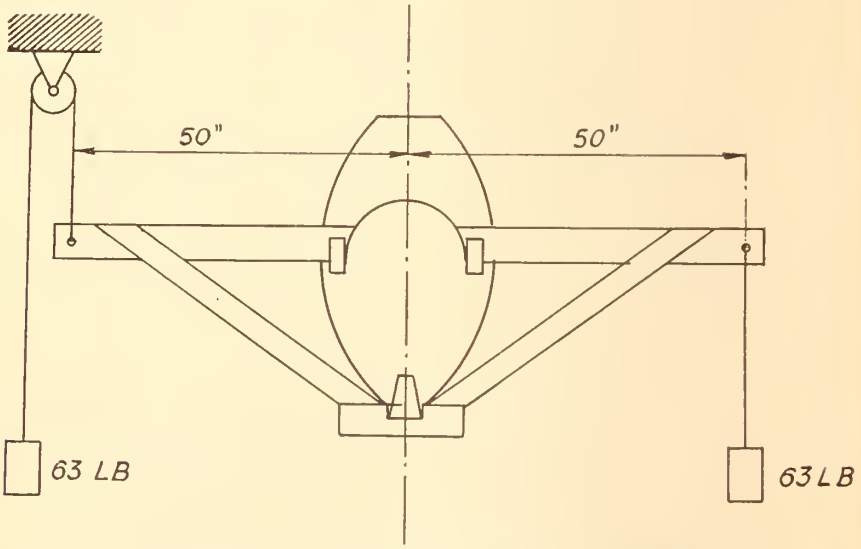

Fig. 10. Torque application arrangement at Station 36-in.

by a towing cable, in flight in aero tow or winch take-off. Especially the sideways component of the towing load was critical in the region of the cut-out for the cockpit. Because it is practically impossible to find the shear stress distribution in an open shell made of an anisotropic material—the combination of spruce stringers and plywood covering laid at 45° to the centre line—a mixed experimental-analytical method of stressing was used. In order to find the shear stress distribution in the outer skin, one must know the location of shear centres in each section of fuselage in front of the main spar bulkhead. This was done experimentally by fixing the main fuselage bulkhead and loading the front portion of it by a known torque. By using a proper record-

ing arrangement attached to each frame, the relative rotation and hence the shear centre, was found. In Figs. 9 and 10 the location of shear centres thus obtained is shown, as well as the method of torque application. From an applied torque and from the position of the shear centres, the shear stress distribution at each section was found, as well as the modulus of torsional rigidity. Knowing these two quantities, as well as the corresponding section geometry and areas, it was possible to carry out the stressing of the front portion of fuselage. In Fig. 11 a typical shear flow distribution is shown for Frame No. 6.

Besides an extensive record, the C.A.R.-05 specifications require a number of proof and operational tests, mostly to the control system and towing arrangement, covering all parts of the glider which are directly loaded by these systems. The purpose of the tests is to prove that the parts work satisfactorily under operational loads and that the stiffness of the glider components involved is adequate.

These tests were executed by loading the corresponding control surface with proof loads and measuring the forces acting at the control stick or pedals. Usually the requirement is that the loaded system has to withstand the proof load for one minute without any permanent set or damage. Some of the requirements are severe, as, for instance, a requirement of loading the whole rudder system by 400 lb. applied to each pedal. This load is balanced by stretching the control cables and is resisted by the rudder horn and hinges.

Another group of tests was performed on the launching and towing release mechanism including the relevant part of the fuselage. The proof load in the towing cable was 1,124 lb., applied to the front part of the fuselage in four different directions. Fig. 12 shows the manner in which the fuselage was held in position and loaded. The proof was applied for one minute without damage or permanent set, and then reduced to 562 lb. and released by the normal release mechanism, as required for operational test. The most severe case was that in which the tow force acted sideways at 30° to the axis of the fuselage, and was resisted by sideways bending of its front portion. In this case the fuselage was maintained on a cradle on its left side at the main bulkhead and the tail held by a dummy tailplane. The glider passed through the operational test 562 lb. satisfactorily. However, at the full load of 1,124 lb. the outer skin behind the pilot's seat started to buckle. It was therefore decided to add a few spruce intercostals in the affected area. It is worth while mentioning that the corresponding British requirements specify a slightly lower towing load and a side angle of 15°. The proof load side-component in this case is slightly smaller than the side-component attained successfully at the operational test required by C.A.R.-05.

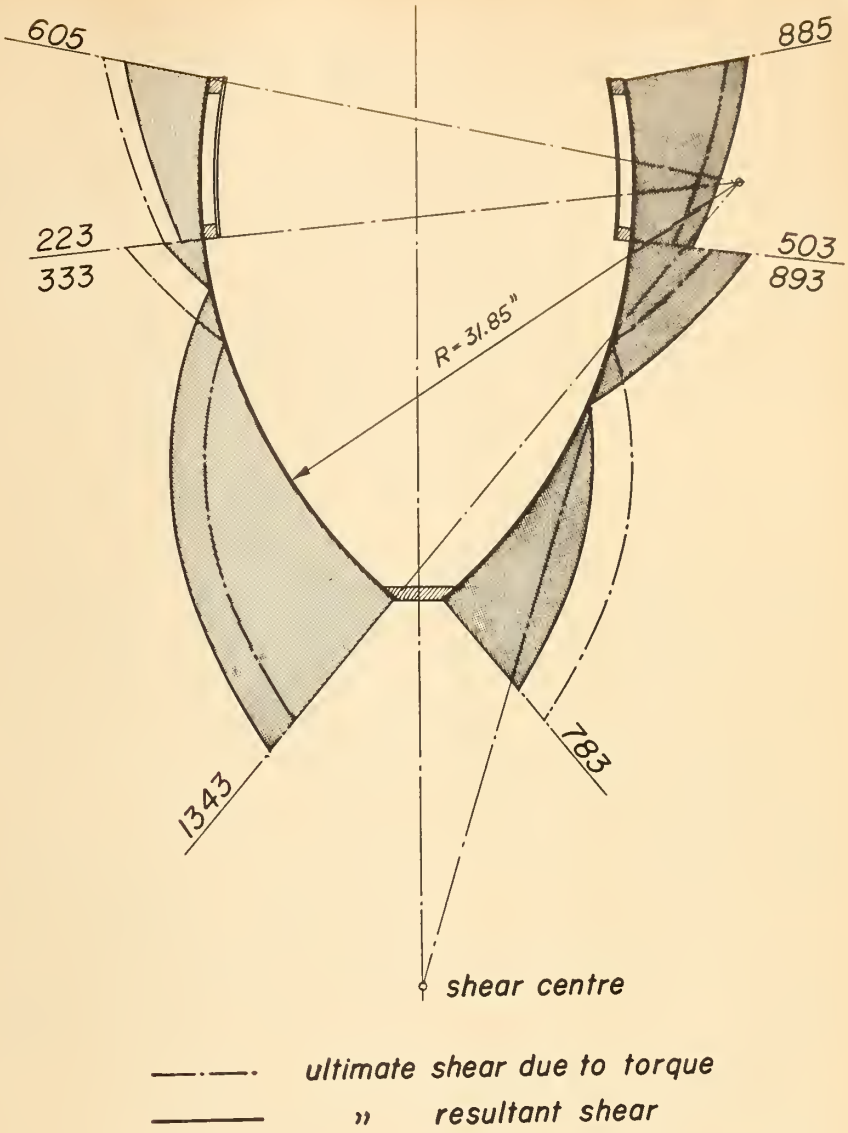

Fig. 11. Shear stress distribution at Frame Station 51-in.

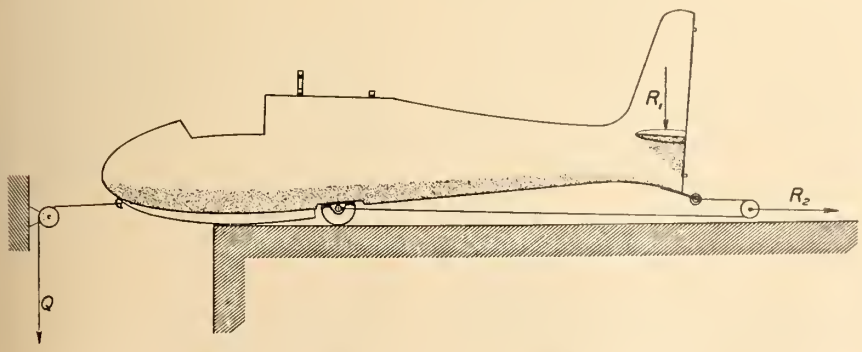

Fig. 12. Method of load application of load for aero tow test.

The Use of Aluminium In Contact With Other Metals

by

Hugh P. Godard

Head, Chemical Division
Aluminium Laboratories, Ltd.,
Kingston, Ontario.

Not very long ago we published a paper from the Aluminium Laboratories dealing with the corrosive effects of common building materials—concrete, mortar and plaster—on aluminium. Aluminium is often used in direct contact with other metals in building construction and probably even more frequently in its industrial applications. This short paper predicts in a general way what corrosive effects may be expected under such conditions.

Aluminium alloys possess good resistanee to weathering (1, 2), to seawater (3) to many natural waters (4) and to many chemieals (5). In common with other metals, this good behaviour depends in part on good design (6). Probably the most common cause of corrosion of aluminium in service is use in contact with other metals, whieh under unfavorable eireumstances ean lead to galvanic eorrosion.

The general principles of galvanic corrosion have already been deseribed (7). For any given pair of metals the severity of galvanic corrosion depends on:

(1) Degree of electrical contaet, i.e., electrical resistance of joint.

Unless there is electrical contact between the metals there will be no galvanic corrosion. If contact is increased by paint films or build-up of corrosion produets, the amount of corrosion will be reduced.

(2) Conduetivity of solution.

In fresh waters with low electrical conductivity there is little galvanie corrosion; it may be severe in seawater, which is highly eonductive.

(3) Relative anode and cathode areas.

The larger the ratio of anode to eathode areas, the less severe will be the galvanie corrosion. Conversely, large cathode to anode area ratios may produce severe corrosion. For this reason, fasteners such as bolts, screws and rivets should always be eathodie to the metal joined.

(4) Polarization.

Polarization is the reduction of potential with flow of current, which reduces the amount of current. This occurs more with some metal pairs than with others.

Aluminium stands high in the electromotive series and in most galvanic series of metals, and is usually anodic to other metals with which it is in contact, with the exception of magnesium and zinc. However, the severity of galvanic eorrosion depends to a large extent on environment and is less in most eases than is generally realized.

Influence of Environment

Atmosphere

Galvanic corrosion is most pronounced in marine atmospheres; the most severe condition is found on board ship. Ashore, the worst location is on a pier and severity decreases rapidly with distanee from the shore, depending, of course, on topography and on the prevailing wind. At the Kure Beach, N.C., corrosion testing station, for example, there is a several-fold reduction in galvanic corrosion on going inland from 80 feet to 800 feet from the water's edge. In most locations galvanic corrosion will be slight a mile inland, while it is doubted if any marine galvanie influence can be deteeted five miles inland. As Canada's inhabited shoreline is relatively short, marine galvanie corrosion is not a major national problem.

In city atmospheres moisture films on a surface are acidie and have a tendeney to promote galvanic action between dissimilar metals in contact. Rain has a benefieial action in both marine and urban atmospheres, tending to dilute and wash away conducting water films. Fog, on the other hand, has a deleterious effeet.

In rural atmospheres there is very little galvanie aetion because the rainwater is pure and is a poor electrolyte.

Natural Waters

The influence of natural waters on galvanic corrosion depends on their conductivity, which is proportional to their solids content. However, most potable waters have little effect, because they usually contain less than 300 ppm. of dissolved solids. On the other hand, galvanic corrosion is a major problem in seawater, which has over a hundred times this amount of dissolved salts.

Other Environments

Galvanic eorrosion may prove to be a problem in other special environments, such as in the chemical and food products industries. While one cannot generalize, much experience with these produets has been gained and is available. In some cases, tests will have to be made to determine the galvanic tendencies of pairs of metals and the severity of galvanic action.

Influence of Other Metals

Copper, and its Alloys

Where possible, it is best to avoid joining aluminium to eopper or its alloys, beeause this produces the

most unfavorable galvanie couple likely to be encountered in practice with aluminium alloys, but if the couple is in a dry atmosphere, there will be negligible galvanie action. For example, in several plants indoor aluminium-to-copper bus bar joints have not corroded after many years. Similar connections gave no trouble in the electrical system of the liner *Aquitania* during her 37 years' service. In domestic refrigerators a flash butt welded joint between aluminium and copper tubing performs satisfactorily.

In rural atmospheres where the rain water is pure, galvanie action will be slow. For example, copper nails driven through aluminium sheet and exposed at Kingston for eight years have produced only incipient and barely visible pitting.

In industrial atmospheres where rain and condensate are more conductive, action will be more rapid. Yet in one case in urban Toronto, equal sized aluminium and copper electrical cables were clamped together for several years and only a small amount of corrosion of the aluminium was evident.

On board ship and in severe marine environments direct contact of copper and aluminium should be avoided.

In water-handling systems internal galvanie corrosion at joints between copper and aluminium piping will depend on the hardness of the water and on its temperature. In soft waters it will be negligible; in hard waters, where corrosion may occur, one precaution is to install a short length of replaceable heavy walled aluminium pipe at the connection. Insulating couplings are available to avoid direct metal contact. If the water picks up copper from the copper part of the system, it will tend to deposit it on the aluminium surfaces and promote pitting. This can be alleviated by the use of Alelad aluminium, which may increase the service time before perforation by a factor of five or ten.

Mild Steel, and Wrought and Cast Iron

In all but marine atmospheres the galvanic action of mild steel and of wrought and cast iron on aluminium is slow. Aluminium alloys containing copper, such as 17S-T, 24S-T and 26S-T, suffer less galvanic corrosion in contact with steel and iron than alloys such as 2S, 3S, 57S and 65S.

In natural waters there is little galvanie action of these couples and in some waters aluminium may even be protected by iron. Rust deposits carried into aluminium pipe by the water are not detrimental. Aluminium water piping can be directly connected to steel in most cases, especially if a galvanized fitting is used.

In structural applications the faying surfaces of steel-to-aluminium joints should be filled with an inhibited joining compound. For marine construction, such as the installation of an aluminium superstructure on a steel hull, the contacting steel members should be galvanized or sprayed with aluminium or zinc, jointing compound used and the joint be kept well painted. Steel rivets are preferred and where possible galvanized steel washers should be placed under the rivet heads on the aluminium side. Where this is not feasible, the steel rivet heads on the aluminium side should be metal sprayed with aluminium after driving.

Stainless Steel

In normal atmospheres and natural waters, aluminium can be used safely in contact with stainless steel. In severe marine atmospheres, stainless steels tend to corrode aluminium, so the junctions should be painted. In seawater, unpainted connections should be avoided, especially if the area relationship is unfavorable. The corrosion rate is lower than that produced by contact with copper.

Chromium-plated Steel

In most fresh waters, and in all but marine atmospheres, aluminium will perform well in contact with chromium-plated steel.

Lead

Aluminium may be used with lead in all but marine atmospheres. Lead washers may be used on nails for aluminium roofing sheet in all but the most severe marine atmospheres and even here the galvanie action is slow. For example, it took 37 years to perforate a 0.032 in. thick aluminium sheet roof around lead nail washers in Sydney Harbor, Australia.

Zinc and galvanized iron

In the atmosphere, zinc is anodic to aluminium and will protect it when in contact. This also holds in most natural waters. In alkaline solutions, zinc becomes cathodic to aluminium.

In corrosive atmospheres, aluminium should not be placed in contact with galvanized iron unless the combination is painted, because the aluminium accelerates corrosion of the zinc and when this is consumed, the exposed iron galvanically corrodes the aluminium. When painted, the couple is satisfactory and maintenance of paint over the joint is much less difficult than on aluminium-steel connections.

Cadmium

Cadmium is very slightly cathodic to the common aluminium alloys — it is anodic only to the copper-containing alloys — and may be used safely with them under all conditions. Cadmium-plated steel is also recommended for contact with aluminium; however, when the cadmium itself corrodes away, a steel-to-aluminium contact is made.

Magnesium

Magnesium is anodic to aluminium and corrodes preferentially when coupled. In corrosive atmospheres, such contact may tend to corrode the aluminium as well. Large galvanie corrosion currents produce an alkaline (corrosive) condition on the aluminium. Certain aluminium-base alloys containing magnesium, such as Alean 56S (5 per cent Mg) and 350 (10 per cent Mg), produce the least galvanic action. The two metals may be safely used together in most natural waters and in all but marine atmospheres.

Summary

Some general observations have been made on the galvanic corrosion tendencies of aluminium when placed in contact with other common metals. The resulting amount of corrosion for a given combination depends largely on the conductivity of the electrolyte, the relative areas of the two metals and the electrical resistance of the joint.

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Will the Ice Age Return?

by

N. J. Berrill

Strathcona Professor of Zoology,
McGill University,
Montreal.

If the author's conclusions are correct, engineers may ultimately have to contend with climatic conditions far worse than permafrost, the one currently receiving so much attention. It would appear that we might well focus some attention on the future conditions suggested as possible in this paper, which was originally presented before the Montreal Branch of the Humanities Association of Canada. The author is a zoologist by profession, best known through his recent book "Sex and the Nature of Things".

The Arctic is getting warmer and so is the Antarctic. Canadian winters are losing their bite and are a little less stretched out than they used to be not so long ago. All this is no illusion. In the last 50 years the mean annual snowfall in Montreal has decreased by nearly 30 inches. Thirty years ago the polar front, the edge of the mass of cold Arctic air that pushes south every winter, extended across the southern United States; now it seems to wobble somewhere near the international border much of the time, bringing unseasonal, unsettled and unwanted mid-winter spells of mild weather to Canadian cities. Even the deep freeze of the Yukon winter is milder by seven or eight degrees than at the start of the century, and since that time the glaciers have been receding rapidly, both in Arctic Canada and in northern Scandinavia. Even the great Arctic ice sheet has shrunk several hundred miles closer to the pole. Cod have returned to the now unfrozen waters of Davis Strait and the herring are retreating from the overly warmed waters off Maine and Nova Scotia. New forests invade the tundra along the eastern Hudson Bay, but farther south the birch is dying throughout New England and the eastern Provinces; it can't escape the warmth. All of this fits into the picture of a warmer world. The trend is clear, but how long has it been going on, and how long will it last?

A Question of Time

It is all a question of time and of whether you take a long view or a short one. Official records show that the present trend has been going on for at least a century and there are records of another sort that suggest it may have started much further back than that. For when glaciers melt and the weight of ice is lifted off the land, the land rises, though not at once. In Spitzbergen, where glaciers have been shrinking as in other places, the remains of the activities of seventeenth century whalers are now many feet above where they used to be. The world has perhaps been warming up for several centuries and it may go for several more, at least beyond the time of our individual lives. And the process seems to be a steady one. This winter the ice sheet failed to form off southern Labrador for the first time and harp seal herds that use it as their nursery could neither land there nor be caught and killed. It's a very ill wind that brings no one any good.

A Warmer Country—But . . . .

If it is a warmer country you want with much longer frost-free periods in the southern parts and new extensive forests reaching far into the north, then this is the rosy side of things. Yet if the trend continues until no more ice is left in either the Greenland ice cap or in Antarctica, particularly if the melting process should accelerate, there will be the devil to pay. For the level of the sea will go on rising as long as the ice melts and if all melts the rise will be another 150 feet. The rate is slow enough at present, goodness knows; about five inches in twenty years or only two feet in a century. Yet it could speed up and then the question arises whether New York and London and all the other great seaport cities will die of old age, or be encroached upon and finally submerged while still struggling to survive. More than cities would go, for much of the finest agricultural land in the world—the valley lands of the Mississippi and of the Amazon, the St. Lawrence valley as far as Lake Ontario, much of the rich farm lands of the east—would become submerged; Holland would disappear entirely; the sea would flow freely through the Mediterranean into the Indian Ocean, and the sands of the desert perhaps become the floor of shallow seas as they were once upon a time.

This is the prospect if the ice age is behind us and if the present process of warming up continues a little longer and does not reverse itself. It is hard to realize that ice ages are abnormal because we accept the polar ice caps as a natural part of the world we live in. The last ice age is treading on our heels even yet, but before that we have to skip something like 250,000,000 years, almost but not quite back to the

age of the coal forests, before we find evidences of another, while the rocks indicate another equally long ice free interval before we see signs of still an earlier one. There is no satisfactory theory to explain why ice ages come and go when they do, although there is some connection with the great periods of mountain building. What now concerns us more is the nature of this last one. We are ice age people, though we live in warmer times. There are no indications that man as we would recognize him existed before the ice age as a whole was under way. When it was over, or apparently so, there were men camped south of the great retreating glaciers both in North America and in Europe. Somewhere between the beginning and the end we seem to have found our place.

This is part of a long story and somewhat beside the mark, but whatever the details of our human history may be, the nature of the ice age that still lingers with us concerns us vitally even now. For an ice age is not one continuous freeze. It comes and goes with a rhythm all its own, and I know of no evidence giving assurance that its rhythmic beat has ended. The ice age started half a million years or more ago, a length of time that is ominous in itself. The scarred rocks and glacial sediments give an outline of events, of the alternating advance and retreat of the northern ice cap. Once it started the ice came quickly, from massive centres over Greenland and Scandinavia, invading North America as far south as Chicago, with a subarctic climate extending far beyond its edge. And roughly speaking it remained some 60,000 years. It is difficult to be sure of the actual time, but if the half million years assigned to the ice age as a whole are anywhere nearly correct, then we can estimate the duration of the subdivisions with reasonable accuracy.

The Rhythm

Here is the rhythm—60,000 years of ice, 60,000 more or less without, 60,000 more of ice, then an interglacial period of some 200,000 years, then another 60,000 glacial years, then 60,000 of withdrawal, and a final glaciation of from 100,000 to 200,000 years with three milder periods within it. These are round figures and may be far from being as equally equated as I have stated. But the essence of the truth is there: long periods when America north of the Mason and Dixon line and most of Europe were under ice, which alternated with equally long periods when ice withdrew at least as far as it now has gone. During the great interglacial period in the middle the ice may well have disappeared altogether. And it may mean something, too, that the oldest skull of our own human species yet found belongs to this particular period.

With this sort of geologic history so recently behind us you begin to wonder where you stand. Is the ice age over? Are we entering a long interglacial period with several tens of thousands of years ahead of us with no more ice than at present? Or is this mild interlude no more than the fourth wobble within the last glacial period? As individuals I suppose it doesn't matter very much to any of us, but as a civilization, as members of a species that we feel now owns the earth, I think it matters a lot. Human destiny concerns us, as well as our individual lives. At any rate, it would be nice to know what is likely to happen.

When was the big ice last farthest south and what has happened since? The answers to these questions may tell us what we want to know, or at least give us some suggestion of what the future holds.

Two Keys to the Past

We have two keys that help unlock the past. One tells us something about the climates and the other gives the dates. The first consists of pollen grains, like those that give you hayfever, except that these are dead. In particular the pollen grains of trees—of spruce, pine, fir and hemlock, of hickory, chestnut, beech and oak—all have their distinctive features and for thousands of years they have been settling in layers with the mud at the bottoms of lakes and swamps. A lake may long since have filled up, but if its past existence is suspected, its contents can be tested. The beds of peat bogs and of old lakes are stabbed with coring devices and the long column of dried mud and pollen reflects the changing past. If oak pollen, for instance, was dominant the weather was warmer; spruce pollen implies that the climate was cold.

The other key is virtually a clock itself, an atomic time-piece built into the remains of anything that was once alive, whether animal or plant. Its only drawback is that there is a limit to the period of the past that it can measure. It is not sensitive enough to use for recent centuries and it runs out of time about thirty thousand years ago, but for dating events since the last great advance of the ice it is ideal. We have here a postwar peacetime application of one of the fruits of atomic warfare, for the method exploits the discovery of radiocarbon, a radioactive form of carbon that can be distinguished from ordinary carbon and the proportions quantitatively estimated in the nuclear physics laboratories of a number of universities. The underlying principle is magnificently simple. Radioactive carbon, better known as "Carbon 14," is continuously produced in the upper atmosphere by the action of cosmic rays, which transform nitrogen in the air into it. This becomes incorporated in carbon dioxide and is absorbed by plants and by the animals that eat the plants. As soon as the organism dies and ceases to take in fresh carbon, the built-in clock begins to run down. The Carbon 14 begins to tick away the years. In 5,568 years, on the average, only half of the original store of radiocarbon atoms is left; after another 5,568 years only half of this half are left, and so on. It makes it possible to date, among many other things, the age of pieces of wood found with the mud and pollen.

Putting the carbon and pollen analyses together gives a dramatic picture of the retreat of the ice cap, to some extent unexpected. Up to within the last ten years the ice was thought to have reached its farthest south for the last time some 20,000 years ago, and that men first entered North America by crossing the Bering Strait after the ice withdrew. Carbon 14 gives a different verdict. At Two Creeks Forest Bed in Wisconsin, close to the southern limits of the last ice advance, an old forest lies shattered. The trees all lie pointing southwest and have splintered ends, toppled by an advancing glacier. The carbon clock dates them as having been alive only 11,000 years ago; at this time the ice was still advancing. Yet woven sandals found in Oregon and other remains, according to their carbon content, indicate that men were living south of the ice at least 10,000 years ago. How and when did they arrive? Bison which were frozen in the permafrost of northern Alaska have been dated as older than 28,000 years and must by the nature of things have remained frozen all the time. Did men get across while conditions were Arctic, or in far more distant and warmer times, or is there a catch somewhere in all of this?

Yet the crash of the ancient Wisconsin forest seems to have been the

turning point. It went down before the glacier 11,000 years ago, but at the same time in Bermuda, more or less in mid Atlantic, another forest was being flooded by the sea. The ice cap as a whole was melting and the sea level was rising.

As polar ice retreats, the sub-arctic tundra along its southern margin gives place to pine, then to fir and spruce, and last of all to hardwood forests. This goes on in northern regions even now as the seasons get milder and the sequence has been the same from the first. Pollen grain analysis shows the course of withdrawal, radioactive carbon shows when it happened. This is the sequence: the pine belt south of the Arctic tundra lay in West Virginia in 7500 B.C. By 7000 B.C. it had shifted north to Connecticut. The line passed through Southern Minnesota in 6000 B.C., through Northern Minnesoto in 5000 B.C., and in 4000 B.C. it passed through Aroostook County, Maine.

So far, so good. It looks as though the same steady withdrawal of the ice and the consequent shifting of the tree zones is still continuing and perhaps will keep on going and that our glacial worries are over. Yet it is too good to be true, for there have been some disturbing changes since the glacial ice withdrew.

A Mystery

To start with there is a mystery. Horses and camels and many other beasts survived the ice age as a whole and were abundant in North America at the end of the last glacial period. They were not killed off by cold. And while traces of early men have been found associated with the remains of mammoths and of extinct species of bison, these men were much more primitive in their hunting tools than the North American Indian races that arrived later. They cannot be held responsible for what happened. The camels, the horses, the mammoths and a whole host of other animals simply disappeared. This hemisphere was without the horse until a few centuries ago when the Spaniards reintroduced it. The only explanation that makes much sense is that there was some great climatic change and that this group of large animals died out for lack of food or water or a combination of the two. Buffalo were the exception. Whether this actually was the cause of their extinction no one knows, but the climatic changes did occur with almost catastrophic suddenness.

Pollen grains from dated levels tell the story fairly clearly. Following the end of the last glacial period the pollens of pine and spruce predominate. Then between 9,000 and 10,000 years ago the pine diminishes and oak surges through the forests, with pollens of other trees indicating a climate that was warm and dry, a sudden change that may well have been a crisis. In any case the warmth remained, and the period from about 9,000 to 6,000 years ago is labelled by the trees that grew then as being warm and moist; from then until 3,000 years ago it was warm and dry again. The peak of warmth according to this form of reckoning was between 7,000 and 8,000 years ago, 3,000 to 4,000 years after the end of the glacial advance.

There was apparently a post-glacial peak of high temperature in both the northern and southern hemispheres, with a little easing towards a cooler state during the following 6,000 years. About 1000 B.C. the temperature in general began to fall, with occasional recessions, until now the average appears to be nearly 8°F. lower than it was. This may not seem like very much, yet it takes a surprisingly small drop to make an ice age. Once winter snow fails to melt entirely during the following summer, the end comes quickly.

The sea shows a somewhat similar picture. During the same warm post-glacial period, from 3,000 to 8,000 years ago, warm water species of seaweeds, mussels and other molluscs inhabited the seas around Iceland, Spitzbergen, Siberia and the Canadian Arctic islands. It has become colder since that time and these and other organisms no longer live there.

And we get the same story from the land in other ways than from pollen grains. Trees grew to a line 1,000 feet higher than now along the mountain ranges of Europe and Scandinavia and 200 miles farther north in Siberia. The Scandinavian glaciers melted away almost completely and so did those of Iceland and most of those of the Rockies and High Sierras. The Arctic Ocean may well have been free of ice.

The climate began to worsen fairly rapidly about 500-800 B.C. Swiss lake dwellings and salt and ore mines in the eastern Alps were abandoned. The higher latitudes and higher altitudes became deforested. Glaciers in Iceland, Spitzbergen and Sweden are known to have flowed over forests and marshes and glacial advance is evident in both North America and Patagonia.

So where are we now? We are definitely in a period which can be called cool and moist. For most of the Christian era the temperature on the average has been slowly falling. The Greenland colonies which were established and maintained without much difficulty during the first millenium became frozen out early in the second. Now the temperature is rising once again, but records show that since the seventeenth century there have been many cycles of advance and retreat of ice, some lasting a few years, some a third of a century or longer. The present warming-up may be just one more of these, or it may, of course, continue till all the ice has gone and the lands are flooded. But some eminent geologists think otherwise and consider that many of the present glaciers are successors to and not the remnants of the last glacial period; that temperatures have already fallen from the post-glacial maximum for one-third of the way necessary to bring on the next deep freeze; that the present climate is extremely abnormal and that we are about midway between one glacial period and the next. If the glaciers come again as they did but a few thousand years ago, man would be banished from the vast and now most populous areas of the present temperate latitudes. Either way, it seems to me, humanity will be caught. If the ice all melts, the sea will swallow much of what we value most; if not, the ice will come again and push us under protest into the narrowed tropics.

The Editor invites discussion

on papers

appearing in the *Journal*

Discussion of Technical Papers

A New Concept in Modern Office Building Construction

by G. Lorne Wiggs, M.E.I.C., Senior Partner, Wiggs, Walford, Frost & Lindsay, Montreal.

The Engineering Journal, April 1954, page 417

C. D. Carruthers, M.E.I.C.[1]

I would like to confirm and amplify some of the points Mr. Wiggs has made regarding the structure, particularly as it affects the mechanical work.

The spans were 50 feet and the beams were spaced at 10-foot centres, and we used 30 inch deep beams. Because of the small amount of air required for ventilation there were smaller ducts, and this enabled us to get under the beam. The allowance of 8 inches required for lights allowed sufficient space for the duct.

In one later building for which we were also associated with Mr. Wiggs, we actually cut holes in the beams and reinforced these holes, in order to allow the ducts to pass through the beams. The comments I have had from the owners are that the system is working well and it certainly has an excellent appearance.

E. B. Jubien, M.E.I.C.[2]

I am going to confine my remarks about Mr. Wiggs' paper to that part of the paper which deals with our new head office building. Let me say in the beginning that I think Mr. Wiggs has covered the ground very thoroughly, particularly in regard to the mechanical facilities; namely, electrical air-conditioning and ventilation of the building.

I think I can also safely state that the equipment has operated very satisfactorily and the results have been even better than we expected. We are able to maintain in this building practically constant temperature and humidity throughout the twelve months of the year. I have in my office a recording temperature-humidity instrument, and the charts from this show almost perfect circles day in and day out. We maintain a normal temperature in the winter time of about 72 deg. F. and a relative humidity of about 42 per cent. In the summer months, the temperature is usually about 76 deg. F. maximum with a relative humidity of 50 per cent.

I notice in the winter time when the exterior walls and windows are cold that the radiant heating panels seem to offset this condition and one is able to sit quite close to the walls or windows and still feel comfortable.

Some of you may be wondering if this additional air-conditioning equipment can be justified on a dollar and cents basis. I think I can state definitely that we feel that it does pay for itself in a very short time. We notice, particularly in the summer time, that the amount of work produced is not affected by outside temperatures. In our draughting room, for example, the draughtsmen are able to work without having the draughting paper stick to their hands or become soiled. No time is lost due to having to close our offices before five o'clock, and our staff are able to eat in the cafeteria the regular hot meal even during the hottest summer day. Some interesting statistics have been maintained by one of our large departments and the results indicate that the time lost due to illness has been reduced by about one third, particularly during the winter months.

We have found it desirable to operate our refrigeration unit during the spring and fall months, viz., in May and September, in order to reduce the amount of relative humidity to make it more comfortable for the occupants of the building. This is a condition which we had not foreseen and is one which I think has been largely overlooked in the application of air-conditioning in an office building in climate such as we have in Montreal.

It is absolutely essential with an elaborate system of air-conditioning such as this to have a fully qualified man in charge of the installation. This man must have a good knowledge of refrigeration, ventilation and the operation of instruments; otherwise the results would be unsatisfactory.

One of the first essentials, also, is to educate people to keep the windows closed. This has been a problem but gradually it has been accomplished, and the result is that we are able to maintain our building walls, ceilings and floors in a much easier fashion because no dust or dirt can enter.

G. Lorne Wiggs, M.E.I.C.

In the course of the discussion John H. Ross, consulting engineer of Toronto, commented on the fact that the author had made no statement regarding the cost of a radiant heating and cooling system combined with air conditioning as compared with that of a conventional air conditioning system.

Both Mr. Carruthers and Mr. Jubien have added something to my paper and I thank them for doing so. I am glad that Mr. Carruthers has mentioned a part of the space saving of the system and has born testimony of its excellent appearance. I know that Mr. Jubien and his staff have kept a constant check on the operation of the radiant heating and cooling system in the Dominion Textile Building so that his statement that the system maintains a practically constant temperature and humidity really means just that. It is also interesting to know that a winter time temperature of about 72°F. has proven to be correct, whereas certain American engineers are trying to convince us that 75°F. or 76°F. is the ideal. To my mind maintaining temperatures of 75 or 76°F. is not only uncomfortable but represents an appreciable waste of heating. I believe that the temperature should be kept at 75 or 76°F. during the hot summer months.

Mr. Jubien has commented on the offsetting of the radiant heat transfer from the occupants to the cold exterior walls and windows. The elimination of this heat transfer is one of the great advantages of the use of radiant heat panels under the windows. His statements regarding the reduction in time lost due to sickness and to uncomfortably warm weather conditions as well as the reduction in building maintenance have resulted from the installation of the radiant heating and cooling system certainly bears out what we have contended for some time.

In reply to John Ross' question I wish to say that it was an oversight on my part in neglecting to deal with any of the financial as-

[1] Wallace-Carruthers & Associates Limited, Toronto.

[2] Chief Engineer, Dominion Textile Company Limited, Montreal.

pects of the subject. I do not have any of the cost figures with me but I will present such figures and make such comment on them as I can from memory. When we started on the Manufacturers Life Building design, in association with Mr. Charles Leopold, we decided to make preliminary layouts of not only a radiant heating and cooling system combined with air conditioning but also of a conventional air conditioning system. Estimates of the cost of each of these two systems were prepared. Then the space requirements of each system were determined and the cost of providing the difference in space required was estimated. As a result it was found that although the radiant heating and cooling system itself cost somewhat higher than the conventional system, the radiant system took up appreciably less space than the conventional system. It was found that the difference in cost of the additional space required by the conventional system would have amounted to considerably more than the extra cost of the radiant system. In other words, taking the saving in cost of the building into account, the radiant system is actually more economical to install than a conventional system.

In closing I would like to thank Messrs. Carruthers, Jubien and Ross for reviewing my paper and preparing discussions of the same, because discussions always do contribute much to a paper.

Testing of Columns with Uniformly Distributed Transverse Loads

by Paul C. Paris, Lehigh University, Bethlehem, Penn,
The Engineering Journal, August, 1954, Page 945

I. F. Morrison[3]

Editor's Note: This contribution is not meant as a detailed discussion of the paper, but as a letter commenting on it.

In the paper on Testing of Columns with Uniformly Distributed Loads I find it difficult to follow the analysis. For example, equation (3), which is "by elastic energy", is not the equation of strain energy. The right hand member is one term of the Maxwell-Mohr equation. It is a virtual work equation of a sort. It is not explained what becomes of the other terms of that equation or that they are without influence in the case concerned. Moreover, I cannot discover what F is intended to represent or why the right hand side of the equation (4) is equivalent to that of equation (3). However, these are minor points.

On page 946 one finds that —"The ease of computation proves (8)"— i.e. equation (8) on the previous page —"to be readily applicable to design". This statement is perhaps open to question. One might as well say that the Engineering-News Formula is applicable to the determination of the safe loads on piles because it is easy to apply. In fact, that is its only recommendation. It is also based on energy but not elastic.

The tests, for what they are worth, are interesting. However, here again there are important uncertainties and some confusion. The term "elastic limit" is used. I think the author means the yield point which is quite a different thing. Nor can I find any value for the yield point of the particular material used in the tests and since the so-called "elastic limit stress" appears in (8) it is not possible for one to check the graphs in Figure 6. Also the value of E used is not stated. Of course since this is a non-structure sensitive property of steel the value might be assumed although actually three significant figure accuracy is required here if equivalent accuracy is to be maintained in the computations.

It will be noted from Figure 5 that the axial loads applied to the specimen are of the elastic or reaction type. On the other hand, the lateral loads are of the gravity type. The behavior of a long column under reaction loads is different to that under gravity type loads. Most loads in practice are of the gravity type. There is therefore some doubt about applying a formula to practical full scale design which finds its validity in small scale tests based on a combination of reaction and gravity loads.

The writer is not indebted to anyone for these thoughts, which are based on a number of years experience in the testing of materials.

Paul C. Paris

The theoretical analysis involving equations (1) through equations (8) was included in the present paper as a terse statement of the detailed treatment presented in Prof. Van den Broek's work, "Columns Subjected to Uniformly Distributed Transverse Loads", *The Engineering Journal*, March 1941, and is also found in his book, "Elastic Energy Theory", John Wiley and Sons, Second Edition (p. 236). Either of these two sources gives a rigorous discussion of both the methods and assumptions in derivation of equation (8).

The commentator's suggestion that "yield point stress" should be used in place of "elastic limit stress" throughout the work seems to be a misunderstanding between us in semantics. "Yield point stress" is often found by various empirical means (such as the 0.2% offset method) or might also be defined as the stress occurring when the first particle of material in a specimen sustains an irrecoverable deformation (or has yielded). This confusion is avoided by using the term "elastic limit stress", meaning the highest stress to which a material may be subjected without permanent deformation. This stress was found to be 39,900 p.s.i. for the material tested. The modulus of elasticity was measured as 29.4×10^6 p.s.i.

The commentator's doubt of the reliability of tests in which the axial load is of the "reaction type" seems a bit unfounded. In the tests described in the work, it was the object to find the load which caused a particular stress, the elastic limit stress, to occur in a column. For any particular system this load is a unique load, regardless of the method by which it is applied. If one is to design on the basis of elasticity, the loads recorded in the tests are uniquely those which are the maximum load which may be sustained elastically, and are thus the criteria of design.

The design formulas presently in use are of an empirical nature and thus in certain cases are so conservative a criterion of column strength as to be uneconomical. Equation (8) is the result of an effort to obtain a theoretically sound formula in a form applicable to design, in order to promote economy. For the small scale tests discussed in this work its accuracy is proven. In applying it to full scale design it is evident that size effects may introduce some error not present in small scale tests. Also imperfections in full scale members may be present and thus affect load carrying capacity. If so these effects might be suitably compensated for in the factor of safety of design. The use of equation (8) with a suitable factor of safety is propounded as a more accurate and thus more economical design criterion than empirical methods for beam-columns.

[3]Emeritus Professor of Applied Mechanics, Department of Civil and Municipal Engrg,. University of Alberta, Edmonton.

Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

MIRACULOUS BUBBLES

Compressed Air, v. 59, n. 8. August, 1954, p. 230.

Myriads of bubbles of ordinary air rising through water do some extraordinary things. On the prosaic side is their service to wild life. Injected beneath ice caps on fast-frozen ponds they supply life-giving oxygen to fish. Introduced into lakes before freezing takes place they maintain open water all winter for migratory geese and ducks.

In the field of industry, the evanescent bubbles achieve more spectacular results. For many winters they have protected hydroelectric dams against damage from pressing masses of ice and kept intakes to turbines open regardless of plummeting thermometers. Similarly, lumbermen learned in recent years to utilize them in order to prevent log ponds at sawmills from freezing over during cold weather.

Older than either of these applications is the idea of the Brasher compressed-air breakwater for calming raging seas. The outstanding feature of all these operations is their utter simplicity. They require no more than some perforated piping fed with compressed air.

A New Canadian Application

In Canada a new and equally amazing way of putting the tiny bubbles to work is credited with having saved a million dollars at its first trial. Creating a compressible curtain in the water of the forebay of the huge Sir Adam Beck No. 1 generating station, the bubbles absorbed the shock of blasting out a 12,000-cu.yd. plug of rock with 6 tons of explosives, leaving the upper portion of the powerhouse, only 85 yards away, unscathed.

The scene of this remarkable demonstration is the point where two great streams of water, taken out of the Niagara River 6 miles upstream from the falls, converge to form a pond or forebay that feeds water to either of the two adjacent Adam Beck power plants—Nos. 1 and 2—of the Hydro Electric Power Commission of Ontario. The 500,000-hp. No. 1 station has been in operation for 34 years and is served by its own waterway. No. 2 station, which will eventually house spinning turbines rated at 1,828,000 hp. is now nearing completion. A separate conduit, consisting of a tunnel underneath the city of Niagara Falls, Canada, and an open canal elsewhere, was built to supply it with water. When the forebay for No. 2 plant was excavated, a rock wedge was left between it and the adjacent pool servicing No. 1 station. In order that the powerhouse might receive water from either system, the engineers had to join the two forebays by removing the rock barrier.

Because water is noncompressible and would transmit the shock of the blast directly to the superstructure of No. 1 plant, the obvious procedure would have been to close down the generators, drain No. 1 forebay and blast out the obstruction "in the dry". That would have entailed buying powers at an estimated cost of one million dollars.

However, Adolph LaPrairie, an explosives expert for Canadian Industries Limited who served in an advisory capacity in determining the blasting technique, was familiar with some of the remarkable accomplishments of air bubbles. Why not, he thought, build an "air cushion" in the forebay of No. 1 powerhouse to dissipate the waves of concussion set up by the detonation? If the scheme worked, the entire 25,000-odd-ton rock plug could be shattered with one blast and there would be no need to shut down the station.

Experiments on Miniature Scale

LaPrairie's idea appealed to the Ontario Hydro engineers enough to try it out on a miniature scale. At the commission's laboratories in Toronto, R. C. Jacobsen, a physicist, and A. T. Edwards, an engineer, rigged up a tank of water bisected by three perforated air pipes on the bottom. Sensitive pressure gauges were set up at one end of the tank and C.I.L. blasting caps were detonated at the other.

The first test showed them that they were on the right track, but that adjustments were needed. For two months they experimented, varying the volume of the air released and the diameter and spacing of the holes in the pipe to determine what size and quantity of bubbles would be most effective.

Full Scale Method

From the information gained they laid out, full scale, the piping necessary to produce the desired dampening effect. Three 3-inch lines, each perforated with 36 holes per foot, were clamped together 9 inches apart. They were closed at one end, and a 6-inch air-supply pipe was manifolded to the other ends. The assembly was then lowered to the forebay floor, crossing it on a line parallel to the face of the rock plug and the powerhouse but farther away from the latter.

Vertical blastholes that had been drilled in advance in the rock barrier were then loaded with "Nitrone", an explosive that was selected because it is not highly sensitive to propagation and comes in water-excluding steel containers.

To be on the safe side, the headworks of the generating station were protected with bags of sand, but this precaution proved unnecessary. The air cushion, composed of millions of compressible bubbles absorbed the concussion so well that the hammering effect transmitted through the water to instruments at the building wall was only 1/70 as intense as it would have been without the shock absorber. It was not strong enough to be damaging and, far below, the turbines kept on spinning the generators without a break.

Based on calculations made by the engineers during their experiments, the desired cushion of bubbles was obtained by forcing 90-p.s.i. compressed air into the piping system at a rate of 3,750 c.f.m. The upward rush of the churning air raised the surface of the water about 4 feet above the normal level. The installation cost amounted to around $2,000.

Following this initial success, the same scheme was used down in the Niagara gorge to soften a blast that removed a similar ledge of rock from between the stream and the tailrace excavation for the new plant. This second air curtain was 750 feet long. Canadian Industries Limited has applied for a patent on the technique and believes that it can be applied to advantage wherever underwater blasting has to be done in the proximity of harbor structures, bridge piers and the like.

CONTROLLING MACHINE TOOLS AUTOMATICALLY

Frederick W. Cunningham, *Mechanical Engineering*, v. 76, n. 6, June 1954, pp. 487-490.

Machine tools have been controlled automatically and satisfactorily for a great many years. The automatic screw machine is familiar to all engineers. Another type of machine that is widely used is the copying or tracer-controlled machine. On these machines a first piece or template is made by conventional methods, and then a cutting tool is guided automatically so as to duplicate the form in the workpiece.

All of these machines have the disadvantage of requiring that a master piece or, in the automatic screw machine, a set of master cams, be made and installed every time the machine is to be changed from one job to another.

When a single piece is required, the simplest way of getting it is probably to hand a rough sketch to a good mechanic and let him make it. If 10,000 or 50,000 pieces are to be made, the machines mentioned are available.

If, however, the number to be made is 6, 10, or 25, there are no good ways of making them. If they are given to a good mechanic, he makes the second piece a little faster than the first, but the third takes just as long as the second, and he easily can spoil the fifth. He has to stop his machine repeatedly to change tools and measure the work. He rarely takes as heavy a cut as the job will stand, as he is afraid of spoiling it, and if he spoils it, he has to start over again.

Use of Tape or Film

During the past 150 years or so, these considerations had led to the development

of machines that can be controlled by a tape or film. It was about 1804 that J. M. Jacquard invented a loom which was controlled by punched cards linked together in a chain.

With a tape system, when new orders come in for spare parts, it is necessary only to take the tape out of the file and put it in the machine, and to put in a piece of stock. In fact the operator does not even need to know what the machine is going to make. He has to know what size stock to put in and where to put it.

For exceptionally complicated pieces it is possible to prepare tapes on some of the large modern computing machines. For simple pieces, however, it should be possible to prepare a tape in the user's plant.

If the information can be put on teletype tape, the interesting possibility appears of telegraphing spare parts all over the world.

In the machine-tool field, the problems are somewhat different from those on the earlier devices. Most of these machines employ a hole in the tape for each particular operation or location. On the player piano, the presence of a hole causes a particular note to be struck. On the loom, a hole in a selected location will raise a particular thread.

On a machine tool, it may be desired to locate a point to 0.0001 in. or 0.0002 in. on machine having a total travel of 50 or 60 in. This is one part in 500,000 or 600,000. Obviously, it is impossible to have a tape 500,000 holes wides, and have each put up a locating pin 0.001 in. from the next one.

There are several ways to escape the problem. One is to use a coding system of some kind. The simplest system is merely the use of decimal dimensions; that is, if the cutter is to be 19.5732 in. from the zero point, the digits 195732 are punched in the tape. This will require that 60 spaces be available for this co-ordinate. A binary system would permit a reduction to 19 spaces while a combination system using 4 spaces per decade would require 24.

The number of spaces can be reduced greatly if it is not necessary to give a single order that will drive the machine from end to end. If it is possible to put in each time an order which does not differ from the preceding one by more than 0.0050 in., it is necessary to put in only the last two digits. If the preceding order had been executed properly, this would be sufficient. The simplest type of control system is one in which successive equal steps are transmitted to the tool. As frequently as the system will allow, a step is either fed in, or it is omitted. Such a system requires a reliable response device.

It also requires a greater length of tape than a control which uses a code to indicate the final co-ordinate of the tool. If the steps are 0.0001 in., and the signals on the tape are $\frac{1}{8}$ in. apart, a tape over a mile long would be required to make a single 60-in. cut. At a cutting speed of 1 in. per sec., the speed of the tape would be over a mile a minute. A magnetic tape will permit much closer spacing of orders than $\frac{1}{8}$ in., but it is somewhat difficult to make changes on such a tape.

The Degree of Flexibility Desired

A matter of great importance to the engineer concerned with automatic control is a knowledge of the degree of flexibility that is desirable to put in a system. It is possible to construct a machine to do almost anything that may be desired under the control of a tape.

The degree of flexibility required depends to some extent on the machine to which the control is to be applied. On a jig-boring machine, the important feature of the control is that it shall locate the workpiece accurately and quickly. A slight lack of uniform velocity of approach is not important nor is control of that velocity over a wide range.

In a lathe, the degree of flexibility required may be important. A simple type of control can be built to do straight turning. To turn accurate tapers may add appreciably to the cost of the control system, while to be able to cut irregular forms may add very considerably.

In the case of a round hole, there are four dimensions in a jig-boring machine. There are the X and Y-co-ordinates, the depth of the hole, and the diameter of the hole. Each dimension requires some sort of control system. In cutting a thread there is also the phase relationship of the longitudinal feed to the rotation of the workpiece.

The Playback Machine

One type of control which has received much attention in the past is the playback machine. This machine is rather appealing to many people. A machinist operates a machine tool in a normal manner. As he does this, the motions of the machine are recorded in some way on tape or film, magnetic tape or motion-picture film, or anything else. Then when the machine is played back, the motions that the machinist put the machine through are repeated. One of the disadvantages of this is that if the machinist makes unnecessary motions, which he may, those motions are repeated. It is also probably true that a machinist rarely operates a machine tool at maximum possible cutting rates. Especially after the first few operations, he doesn't want to spoil the piece, and he takes extra unnecessary cuts or less speed than the machine is capable of tolerating. In consequence his faults are repeated every time he makes another piece.

Such machines have been described in a number of patents. Some of them are rather old and it is hard to see in reading these patents why these devices have not come into use. They look pretty practical but apparently they have not been used to any extent. It is understood that M. Faure in France is working on a machine on which the record is not made until the operation is complete; that is, a man can take his cut and decide if that was the cut he wanted, and then if it is, he pushes the button and records what he did. If, however, he decides that he should have fed it in a little further because the work comes out a little oversized, he can go back and go through that operation a second time with a suitable correction before it is permanently recorded.

Importance of Reliability

It is important that the equipment be reliable. Some safety precautions certainly need to be taken. To make the thing completely foolproof is probably impossible. The author's experience with automatic control has been that failures have been mechanical. To be completely, or as nearly, foolproof as possible perhaps would involve a completely double system with two tapes —a transmitting tape which would transmit to the machine tool what it was supposed to do, and a checking tape which would receive information from the machine tool or from the workpiece, perhaps from a diamond that is leaning against the work, or from a point as near as possible to the work. This would transmit from the machine back to the checking tape prepared independently, in which case any discrepancy between the order and the response would result in stopping the machine, or ringing an alarm, or whatever is necessary.

An important reason that automatic controls were not applied to machine tools many years ago (although patents indicate that people knew pretty much what they wanted to do), was the lack of sufficient experience with servomechanisms, vacuum tubes, and the like. During the past 20 years a great deal of progress has been made in the servomechanism field for military purposes. Vacuum-tube servos and thyratron servos are both reliable.

Work is being done today with transistors, which it is hoped will be better than tubes. The principal advantage so far is that they don't run as hot as tubes because they have no cathodes to heat.

The power requirements for machine-tool control may turn out to be surprisingly large. Lathes, for example, may require, under the worst conditions, 3 or 4 per cent of the power required to drive the spindle; that is, a lathe, which is developing 25 hp. at the tool may require as much as a horsepower to drive the tool carriage. Of course it is rather unusual for lathes to be delivering as much as 25 hp. to a tool, but it is quite possible for a lathe to require over $\frac{1}{2}$ hp. to drive the carriage.

There also has been a great deal of work done for military purposes in various types of computers. These may be of value in the control of machine tools. As yet, they have not been used very widely. Computation, of course, could be done by digital methods if the digital computer were sufficiently fast, but as it is necessary to come out finally with a shaft rotation there are, necessarily, analog elements in the digital system.

Some Modern Applications

Several tape-control machine tools have been constructed or described within the past few years. One simple system is credited to Dr. Hermans Cousins. It makes no attempt to operate the machine tool at its maximum capacity. Its function primarily is to machine parts so intricate as to be extremely difficult to machine by ordinary methods. The equipment uses a tape about $4\frac{1}{2}$ in. wide and handles 4 co-ordinates with 16 possible values for each of the co-ordinates. There are 4 tracks in the tape, for each co-ordinate. The combinations of the four of them give 16 possibilities There is no provision, at present for backlash compensation. If the amount of backlash is known, it can be allowed for, or if turning is done from the outside, it is always in the same direction.

Another system is considerably more elaborate. That is a numerically controlled milling machine. In this machine, the operation in each co-ordinate is in essentially a straight line although it actually is divided up into little steps each way. However, it is necessary only to put in, in coded form, the length of travel which a cut is to have, and the time which it is to take to complete that cut. The minimum time that can be used is 2 sec.

The machine operates by taking steps at a fixed rate of 512 per sec., and then taking as many of those steps as are necessary. If the machine is to travel at full speed, in a second it will take all but one of them. If it is to travel at half that speed, it will take every odd step, or at a quarter of that speed, it will take the second, sixth, tenth, and so on. Intermediate speeds are taken by adding groups of steps. At $\frac{3}{4}$ speed, the steps used for half speed are taken with

those for ¼ speed. There is a rather ingenious system for doing this, based on the properties of binary counting systems, and the use of the pulse which does not carry to the next one.

A few years ago, a lathe was built on which the information was fed in, in the form of the co-ordinates of the point at which the tool was to end its motion and the speed with which it was to travel in each direction. Each of these was fed in digitally in the form of a voltage from a decade voltage divider. The voltage divider actually consists of taps on a toroidally wound transformer. It has been found that the voltage from these taps is proportional to the number of turns within a part in 100,000 or better. Even this is not a limitation. By a little manipulation of high and low-speed systems, it is possible to operate to much closer tolerances than this. The velocities when the machine was built were not in as close steps as they could have been.

As built, this machine was capable of driving the carriage about 60 ipm., at no load. Maximum power was delivered at about half this speed. The accuracy of the machine, or at least its reproducibility, was very good. Successive pieces did not vary more than 0.0002 in. in diam., which is closer than most lathe operators can set the cross slide on a manually operated lathe.

Another example of an automatically controlled machine tool is a Fellows gear shaper, to which servos have been added for cutting noncircular gears. The principle of operation is that any noncircular gear can be generated by a rolling of the pitch line of a circular gear along the desired pitch line of the noncircular gear. On the gear shaper, the motions available are rotation of the work spindle, rotation of the cutter spindle, and motion of the cutter spindle toward the work spindle. In normal operation of the gear shaper, the two spindles merely are geared together in the proper ratio; the cutter spindle is driven toward the workspindle during a portion of the rotation, while the cutter is fed into the work, and then both proceed to rotate at constant center distance.

In the noncircular case, it is necessary to rotate the work spindle and the cutter spindle at relatively varying rates, and at the same time, to drive the cutter spindle toward or away from the work spindle. The method of doing this is to divide up the required motion of each of these into steps. The steps of work rotation are 2 min of angle, the steps of cutter rotation are equivalent to 0.01 of a tooth, which is 0.15 deg. on a 24-tooth cutter, and the steps of motion of the cutter spindle toward the work spindle are 0.00025 in.

The computation is a little involved, but ends up in making steps of any one of the three or any combination of the three motions. The principal features of the system are the use of standard components. There is little special work, as the film is 16-mm. film and is run through a home movie projector from which the intermittent motion has been removed. As each spot passes over a phototube, a relay is operated and a stepping switch, which is not used as a switch but is geared to a synchro. The three synchros transmit over to receiving synchros which controls servomechanisms on the gear shaper. The operation is not terrifically fast.

The philosophy of the machine was quite different from the lathe. In the case of the lathe, the object was to make a machine which would be converted quickly from one job to another.

In the case of the noncircular gear, the object was to make a machine which would make a piece which was difficult to make by any other known means, and the amount of work required to set up to make this was of secondary importance.

The last device to be considered is the only one that has been described so far which uses any of the more advanced techniques of the military computers.

This device operates from punched cards on which successive co-ordinates are punched. These co-ordinates are then reduced to the fourth differences between co-ordinates, which of course, do not have as many figures as the co-ordinates themselves. These differences are fed into a group of roller and disk integrators which integrate the position while the work rotates.

ENGINEERING AND INDUSTRIAL DEVELOPMENT IN THE U.S.S.R.

J. D. A. Morrow, *American Engineer*, August 1954, pp. 14-16, 37-40.

The subject of this article is of blazing importance to the people of this country. The tremendous engineering, scientific, and industrial effort of the U.S.S.R. is profoundly affecting our way of life. Its immediate purpose is the conquest of the world. The power of the United States is the chief obstacle to the easy accomplishment of their ends. We, therefore, are the first target for destruction.

In the main, everything reported here comes from authoritative published sources available to anyone who will take the trouble to get them and study them. The data thus obtained are supplemented by information that we receive from our representatives who do business in 71 countries of the world outside the Soviet Bloc. This information is still further supplemented most valuably by foreign manufacturers and engineering companies with whom we have regular dealings and friendly relations and whose officials, through personal contacts and visits, are more intimately informed of what is going on behind the Iron Curtain than we are.

There are vast and intentional differences in the status of great segments of the Soviet population. Entire areas of population are ruthlessly exploited for the benefit of others. The agricultural workers are an example. Prices for their products have been steadily cut, their incomes reduced, and their standards of living mercilessly lowered, in order that city dwellers may have cheaper food. Cities are the "hot beds" of revolution, not the scattered people of the countryside. Consequently, city dwellers are deliberately favored.

The Key to Soviet Development

The key to Soviet industrial development is, of course, their engineering and scientific base for such expansion. A paragraph or two, first, about the Soviet educational system is therefore pertinent.

Immediately after the Bolshevik Revolution, college students swarmed out of their classrooms shouting, "We're free, no more examinations!" Professors and instructors who tried to maintain the old scholastic standards, soon disappeared. Presently, however, the Soviet leaders discovered that while young Bolshevik students under that system might make good party members, they were worthless as engineers and scientists. The present system was then inaugurated.

System Planned for Specific Purpose

The Soviet educational system is planned and administered to accomplish specific purposes of Soviet ideology. It is highly effective for that purpose. The children of agricultural workers leave school at the end of the fourth grade and go to work. Any higher education is denied them, but for the rest of the Soviet youth, the educational system is highly competitive. Beginning at high school, it constantly skims off the cream of each class for further educational advancement. More and more schools of higher learning are being built and staffed. Students for further education are selected from the high school graduates by searching examinations. The same procedure prevails through college. The result is that the brightest and best students are the ones that advance to the highest levels of learning.

Instruction is modelled on German methods and is strong on basic fundamentals. The requirements for the Soviet equivalent of our B.S. and M.A degrees are generally more rigorous than ours here and a Russian doctorate in engineering or chemistry, for example, represents a definitely higher level of scholarship than in the United States.

To make the education and training of their engineers and scientists more practical, they have established many special schools that follow the system employed by Antioch College, the University of Cincinnati, and similar American institutions. Hundreds of these schools are now scattered throughout Soviet Russia, teaching the students "Amerikanizatatsiya."

The Rector of Moscow University, I. G. Petrovskiy states that at the present time there are 890 college-grade schools in the U.S.S.R. with 1,500,000 students. From these schools in the past school year, over 200,000 men and women were graduated. Only 19,000 were from the universities. The remainder came from the specialized schools.

Dr. Demitri B. Shimkin, of the Russian Research Center and the United States Census Bureau, estimates that, of the students graduated in Russia last year, approximately 50,000 were engineers. In contrast, our 1,327 college-grade schools, with an enrollment in 1952 of 2,150,000 students, granted degrees to 403,000 graduates, of which number only 30,380 were engineers. Thus, it appears that the Soviet technical and scientific educational system is turning out an exceptionally intelligent and highly educated group of engineers and scientists at a faster rate than we are training their opposite numbers, that the Soviet graduates represent a higher level of scholarship than do ours, and, further, that the Russian graduates are better and better able to translate their new discoveries and inventions into practical commercial processes and machines.

The Field of Invention

Respecting invention in the U.S.S.R., Dr. J. G. Tolpin says "It is the official policy of the Soviet Government to encourage inventive activity by all means, including patent protection." Only inventions suitable for industrial utilization are patentable.

The amount of remuneration allowed an inventor may be quite substantial. Earnings from inventions and technical improvements up to 10,000 rubles are exempt from income tax. Further, inventors are given preference in applying for positions in research institutions and the patent rights can be inherited.

The U.S.S.R. is not a member of the International Patent Convention. Our patent attorneys advise me that so far as Americans are concerned, although there is theoretical reciprocity, these provisions are practically non-operative.

Technical Publications

Within the U.S.S.R. there are many technical and scientific publications regularly printed and issued to which Russian engineers and scientists can subscribe. In some fields, their publications, particularly in mathematics, are more numerous, detailed, and frequent than American publications in similar fields.

Until 1950, practically all Soviet scientific journals and a large number of technical magazines could be subscribed to at the Soviet Book Store in New York, and the issues arrived here regularly. However, since 1950, more and more Russian technical and scientific publications have been withdrawn from foreign subscriptions.

The life of an engineer or scientist in Russia has its special hazards. Engineers who develop successful new machines may be rewarded with a Stalin Prize. Their names appear in Pravda and in Isvestia, but if the machine does not work, they may be given three days to make it work or else.

Consequently, today nearly 55 per cent of the educated engineers of Soviet Russia have found the "shelter" of administrative jobs, inspectors, checkers, and other management positions.

Importance of the Competitive Element

Here it is desirable to emphasize the importance in the Soviet regime of the competitive element. In the U.S.S.R. the chief function of the government-controlled labor unions is to set norms of production for every worker, for every section of every plant and mine, and for each factory and mine as a whole. Failure to attain the norms is punished and performance in excess is rewarded. Furthermore, in industry and science, competitions of all kinds are constantly held.

The results of the program of scientific and engineering education in industrial expansion in the U.S.S.R. are of great significance. The industrialization programs carried through prior to the war enabled Russia, during hostilities, to produce enormous outputs of war materiel.

Since the war, the pace of its industrial effort has been steadily and greatly increased. Today in the output of coal, steel, and electricity, Russia is the second nation in the world.

Now, a word or two about factors affecting Soviet productivity. Their plant and equipment is fairly good, but the quality of their labor force is poor because of a very large proportion of female and child labor.

The task of industrializing Russia is so huge that it cannot all be done under top priority. Furthermore, to hasten the accomplishment of their major objectives, the Soviet leaders have set up severe stresses in their economy and between different groups in their population.

One crucial fact about Communist Russia we must ever keep clearly in mind; namely, when the Soviet leaders give top priority to a particular project and, regardless of all interference, ruthlessly focus their best brains and facilities on that one objective, as a lens focuses the light and heat of the sun to an incandescent point, they accomplish amazing results.

We must remember every moment that in the end both our political and military leaders rely upon us. The infinite responsibility rests upon our engineers, scientists, and manufacturers to outstrip our Soviet enemies and to maintain such superiority over them that fear of instant retaliatory obliteration will keep the peace of this world.

"ROCHDALE" ACCELERATED CARBONISATION PLANT

The Engineer, v. 198, n 5141, Aug. 1954, P. 193-195.

With the conversion of sixteen of its complement of continuous vertical retorts to the "Rochdale" process, the Partington works of the North Western Gas Board becomes the first gasworks to exploit commercially a notable British patent which surprisingly has lain idle for over thirty years.

The process is essentially that of injecting additional gas in the base of an orthodox retort to improve the heat transfer characteristics from the wall and within the coal charge itself. It not only doubles the rate of gas production, improves the size of the coke produced, and improves the overall thermal efficiency of the plant, but it holds the immediate promise of enabling the more extensive use of low-grade coals not hitherto suitable for carbonisation in the more common gasmaking processes.

Carbonisation of the coal is accelerated by the carrier gases in the "Rochdale" retort by virtue of three factors. First, as the gas is injected at the base of the retort, it is heated by the coke lying there. Its subsequent passage up the retort increases the temperature of the coal charge, thereby increasing the amount of heat reaching the coal charge in any given period of time. There is accordingly a higher utilisation of the heat which is normally left in the coke or transferred to the steam in the conventional process.

Heat Transfer

Heat transfer within the charge itself and from the walls of the retort is largely by the mechanism of conduction in a poor conducting medium, i.e. lumps of granular material surrounded by gas spaces and even used as a conducting insulator elsewhere. Consequently another advantage of the injected gas in the "Rochdale" process is that of greatly supplementing the conducted heat by convected heat transfer. As a third contribution to the process the passage of the carrier gases around the inside walls of the retort induces a greater heat flow across the walls themselves. During the "Rochdale" trials and in subsequent normal operation it has been shown that a vertical retort plant operating with gas injection by the "Rochdale" process can carbonise an average of 14.3 tons of coal per twenty-four hours, compared with 6 to 8 tons in normal practice. Using "water gas," made from coke, as the injected gas, the output from a vertical plant normally rated to produce 4,000,000 cubic feet per day could be expected to increase to 8.35 million cubic feet under average conditions and at least to 7.7 million cubic feet under poor conditions, after allowing for the volume of gas injected.

The carrier gases (coal gas and blue water gas) are brought to the retort house in two overhead steel mains, one for the coal gas, the other for the blue water gas. Blending these gases in varying quantities enables the calorific value of the injected gas to be so adjusted as to enable that of the gas produced from the retort to be held constant. After blending, the carrier gas passes into one large main and off this main a supply of gas is taken to each of the sixteen converted retorts through a governor whose purpose is to ensure that, regardless of any variation in pressure at the base of the retort, gas is injected into the retort at a constant hourly rate.

It should be noted that when the "Rochdale" process is applied to continuous vertical retorts approximately twice as much coke has to be discharged from the retort as when the retort is worked conventionally.

Automatic Control

The work of the retort operator has been greatly simplified by installing a small automatic control at the base of each retort. This equipment, operated hydraulically at a pressure of 750 lb. per square inch, is controlled by a single lever. By turning the lever clockwise from twelve o'clock to three o'clock injection of gas is automatically shut off and steam is instantaneously turned on to the base of the retort. The steam remains on for a predetermined time, at present $1\frac{1}{2}$ minutes, after which the lever is moved into the second quadrant and the coke is discharged. The lever is then moved to the third quadrant, which closes the door again and turns on the steam to the retort for a further $1\frac{1}{2}$ minutes. When this period has expired the lever can be returned to the original position, which completes the cycle.

The coke car, which guides the coke from the discharge door to a belt conveyor, is brought automatically to the correct position beneath the discharge door of the retort simply by pressing a button on the base of that retort.

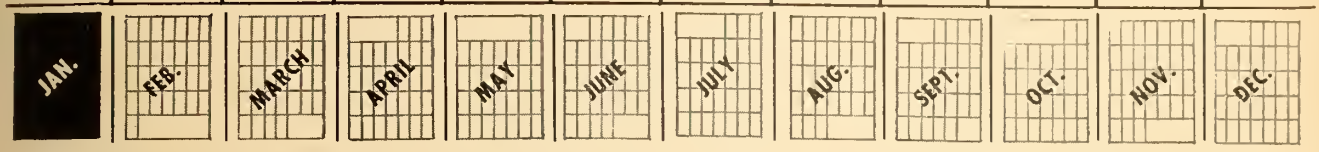
Possible Cost Reductions

It appears that if present expectations are realised it should be possible to achieve a reduction of about two-thirds in capital costs on carbonising and ancillary plant and approaching one-tenth in production operating charges, on the additional gas gained by the "Rochdale" process. Altogether, production charges incurred up to the point where the gas enters the gasholder are estimated at about 20 per cent less on the "Rochdale" increment than on the original output.

The average size of coke produced, which largely determines its selling value, is substantially increased by gas injection. This is due to the fact that the admission of steam to the coal charge, which forms a part of the normal carbonising process in vertical retorts, is eliminated in the "Rochdale" process and the breaking up of the hot coke under the impact of steam is consequently avoided. During the "Rochdale" trials about 8 per cent of the coke produced was found to be "breeze" of less than $\frac{3}{4}$ in size, compared with about 20 per cent in normal practice. As the ratio of coke price to "breeze" price is at present about $2\frac{1}{2}$ to 1, this is an important factor.

There is a further aspect of this process which could, under particular coal supply or coal price conditions, prove even more important than the savings in capital and operating costs outlined in previous paragraphs. Recent trials have shown that it is possible by means of gas injection to process small coals at economic speeds of carbonisation.

Month To Month



Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Confederation

According to many dictionaries, the word confederation means "an alliance, a league, a compact for mutual support." These would seem to be clear words leading to a worthy objective. No wonder, then, that engineers across Canada are caught up in a whirl of discussions, meetings and deliberations at which confederation is the issue.

A recently completed visit to western branches by the president and general secretary disclosed that the chief interest of the branches there is confederation. Visits with the associations in the west indicated that with them too, the proposals that may lead to confederation are high on the list of important things to be studied. It is evident that until this subject is settled many other matters will have to stand aside.

It should not be surprising to anyone to find that in some instances—fortunately not many—there is a misunderstanding of the principles back of the proposal put forward by Mr. Herbert Smith, and some confusion as to the positions of various organizations that are concerned with it. There is no official decision or opinion—so far as is known—of any of the organizations that are studying the situation, but there are committees working on it which are likely to have some detailed reports and recommendations shortly. Until these committees report to their governing bodies, anything that is said is pure conjecture.

There can be no doubt in the mind of anyone that close affiliation which will lead to the elimination of competition, overlapping and some expense, and that will promote joint actions, better service to the profession and to the public, is a worthy objective. Even without the reports of the committees, that much can be acknowledged, and being acknowledged would seem to be a mandate to the committees and to the councils of the organizations concerned.

Under the instruction of the Council of the Institute, the president has discussed confederation with the executives of all the branches he has visited. It can be reported that in every instance the group has favoured the idea, although a few individuals here and there have been critical or have lacked enthusiasm for it. On the whole it can be said that right across Canada there is a great surge of enthusiasm for it that amounts almost to a demand that this time success must be achieved.

In many cases the interest in confederation has been so great that concern has been expressed over the lack of any appearance of progress. Some people have asked for immediate conclusive action. They can see no reason for taking so long over it, and it is not difficult to understand this attitude. However, those who have the matter before them for close study agree that, while no time should be lost unnecessarily, sufficient time must be taken to determine with some precision the best basis for the establishment of the much desired confederation. Before any proposal is put to the various memberships, it must be a workable one that will make the most of the opportunity, and that will be acceptable to the great majority of the members. This is not too easy of achievement, but if all the factors are studied thoroughly now, and proposals agreed upon between the committees, acceptance by the membership should follow. All this will take time, but without such studies and agreements the possibilities of success will not be so favourable. This is a time for patience and confidence.

So far it appears that the committee appointed by the Dominion Council and the committee appointed by the Institute are thinking along similar lines. The situation is very encouraging.

The Institute's committee under the chairmanship of R. E. Heartz

Cover Picture

Facilities capable of handling 8,000 long tons of iron ore per hour are described in the paper "Ore Handling Facilities at Seven Islands", on page 7 of this issue.

The cover picture illustrates two of the conveyor belts on the dock, with one of the shiploaders immediately in front of the 1,000-ton bins. To the left of the latter are the inclined conveyor and drive house.

have met at Quebec, Toronto and Ottawa. A fourth meeting has been called for Montreal on January 20. It is planned that after the Montreal meeting a report will be prepared, from which Council can determine the next steps to be taken by the Institute.

To Enhance Public Appreciation of the Profession

Recently the Institute has undertaken a project that is unique in its affairs. It is hoped and expected that through branch co-operation this project will make a real contribution towards enhancing the public awareness of the engineer, and of the breadth of his training and his interests.

At the November meeting of Council authorization was given for the purchase of a special motion picture at a price of $4,000. This film depicts in full colour and detail the work of Leonardo da Vinci, one of the great engineers and scientists of all time, who over five hundred years ago invented and designed many things that today are regarded as ultra modern.

The film shows pages from Leonardo's note books, with his diagrams, sketches and computations. In the film many of these sketches have been animated cleverly by artists who specialize in that feature of modern cinematography, to show the actions that must have been in the mind of the imaginative genius. Thus the flight of birds is illustrated, as part of the study Leonardo did in preparation for his design of the first device by which man could fly.

The film shows as well the other sides of this great man, as an architect, a sculptor, a philosopher, a poet, a medical scientist and a painter. Each facet of this gigantic mind created ideas and things that of themselves are each sufficient for a separate story. His drawings of the human body, which he made from a long series of dissections, show the nervous system, the muscular system, the organic system, the bone structure, the brain, and so on. No one before him had ever made so careful a study of anatomy, and of course no one was so able as he to put down graphically the things he discovered.

Among the firsts in his engineering designs and inventions are swing bridges, assault bridges, machine guns, siege guns, armoured tanks, self propelled carriages (the automobile), flying machines, parachutes, helicopters, hydraulic pumps and a host of others.

The film is a masterpiece. It is factual and it is exciting. Its excellence is attested by the fact that it was awarded the Grand Prize at the Venice Film Festival in 1952 —the hallmark of superiority for documentary films. It is a full length feature, taking an hour and ten minutes to show.

The idea back of this project is that the film will be made available to all branches, who, it is hoped, will make it available to the public. In fact it is considered more important that the public should see it than the members. Shortly a circular letter will be going to the branches with suggestions as to several ways in which this objective can be attained.

The Institute will have four copies of the film, so that a branch may have the use of one for a longer period of time than is usual. In this way it should be possible to show it to several different organizations, such as high schools, universities, art galleries, libraries, museums, etc.

An interesting development is that the Life Members of the Institute have made available from their own funds $1,000 to pay for one copy. This means that from Institute funds will be required only $3,000 plus something to cover certain additional costs associated with putting on the film the Institute name along with a short message, distribution, repairs, etc. It is expected that in due course the entire cost will be refunded from revenue received from certain types of showings. These showings should net some revenue for the branches as well.

Here is a fine opportunity to render a service to the public, and at the same time promote the prestige of the profession. If it is grasped by every branch, it may well be a new level of achievement in what is popularly known as "public relations".

Except for three cities, where it will be shown commercially, the film is exclusive to the Institute. Although widely distributed in the United States and Europe, it has never been shown publicly in Canada, except in one instance. The Institute is indeed fortunate to have this wonderful opportunity to render a service to the public and the profession.

Shortly the branches will be receiving the details necessary to their planning. This announcement is simply by way of a preliminary notice.

Life Members

A Life Member of the Institute is one who has been an Associate Member and/or a Member for thirty-five years, or having reached age seventy has thirty years of membership. Each January sees a new group joining this illustrious class until this month with 129 more names added the total becomes 660.

Life membership provides all the privileges of full membership without the payment of further fees. However, most of the members within this group are still active in the profession or in business, and a number of them decided a year or so ago that they should continue to support the Institute financially as well as professionally. A committee was set up under the able chairmanship of Professor C. M. McKergow, and the then Life Members were given an opportunity to contribute to a fund which would be administered by the Life Members themselves, through the committee.

Late last year the committee met and examined the results of their endeavours. It was found that the sum of $2,000 had been subscribed by 218 members. It was agreed unanimously that $1,000 should be offered the Council of the Institute towards the purchase of the film Leonardo da Vinci, which film is referred to in another article in this *Journal*. This amount will pay for one of the four copies that have been ordered. It is planned that the copy will carry on it a note to the effect that it was donated to the Institute by the Life Members.

The Council of the Institute has accepted this offer from the Life Members, and has expressed its pleasure and appreciation of such generous support.

While to some extent the committee were disappointed that more Life Members did not participate in the fund raising, they were encouraged to the extent that again this year they will afford an opportunity for those who wish to do so, to help with projects which the Life Members themselves will select.

Shortly a letter from the committee will go to all Life Members, including those who have reached that exalted state just this year. Perhaps it is well to state here that the committee recognizes that many members on the list have retired from practice, and therefore are not so well able to contribute. Nevertheless, it is hoped a substantial sum may be raised with which the committee may contribute something more to the activities of the Institute which otherwise might not be done.

The membership of the Life Members Committee is as follows: C. M. McKergow, chairman; de Gaspe Beaubien, N. M. Campbell, L. C. Jacobs, J. A. McCrory, M. V. Sauer, and J. A. Freeland, secretary.

Engineering Jobs, 1955

The Economics and Research Branch of the Department of Labour, Ottawa, has just released its annual guess as to what is likely to happen to this session's university graduates. It thinks that there will be distinct shortages of dentists and of graduates in agricultural courses and that graduates in arts and in science may have less trouble in finding jobs than they sometimes have, because it notes that employers "now look more favourably on university graduates as recruits... regardless of courses taken. They feel that the training and knowledge, plus the experience gained in extra-curricular activities, give maturity and tend to make a graduate a valuable employee."

This is a hopeful trend if it results in engineering graduates' being hired to fill engineering jobs instead of to fill places which could just as well be filled by others, albeit the others might require more on-the-job training before they become as useful as engineering graduates fresh from college. There is some evidence to show that employers like recruits who have gone through the engineering mill, not always because of their technical accomplishments, but because their training has produced in them some ability to think straight and some willingness to tackle almost any job and to stay with it until it is finished. Of course, this is the kind of position the engineering graduate wants. He doesn't mind routine at the beginning of his career, but he wants to see a door open to something better ahead.

The Branch says, "This profession (engineering) will not be overcrowded for several years and not even then, unless enrolment takes a marked increase. The class of 1955 may be about (1,350)." Last year there were at least 2,000 jobs for 1954 graduates, not including those unlisted with the National Employment Service and those where the graduate was self employed; the true total was probably nearer to 3,000.

This year's opportunities will be about the same. The three per cent of employers who expect to recruit fewer graduates in 1955 than in 1954, will be offset by those who will recruit more and by those recruiting for the first time. But, be it noted, some positions were not filled in years past because no satisfactory applicant was found, or because "salary expectations were higher than the firms were prepared to pay." The graduate will do well not to price himself out of the market. He should perhaps pay more attention to the intangibles than he sometimes does—to living conditions, to the attractiveness of the job to him and to possibilities of future promotion, for example. Nothing makes one unhappier than uninteresting work in unpleasant surroundings with no marked improvement foreseeable for years to come, if ever.

The demand in 1955 is going to be great for mechanical and electrical engineering graduates, followed by those in chemical, mining, metallurgical and civil engineering, in that order. Geological engineers and engineering physicists will be much sought after, too. But no competent engineering graduate of 1955 should have any trouble in finding himself a suitable job.

These Labour Department surveys are both interesting and useful. This one is a little late to be of as much use as it might be to 1955 graduates and employers. The recruiting campaign has been in full swing for some months now. Many 1955 graduates are already placed and their future employers' needs are to that extent satisfied. But undergraduates who have not yet made up their minds what engineering course to take—there are a lot of them in the early years in all our engineering schools—might well consider demand and supply as two of the factors deserving consideration in making their choices.

The St. Lawrence Seaway and Power Project

When Canadian engineers and Canadian enterprise undertake a project of the scope and importance of the seaway job, it is the obvious duty of the *Journal* editorial department to see that its readers are kept as well informed as possible of the planning and progress of the work.

With that aim, this issue contains the first of what we expect will be regular news stories and articles covering this great development. They will be found under the same heading as above, in the Month to Month section.

Special arrangements have been set up by the *Journal*, in co-operation with the authorities concerned, to obtain new and exclusive releases dealing with the project. If these sources do as we expect, it is our sincere hope that our readers will find the column interesting and instructive.

Season's Greetings

Once again the general secretary acknowledges the many Christmas and New Year greetings that have come to Headquarters. It is realized that these are messages of good will to the Institute, to be conveyed to the Council and the membership by the general secretary.

It would make an interesting but very long document to record the sources of all the greetings. The national interest and the international interests too, bring the Institute into contact directly and indirectly with thousands of people and organizations each year. It is heart warming to have these contacts brought to mind again at this season of the year.

Included in the heavy mail were messages from all over the world; the United Kingdom, United States, Australia, New Zealand, South Africa, India, Korea, Italy, France, Switzerland, Germany, Austria, Sweden, Norway, Denmark, Belgium, the Netherlands, Spain, Portugal, Brazil, Uruguay, Chile, Mexico and Cuba, to mention some of

them. Messages were sent also from centres in Canada from coast to coast.

It is a gratifying experience and an enlightening one, to see these messages from all over. It is impossible to acknowledge them individually. It is hoped that these words of appreciation will come to the attention of the many friends of the Institute, who so kindly sent their greetings.

The President in the West

As has been announced previously the president is not visiting all branches. The new pattern of visits is that a meeting is held at one branch in one area, and the nearby branches are invited to participate in it. Next year the new president will endeavour to visit those branches missed this year.

This "hop, skip and jump" method has now been applied in the Maritimes, Quebec, a portion of Ontario and the west. Additional branches in Ontario will be visited in February, as shown elsewhere in this *Journal*. So far the method has been well received by the members, and of course it has made a great difference in the time demanded of the president.

Western "Swing"

Starting the western itinerary in his home town, meetings which were attended also by the general secretary were held in Winnipeg on November 18 and 19. The president's official visit to the branch will not be held until later, but at this time he and the general secretary had an important meeting with the management committee of the Association and the Institute (the one committee covers both). That evening they attended a regular technical meeting of the branch at which J. T. Dyment, director of engineering of T.C.A. spoke on "What's New in Aircraft".

On Friday, the president and Mrs. Stephens and the general secretary were guests of the Electrical Section of the branch, at their tenth annual dinner and dance. This was a splendid affair, attended by 250 people, with Neville Williams in the chair. This is the oldest and probably the largest technical section of the Institute and is an example for other branches to follow. Incidentally the branch has a successful Civil Section as well.

At Saskatoon

Monday morning, November 22 saw the presidential party in Saskatoon to carry out a full two days program. In the morning there was a business session with a special committee of the Association. It concluded with a luncheon at the Saskatoon Club which demonstrated clearly what was meant by "western beef". In spite of this experience the president and general secretary went on to a business meeting with the council of the Association and the executive of the branch, (one committee here, too).

This session concluded just in time to permit the committee to join with other members of the branch and their ladies for a buffet supper at the Bessborough Hotel. For several years the Saskatoon members have greeted succeeding presidents with this type of meeting. The general secretary reports that each president in turn has expressed great pleasure and satisfaction with it. It has much to recommend it, and might well be equally successful at other branches. It gives the president and his wife an unusual opportunity to meet the members and their ladies.

Tuesday morning started off with a press and radio conference, and was followed by a meeting with the officers and committee of the undergraduate society. In the afternoon the president and general secretary accompanied by the vice-president of the Institute, Dean I. M. Fraser, called on Dr. W. P. Thompson, president of the university, and returned to the engineering building just in time to speak to the two senior years of the student body.

At Edmonton

A crowded program at Edmonton was further crowded by the late arrival of the train. Things began to happen at the hotel even before the baggage was unpacked. First there was a press conference and then a welcome from the branch officers. Luncheon at the Edmonton Club was followed by a meeting with the branch executives. This was adjourned to permit the party to tour the university under the guidance of Dean R. M. Hardy. The tour included a visit with the president of the university, Dr. Andrew Stewart.

Another extremely pleasant feature of the visit to the university was that when tea was served in the faculty lounge of the beautiful new students union, Dean Hardy presented each member of his staff to the president and Mrs. Stephens. This was one of the most pleasant events of the whole western tour. Later the president's party and the branch officers were guests of Dean and Mrs. Hardy at their home for a buffet supper.

That evening the president and general secretary spoke to the students at the university. This was followed by a tour of the new engineering building.

On Thursday morning the party visited the new Sherrit-Gordon refinery at Fort Saskatchewan to see the last word in the manufacture of ammonia, and the production of nickel and sulphur.

That night the branch meeting was held in the new ballroom of the Macdonald Hotel under the chairmanship of Keith Cumming.

At Lethbridge

Friday morning saw the president's party passing through Calgary on the way to Lethbridge. They were met at the station by Herman Hayes, Calgary councillor and Gray Sharpe, branch chairman. Mrs. Hayes and Mrs. Sharpe were there also. After breakfast the group embarked in two cars and arrived at Lethbridge in due course.

It was a happy circumstance that had made it possible to arrange the president's visit to coincide with the regional meeting of the Association of Professional Engineers of Alberta. Because of this, officers of each organization were able to participate in the meetings of both.

The president and general secretary were guests of the Association for lunch, after having attended a portion of the Association council meeting in the morning. After lunch the Association council meeting was reconvened, but was adjourned in time for everyone to take part in the joint dinner meeting that evening.

The chairman of the joint function was L. A. Thorssen, president of the Association, and the special speaker was the president of the Institute, D. M. Stephens. This was one of the largest meetings of engineers ever held in Lethbridge. There were a hundred and seven people present, which was just about the capacity of the hotel dining room.

On Saturday morning, starting at 8:30 there was a regional meeting of the council of the Engineering Institute, with the president in the chair. The morning session was concluded about 11:30, being influenced slightly by the fact that the radio in the adjoining room was bringing in a

Lethbridge. Above, three views of luncheon meeting of the Alberta Association of Professional Engineers. From left to right, at top of page: A. E. McDonald, E. A. Lawrence, T. D. Stanley, J. C. Neufeld, D. M. Stephens, L. A. Thorssen, Alderman Cliff Black, J. A. Haberman, R. D. Livingstone; Junius Jonsson, P. E. Kirkpatrick, J. E. Macdonald, S. H. deJong, C. V. Antenbring, Alex J. Branch, J. J. Hanna, W. G. Sharp, H. R. Hayes, E. Mason. At right: L. A. Thorssen, president of the Association of Professional Engineers of Alberta, and A. E. McDonald, executive secretary.

Vancouver. The head table at the luncheon meeting attended by President Stephens. Left to right, L. E. Wright, J. McGowan, W. O. Richmond, President Stephens, C. Bentall, H. C. Gunning, J. C. Oliver, B. A. Robinson, J. R. Giegerich.

Saskatoon. The president, visiting the University of Saskatchewan, presented to Peter Langeman the E.I.C. student award.

noisy account of the Grey Cup playoffs at Toronto.

Luncheon was a joint affair, served buffet style. Through the kindness and consideration of the chairman of the Calgary Branch, Gray Sharpe, radios were installed in the dining room so that everyone had one at his table. Across the end of the room was a large diagramatic layout of the playing field at Toronto, and as the account came over the radio Mr. Sharpe indicated it on the paper. It was quite a realistic presentation. The Council meeting was continued in the afternoon, adjourning at six p.m.

On To Trail

Saturday night saw the president's party on board their train for Nelson, B.C., where they arrived at noon on Sunday. They were met by the chairman of the branch, W. K. Gwyer and his wife. A very pleasant luncheon was arranged in Nelson with the members resident in that area and their wives.

In the afternoon the group was motored to the guest house of the Consolidated Mining & Smelting Company at South Slocan. There a delightful dinner was served. After dinner the party were motored to Trail, and lodged in the very comfortable quarters of the Company's guest house.

At an early hour on Monday morning the president, under the guidance of various members of the staff, made a quick tour through a portion of the smelter. The luncheon meeting with the members of the branch was held at noon in the Crown Point Hotel.

In the evening there was a banquet for the ladies as well as the gentlemen, to which were invited the members of the Canadian Institute of Mining and Metallurgy, the Chemical Institute of Canada, and the Association of Professional Engineers of British Columbia. There were about two hundred in attendance. The chairman of the branch presided.

On Tuesday morning the party drove to the Wanita dam, which is the latest power project of the Consolidated Mining and Smelting Company. This was of particular interest to the president, who was greatly impressed with the head of water. Being responsible for hydro-electric power development in Manitoba, where heads are very low, he found those in the area in and about Trail very impressive indeed.

In the afternoon the party drove to Castlegar Airport, and caught the C.P.A. plane to Vancouver.

At Vancouver

Immediately upon his arrival in Vancouver, the president and Mrs. Stephens were gathered up to participate in a reunion for University of Manitoba Alumni, which was held at the home of the past-president of the Institute, Dean John N. Finlayson.

On Wednesday, December 1, the president and general secretary met with the students at the University after which they dined with the dean of the faculty, Dr. H. C. Gunning in the faculty club.

That afternoon the executive of the branch met with the president and the general secretary for a business discussion. From there they drove to the Stanley Park Pavilion where the branch dinner was held, with the chairman, W. O. Richmond, presiding.

On Thursday, starting at nine o'clock a.m., the party drove to Chilliwack to see something of the training course given there to sappers and to engineering students. A delightful luncheon was served in the officers' mess, with Lt.-Colonel D. W. Cunnington presiding. Colonel H. L. Berry was also present.

The important part of this visit was the placing of a wreath on the sappers' memorial by the president of the Institute. The weather was perfect, and the ceremony was carried out with great dignity and precision.

At Vancouver the meetings had been arranged to coincide with the meeting of the Association of Professional Engineers. Consequently on Friday, December 3rd, and Saturday the 4th, the president and the general secretary spent most of their time at the meetings of the Association.

At the luncheon held in the Vancouver Hotel at noon on Saturday, the special speaker was the president of the Institute. That night the Association held their annual dinner and dance, at which the president's party were guests of the Association. This was a most delightful affair and made a fine finish to the western program of the president.

From Vancouver the president flew back to Winnipeg.

The general secretary continued the tour, visiting the branch at Vancouver Island and the Central British Columbia Branch at Kamloops and the executive of the branch at Calgary.

Throughout this account no mention has been made of the many delightful functions arranged for Mrs. Stephens. At every centre the ladies took over promptly and efficiently.

The experiment of visiting only a certain number of the branches appears to have been successful. It is likely that all presidents will have to visit the four cities which mark the location of the universities, namely Winnipeg, Saskatoon, Edmonton and Vancouver, but the other branches will be visited alternately although it is hoped that either the general secretary or the field secretary, Colonel Grant, will be able to visit the balance of the branches sometime within the same year.

Elsewhere in this issue of the *Journal* are reproductions of some of the photographs taken during the branch visits. More will appear in the February issue. They will tell in a more interesting way something of the tour and of the pleasure it gave the president to meet so many members.

President's Tour in February

The following is the outline of the president's itinerary for the month of February and three days in March. All of the meetings are in the province of Ontario except for one in Montreal.

Lv. Winnipeg: Thursday, February 17.
Arr. Montreal: Thursday, February 17 or February 18.
Branch Meeting, Friday, February 18.

Arr. Belleville: Monday, February 21.
Branch Meeting—including Peterborough and Port Hope.

Lv. Belleville: Tuesday, February 22.
Arr. Toronto: Tuesday, February 22.
Branch Meeting—including Huronia Branch, February 22.

Lv. Toronto: Wednesday, February 23.
Arr. Chatham: Thursday, February 24.
District Meeting—including Border Cities, Sarnia and London branches.

Arr. Hamilton: Friday, February 25.
District Meeting, Friday, February 25; Hamilton, including Niagara Falls and Kitchener. Regional Council Meeting, Saturday, February 26.

Lv. Hamilton: Sunday, February 27.
Arr. Toronto: Sunday, February 27.
Lv. Toronto: Sunday, February 27.
Arr. Sudbury: Monday, February 28.
Branch Meeting Monday, February 28, including Sault Ste. Marie, Nipissing and Upper Ottawa and Northeastern Ontario branches.

Lv. Sudbury: Tuesday, March 1.
Arr. Lakehead: Wednesday, March 2.
Branch Meeting, Wednesday, March 2.

Lv. Lakehead: Wednesday, March 2.
Arr. Winnipeg: Thursday, March 3.

Victoria. Left to right, across the top of the page, two groups of members of the Vancouver Island Branch: G. R. Davidson, S. H. Frame, Ken Reid, Wm. Waters, A. S. G. Musgrave, R. C. Thurber, J. U. Copeman, Jack Alton, P. H. Buchan, F. O. Mills, Russell Potter, H. E. Pawson.

Calgary. The Calgary Branch executive. Front row: W. G. Sharp, H. R. Hayes, W. E. Hawkins; Second row, R. F. Bailey, D. A. DeWolff, and D. F. Kobylnyk.

Kamloops. Left to right: (seated) J. W. Nelson, M. L. Wade, W. Ramsay, M. L. Zirul; (standing) P. Fleming, R. G. Mulcaster, F. Ranester, Grant Starr.

Saskatoon. Below, left, an engineering student audience for President Stephens at the University of Saskatchewan. Below right: Mr. Stephens (right foreground) and members of the student engineering society. Around the table clockwise, President Stephens, Blaine Holmlund, president of the society, Don Matheson, Gerald Bates, Doug Kent, Jack Campbell, Hugh Granger, John Rae, Terry Prentice, John Lipsett, Charles Till, Terry O'Kane.

Edmonton. In the left hand column.

The first picture shows University of Alberta engineering students during the president's visit.

Second picture: Gary C. Vliet, fourth year engineering, is presented with the E.I.C. student prize.

Third picture: from left to right, H. W. Tye, H. H. Moore, N. J. Allison, R. M. Hardy, Alderman C. A. Roy, D. M. Stephens, E. K. Cumming, Jim Todd, president of the engineering society at the University.

Fourth picture: left to right, Dean R. M. Hardy, Dr. Andrew Stewart, president of the University of Alberta; President Stephens, E. K. Cumming, branch chairman.

Fifth picture: visiting the Sherritt Gordon Refinery at Fort Saskatchewan, left to right: C. A. Hames, E. L. Smith, F. V. Seibert, an unidentified guide for Sherritt Gordon Mines Ltd., R. B. Kerr, B. Benson, H. L. Roblin, E. K. Cumming, S. J. Hampton, F. Miller, D. M. Stephens.

Trail. In the right hand column, three group pictures taken during meetings at Trail.

Top picture: back of table, Mrs. E. M. Stiles, President Stephens, Mrs. Gwyer, R. Pollard and Mrs. Stephens; front of table, Mrs. B. Affleck, W. K. Gwyer, Mrs. S. Jackson, Mrs. Pollard.

Second picture: left to right, Reverend E. Taylor, Mrs. Mason, Dr. C. H. Wright, Mayor E. G. Fletcher, Mrs. A. F. Brooks, E. Mason, Mrs. R. D. Perry, President Stephens, and W. K. Gwyer.

St. Lawrence Seaway and Power Project

Commencing with this issue, it is the *Journal's* intention to review the news and progress of the St. Lawrence project as a regular feature.

The Power Development

Sought for nearly 40 years, the $600,000,000 development of the tremendous power potential of the St. Lawrence River has begun. During the late summer, international ceremonies signalled the official start on the 2,200,000-horsepower project.

"The availability of low-cost power has always been a major factor in the advancement of Ontario," said Ontario Hydro Chairman Robert H. Saunders. "Its impact upon our operations in recent years has been tremendous. Between 1945 and 1953, Hydro's program of capital construction totalled more than $1 billion — a program unrivalled by any other Canadian public utility."

Canadian and American Responsibility

Ontario Hydro and the Power Authority of the State of New York are joint partners in the production of electric power from a 35-mile long stretch of the International Rapids Section of this historic river. Together, the two entities will build the project, share construction costs, and each will be entitled to one-half of the installed capacity (1,100,000 horse power each).

Authorization to proceed with the power phase came on June 7, 1954, when the United States Supreme Court upheld the right of the Power Authority of the State of New York to participate with Hydro in the joint development from which first power will be generated in late 1958, with virtual completion of the entire project scheduled for the following year.

In order to generate power from the International Rapids Section of the river, it is necessary to utilize the present drop in water level between the eastern end of Lake Ontario and the powerhouse site near Cornwall. Because it is spread over a 125-mile stretch of the river, this drop (the mean is about 92 feet) is of little value for power purposes until it can be concentrated at one point. By effective use of control structures, a headpond will be created immediately above the powerhouse to produce an operating head which will range from 76.6 feet to 87.6 feet while the normal head will be 83 feet.

The order of approval for the power project by the International Joint Commission provides that the forebay water level will be operated at a maximum elevation of 238 feet above sea level for 10 years or less. Experiments may be carried out during this period and if they prove it advisable, the forebay elevation may then be increased above the 238-foot level.

The Power House

Harnessing the river requires the building of a powerhouse and two control dams, all of which will be carried out without interruption to navigation in the present 14-foot canal. The powerhouse — the largest single structure of the project — will be bisected by the International Boundary and will span the channel between the eastern end of Barnhart Island and the Canadian shore, some three miles west of Cornwall. The structure, which in itself will act as a gravity dam, will have a maximum height of 162 feet above the foundation and an overall length of 3,300 feet.

Power will be produced by 32 generating units, 16 in each half of the plant. Constructionally known as a modified outdoor type, the powerhouse will have no conventional type superstructure over the generating room, but the units will be protected by removable housings. The architectural treatment will be simple and functional with facilities being provided for visitors to have a comprehensive view of the powerhouse. Switchyard facilities for Canada will be located some four miles away on the Canadian shore and for the United States on Barnhart Island.

The Control Dams

Upstream from the generating station and stretching from the upper end of Barnhart Island to the United States mainland, the Long Sault dam will be built. The purpose of this structure will be to control the amount of water in the headpond allowing, as necessary, any

Although work on the St. Lawrence power project did not begin officially until August 10, 1954, Ontario Hydro used the period of delay to make exhaustive surveys of the future construction area. Ontario Hydro "model men" (left to right) Keith Henry, Wolf Jenker and Cliff Davidge are shown measuring the rate of flow, by means of model, of the St. Lawrence River.

excess amounts to bypass the powerhouse. This dam and the power plant will combine to obtain the head of water required to operate the turbines.

The Long Sault dam will be a concrete gravity curved-axis spillway structure 2,250 feet long with a maximum height of about 145 feet above the foundation. It will have a discharge capacity far in excess of the maximum flow of the river. The spillway section will have thirty, 50-foot wide vertical lift gates. Because of low winter temperatures, special attention is being given to the problem of keeping the gates and guides free of ice by appropriate heating arrangements.

The third structure, a control dam, will be built 25 miles upstream from the Long Sault dam in the vicinity of Iroquois Point on the Canadian side and Point Rockway on the United States side. Its main function will be to permit regulation of the outflow of water from Lake Ontario. In addition to construction of these three structures, some 14 miles of dykes will be built which will include almost 10 million cubic yards of compacted material, and channel improvements involving the excavation of about 61 million cubic yards of earth and 5 million cubic yards of rock will be carried out so that certain navigational and hydraulic requirements will be met.

The Montreal Area

The Honourable Lionel Chevrier, president of the St. Lawrence Seaway Authority, addressing the Canadian Club on December 13, gave a brief description of the St. Lawrence Seaway facilities in the Montreal area.

Works in the Lachine Section

First, the Authority will build a ten mile canal with considerable channel enlargement extending from above Caughnawaga in Lake St. Louis to the entrance to Montreal Harbour. The canal will follow the south shore. "The principal reason for placing the canal on the south side around Laprairie Basin," Mr. Chevrier said, "is that it would permit the extension of the Montreal Harbour to this area and create an important industrial area adjacent to Montreal." There are other reasons such as the co-ordination of railway and highway communications, which are easier to cope with on the St. Lambert side than on the Montreal side of the river.

Secondly, the Authority will elevate the southerly end of Jacques Cartier Bridge in order to provide clearance for navigation. Plans and designs for this work are being prepared by a competent engineer in co-operation with the Quebec Highway Department. For the same reason, the Authority will elevate the southerly end of the Honoré Mercier Bridge. When these additions are completed, transportation facilities across the bridges will be materially improved.

As for Victoria Bridge, it offers a more difficult problem. "I am happy to say", commented Mr. Chevrier, "that we have found a solution. Canadian National Railways and seaway engineers have agreed in principle upon a plan which will cause no interruption in the normal flow of traffic. It involves the use of the proposed canal embankments which will permit uninterrupted vehicular traffic across the proposed seaway."

Among other works, provision is being made for movable spans for the Canadian National and Canadian Pacific railway bridges, as well as three turning basins, one in the harbour and two in Laprairie Basin in order to allow ships to manoeuvre more freely in and out the Lachine section.

Effects on the City of Montreal

Transportation

"The facilities which I have described with reference to the three bridges", continued Mr. Chevrier, "will leave the transportation problem in a much better position than it is today. At Jacques Cartier Bridge, a modern clover-leaf approach to the bridge will be built on the south side. Concurrently with this work, the National Harbour Board, I am informed, is proceeding with plans to add an additional traffic lane on the downstream side of the bridge. As for Victoria Bridge, the proposed plan will cause no interruption in the flow of vehicular traffic and at the same time will leave the door open for its coordination with plans for improvements of highway facilities across Victoria Bridge. At Honoré Mercier Bridge, I am satisfied that the new approach will materially speed up the flow of traffic across the bridge."

"When one considers that, in this matter as in others affecting seaway construction, the primary rights of navigation must always be safeguarded, I believe the Seaway Authority have approached the problem from a practical angle."

Port Facilities

"There may be a belief", Mr. Chevrier said, "that the port facilities are not adequate — that little is being done about modern facilities. My experience with the National Harbours Board has been that when the business was offering, the facilities were anticipated and provided. My information is that there is a substantial program now under way for the betterment of port facilities."

Concluding his remarks on the Seaway, and its effects on the City of Montreal, Mr. Chevrier expressed the opinion that the natural advantages are obvious. "Montreal is already established as a major trans-shipping point. This advantage is strengthened by the large number of ocean vessels which must come to the Harbour to serve its own great industries. Add to this the potential power development at your back door. I need hardly tell you what this means to the industrial future of this metropolitan area."

Annual Meeting of R.C.E.M.E. Corps Association

Lieut.-Col. A. G. Edward of Montreal, was elected president of the Royal Canadian Electrical and Mechanical Engineers Corps Association at the organization's ninth annual general meeting and dinner, held October 23 at the R.C.E.M.E. School at Barriefield, Ont.

Lieut.-Col. LeSueur Brodie of Toronto, was re-elected secretary-treasurer. Lieut-Col. Edward succeeds, as president, Lieut.-Col. F. W. Cranston of Toronto. About 160 attended the meeting.

The guest speaker at the annual dinner was Major-General H. F. G. Letson, M.E.I.C. advisor on militia, Canadian Army, who told of the progress of the nation's army reserve. Col. J. R. Dunlop, M.E.I.C., director of electrical and mechanical engineering, R.C.E.M.E., also spoke. General A. G. L. McNaughton, M.E.I.C., honorary colonel commandant of the corps, was present for the dinner.

Delegates to the meeting were Lieut.-Col. J. K. Bradford of Toronto, representing the Central Command chapter; Lieut.-Col. Edward,

representing the Quebec Command chapter; and Capt. D. K. Teasdale, M.E.I.C. of Halifax, the Eastern Command chapter.

Also attending were Lieut.-Col. E. D. Gray-Donald, M.E.I.C., of Montreal, chairman of the Montreal group; Major D. F. Cornish, chairman of the Toronto group; Major G. A. Blackburn, M.E.I.C., assistant secretary; and the officers commanding various units of the R.C.E.M.E.: Lieut.-Col. J. M. Harding of Toronto; Lieut.-Col. R. A. Mitchell, of Hamilton; and Lieut.-Col. R. J. Gilmour of Windsor; and Major G. L. Marks, Halifax.

Committee chairmen were Col. H. G. Thompson, M.E.I.C., constitution; Major D. C. Ferguson, nominations; Capt. D. L. Angus, M.E.I.C., prizes and competitions; and Capt. W. L. Shelden, M.E.I.C., publicity.

Among guests attending the dinner were Col. D. M. Buell, director of militia and cadets, Canadian Army; Lieut.-Col. P. A. Costen, representing the Canadian Army Medical Corps; Lieut.-Col. D. S. Ellis, M.E.I.C., dean of the faculty of applied science, Queen's University; Lieut.-Col. T. M. Medland, executive director of the Association of Professional Engineers of Ontario; Major E. E. Grant, representing the Canadian Army pay corps; Major D. D. Campbell, representing the officer commanding the R.C.E.M.E. school; and Major W. A. Campbell, president of the officers' mess at the school.

The ASME Boiler Code

Interpretations

The Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

The following Case Interpretations were formulated at the Committee meeting September 17, 1954.

Case No. 1181-1 (Reopened)

Interpretation of Par. P-112(c)

Revise the last sentence of the Inquiry to read:

May these thicknesses, and the carbon content of the carbon moly materials be increased.

Revise paragraph 2 of the Reply increasing the carbon content from 0.20 percent to 0.25 percent.

Case No. 1192

Special Ruling

Inquiry: May age hardened Nickel-Copper-Aluminum Alloy conforming with SB-164 except that the composition and mechanical properties are as shown below, be employed for bolting material for Code application:

Composition

	Percent
Nickel	63.0 - 70.0
Aluminum	2.0 - 4.0
Carbon	0.25 Max.
Iron	2.0 Max.
Silicon	1.0 Max.
Titanium	0.25 - 1.0
Sulphur	0.010 Max
Copper	Remainder

and is capable of being age hardened at 1100 F.

What are the design stresses for bolting?

Reply: It is the opinion of the Committee that age hardened Nickel-Copper-Aluminum Alloy as described in the Inquiry may be employed for bolting applications. The maximum allowable bolting stresses shall be as shown below.

Case No. 1193

Special Ruling

Inquiry: May the revision to Par. P-242(b) for furnace of the ring reinforced type, as published in the September, 1954 issue of *Mechanical Engineering* be used in the contruction of Code boilers?

Reply: It is the opinion of the Committee that the construction in the pub-

Mechanical Properties; Case No. 1192, Inquiry.

	Min. Spec. Tensile Strength psi.	Min. Spec. Yield Strength psi. (.2% offset)	Min. Elongation in 2 in. %	Rc	Hardness, Min.[1] Brinell 3000 kg. load.
Hot or Cold Finished, Annealed and Age Hardened	130,000	90,000	20	24	250
Hot Finished and Age Hardened	140,000	100,000	20	27	265

[1] Hardness Values for information only.

Bolting Stress at temperature °F.; Case No. 1192, Reply.

Condition	Subzero to 80	100	200	300	400	500
Hot or Cold Finished Annealed and Age Hardened	22,500	22,400	21,500	20,900	20,500	20,200
Hot Finished and Age Hardened.	25,000	24,900	24,500	24,000	23,900	23,800

lished Par. P-242(b) will meet the intent of the Code.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.

Power Boilers, 1952

Case Annulments

Case Nos.	Reason for Annulment
1054	Revision of Par. 51-52, etc.
1168	External pressure charts are available.

Par. P-242. Renumber present Par. P-242 as Par. P-242(a), and add a new subparagraph as (b) to read:

(b) ***Ring Reinforced Type.*** Horizontal cylindrical flues or furnaces (Fig. P-32) may be constructed with completely circular stiffening rings provided:

1. The stiffening ring is rectangular in cross section and is fabricated from one piece of plate, or from plate sections or bars provided full-penetration welds are used in assembling.

2. The stiffening ring after fabrication has a thickness of not less than $\frac{5}{16}$ in. and not more than $\frac{13}{16}$ in. and in no case thicker than $1\frac{1}{4}$ times the furnace wall.

3. The ratio of the height of the stiffening ring to its thickness (H_r/T_r) is not over 8 or less than 3.

4. The stiffening ring is attached to the furnace by a full-penetration weld on each side.

5. The thickness of the furnace wall or flue is a minimum of $\frac{5}{16}$ in. and a maximum of $\frac{13}{16}$ in.

6. The spacing, L, of the rings on the furnace is no greater than $60t$ or 36 in. whichever is smaller.

7. The design temperature of the furnace shall be taken as 100 deg. F. higher than the water temperature.

8. The boiler design permits replacement of the furnace. A flared or welded OG ring would be an acceptable assembly.

9. The completed furnace assembly is stress relieved but radiographic examination is not required.

10. The thickness of the furnace wall and design of stiffening rings are determined by the use of Fig. P-32(a). The notations defined below, and shown in Figs. P-32* and P-32(a)*, are used in the formulas of this paragraph:

t = minimum required wall thickness of furnaces or flues, inches.

L = design length of a furnace section, taken as the greatest center-to-center distance between any two adjacent stiffening rings; or the distance from the center of the first stiffening ring to the center of the furnace weld attachment, inches. In case a flared end assembly is used, the distance shall be measured to the point of tangency between the flare and the furnace and the adjacent stiffening ring.

D = outside diameter of furnace or flue, inches.

P = design pressure, pounds per square inch.

The required wall thickness of a ring-reinforced furnace or flue shall not be less than that determined by the following procedure:

Step 1: Assume a value for t and L. Determine the ratios L/D_o and D_o/t.

Step 2: Enter left-hand side of Fig. P-32(a) at value of L/D_o determined in Step 1.

Step 3: Move horizontally to the line representing D_o/t determined in Step 1.[1]

Step 4: From this intersection move vertically to the material line of the proper temperature.[1]

Step 5: From this intersection move horizontally to the right and read the value of B.

Step 6: Compute the allowable working pressure, P_a, by the following formula:

$$P_a = \frac{B}{D_o/t}$$

Step 7: Compare P_a with P. If P_a is less than P, a greater value of t must be selected or a smaller value of L or some

* Figs. P-32 and P-32(a) are available from the Secretary of the Boiler Code Committee.

For Inclusion in TABLE UCS-23

Stress Values for Spec. SA-369 — Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service

Material and Specification Number	Grade	Nominal Composition	Spec. Min. Tensile	Notes	For Metal Temperatures Not Exceeding Deg. F. −20 to 650	700	750	800	850	900	950	1000	1050	1100	1150	1200
Pipes and Tubes																
Seamless Low-Alloy Steels																
SA-369	FP1	C -½ Mo	55000	—	13750	13750	13750	13450	13150	12500	10000	6250	—	—	—	—
SA-369	FP2	½ Cr-½ Mo	55000	—	13750	13750	13750	13450	13150	12500	10000	6250	—	—	—	—
SA-369	FP3b	2 Cr-½ Mo	60000	—	15000	15000	15000	14700	14000	12500	10000	6200	4200	2750	1750	1200
SA-369	FP11	1¼ Cr-½ Mo-Si	60000	—	15000	15000	15000	15000	14400	13100	11000	7800	5500	4000	2500	1200
SA-369	FP12	1 Cr-½ Mo	60000	—	15000	15000	15000	14750	14200	13100	11000	7500	5000	2800	1550	1000
SA-369	FP21	3 Cr-0.9 Mo	60000	—	15000	14800	14500	13900	13200	12000	9000	7000	5500	4000	2700	1500
SA-369	FP22	2¼ Cr-1 Mo	60000	—	15000	15000	15000	15000	14400	13100	11000	7800	5800	4200	3000	2000
SA-369	FP5	5 Cr-½ Mo	60000	(14)	—	13400	13100	12800	12400	11500	10000	7300	5200	3300	2200	1500
SA-369	FP7	7 Cr-½ Mo	60000	(14)	—	13400	13100	12500	11500	9500	7000	5000	3500	2500	1800	1200
SA-369	FP9	9 Cr-1 Mo	60000	(14)	—	13400	13100	12800	12500	12000	10800	8500	5500	3300	2200	1500

Add to Note (14):

Specification	Grade	For Metal Temperatures Not Exceeding Deg. F. −20 to 400	500	600	650
SA-369	FP5	15000	14500	14000	13700
SA-369	FP7	15000	14500	14000	13700
SA-369	FP9	15000	14500	14000	13700

For Inclusion in TABLE P-7

Stress Values for Spec. SA-369 — Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service

Specification Number	Grade	Nominal Compostion	Spec. Min. Tensile	Notes	For Metal Temperatures Not Exceeding Deg. F −20 to 400	500	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
Pipe and Tubes																			
Seamless Alloy Steel																			
SA-369	FP1	C -½ Mo	55000	(2)	13750	13750	13750	13750	13750	13750	13450	13150	*(12500)*	*(8500)*	*(5500)*	—	—	—	—
SA-369	FP2	½ Cr-½ Mo	55000	—	13750	13750	13750	13750	13750	13750	13450	13150	12500	10000	6250	—	—	—	—
SA-369	FP3b	2 Cr-½ Mo	60000	—	15000	15000	15000	15000	15000	15000	14700	14000	12500	10000	6200	4200	2750	1750	1200
SA-369	FP11	1¼ Cr-½ Mo	60000	—	15000	15000	15000	15000	15000	15000	15000	14400	13100	11000	7800	5500	4000	*(2500)*	*(1200)*
SA-369	FP12	1 Cr-½ Mo	60000	—	15000	15000	15000	15000	15000	15000	14750	14200	13100	11000	7500	5000	2800	*(1550)*	*(1000)*
SA-369	FP21	3 Cr-1 Mo	60000	—	15000	15000	15000	15000	14800	14500	13900	13200	12000	9000	7000	5500	4000	2700	1500
SA-369	FP22	2¼ Cr-1 Mo	60000	—	15000	15000	15000	15000	15000	15000	14400	13100	11000	7800	5800	4200	3000	2000	
SA-369	FP5	5 Cr-½ Mo	60000	—	15000	14500	14000	13700	13400	13100	12800	12400	11500	10000	7300	5200	3300	2200	1500
SA-369	FP7	7 Cr-½ Mo	60000	—	15000	14500	14000	13700	13400	13100	12500	11500	9500	7000	5000	3500	2500	1800	1200
SA-369	FP9	9 Cr-½ Mo	60000	—	15000	14500	14000	13700	13400	13100	12800	12500	12000	10800	8500	5500	3300	2200	1500

Notes: The stress values shown in brackets are to be printed in italics.

combination of both to increase P_a so that it is equal to or greater than P. (An example is shown in Appendix A-200.)

The required moment of inertia of a circumferential stiffening ring shall not be less than that determined by the formula:

$$I_s = \frac{D_o^2 L\left(t + \frac{A_s}{L}\right) A}{14}$$

where I_s = required moment of inertia of the stiffening ring about its neutral axis parallel to the axis of the furnace, inches^4.

A_s = cross-sectional area of the stiffening ring, square inches.

A = factor determined from Fig. P-32(a).

P, D_o, L, and t are as defined above.

The moment of inertia for a stiffening ring shall be determined by the following procedure:

Step 1: Assuming that the furnace has been designed and D_o, L, and t are known, select a rectangular member to be used for a stiffening ring and determine its area, A_s, and its moment of inertia, I. Then calculate B by the formula:

$$B = \frac{PD_o}{t + \frac{A_s}{L}}$$

where B = factor on the right-hand side of Fig. P-32(a).

P, D_o, t, A_s, and L are as defined above.

Step 2: Enter the right-hand side of Fig. P-32(a) at the value of B determined in Step 1.

Step 3: Follow horizontally to the material line for the correct temperature.[1]

Step 4: Move down vertically to the bottom of the chart and read the value of A.

Step 5: Compute the value of the required moment of inertia, I_s, from the formula given above.

Step 6: If the required I_s is greater than the moment of inertia, I, for the section selected in Step 1, a new section with a larger moment of inertia must be selected and a new I_s determined. If the required I_s is smaller than I for the section selected in Step 1, that section should be satisfactory. (An example is shown in Appendix A-200.)

The longitudinal and circumferential joints may be fusion welded of the double-welded butt type, the only requirements being that the welds are stress-relieved in accordance with Par. P-108 and a bend test of a sample of the welding for each furnace meets the requirements of Par. P-102, no radiographic examination being required.

Unfired Pressure Vessels, 1952

Par. UG-23(a). Maximum Allowable Stress Values, revise as follows:

Add 'tensile' before 'stress' in the second sentence.

(b) The maximum allowable compressive stress to be used in the design of cylindrical shells subjected to loadings that produce longitudinal compressive stresses in the shell shall be the smaller of the following values:

1. The maximum allowable tensile stress value permitted in (a).

2. The value of the Factor B determined from the applicable chart in Subsection C for determining the required thickness of shells and heads under external pressure, using the following definitions for the symbols on the chart:

t_h = the minimum required thickness of the shell plates, exclusive of corrosion allowance, inches,

L_l = inside radius of cylindrical shell, inches.

The value of B shall be determined from the applicable chart of Subsection C in the following manner:

Step 1: Assume a value of t_h. Determine the ratio $L_l/100t_h$.

Step 2: Enter the left-hand side of the chart in Subsection C for the material under consideration at the value $L_l/100t_h$ determined in Step 1.

Step 3: Move horizontally to the line marked Sphere Line.

Step 4: From this intersection move vertically to the material line for the design temperature (see Par. UG-20). (For intermediate temperatures, interpolations may be made between the material lines on the chart.)

Step 5: From this interseetion move horizontally to the right and read the value of B. This is the maximum allowable compressive stress-value for the value of t_h used in Step 1.

Step 6: Compare this value of B with the computed longitudinal compressive stress in the vessel, using the assumed value of t_h. If the value of B is smaller than the computed stress, a greater value of t_h must be selected and the proeedure repeated until a value of B is obtained which is greater than the value computed for the loading on the vessel.

The joint-efficiency for butt-welded joints may be taken as unity.

(c) and (d) Same as present (b) and (c).

Annulment of Cases

All Cases that refer to the 1949 Seetion VIII, Code for Unfired Pressure Vessels are to be annulled effeetive January 1, 1955. These Cases are:

864	1025	1077	1109
885	1038	1078	1111
896	1043	1090	1114
897	1054	1092	1115
898	1068	1100	1117
934	1074	1106	1125
994	1075	1107	1135
997	1076	1108	1139
			1140

Material Specifications, 1952

The Boiler and Pressure Vessel Committee have approved adding to Section II the following new specifications:

SA-216-53T, Carbon-Steel Castings Suitable for Fusion Welding for High Temperature Service.

SA-369-53T, Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service. The stress values are as shown in tables for inclusion in Table UCS-23 and P-7.

SB-12-54T, Copper Rods for Locomotive Staybolts.

SB-105-54, Aluminum Bronze Rod, Bar and Shapes.

SB-211-52T, Aluminum and Aluminum-Alloy Bars, Rods and Wire (reinstated).

SB-164-54T, Nickel-Copper Alloy Rods and Bars.

[1] For intermediate temperatures and D_o/t ratios, interpolations may be made between the lines on the chart in Fig. P-32(a).

Thirty-five Years Ago

Comment on the *JOURNAL* of January 1920

The *Journal's* third year began in January, 1920, with a pretty skimpy issue, only 40 pages of text all told and most of that reports of branches or comments on Institute affairs. There was not a single real technical paper, though there were two or three short notes on technical matters. However, the 25 pages reprinted from the Engineering Index gave the magazine a reasonably substantial look, even if the contents did not amount to a great deal. If today's Publication Committee thinks it is beset with difficulties, it should consider the troubles of the early committees and be thankful that it is working in a different generation.

The backbone of January's *Journal* was "The Future of Applied Science", being Gen. C. H. Mitchell's address on the occasion of his inauguration as dean of the Faculty of Applied Science and Engineering of the University of Toronto, delivered in the previous October.

After lauding the engineer for his part in the late war in some 2,500 words of oratory replete with adjectives — "great", "magnificent", "gallant" and others common on such occasions — Gen. Mitchell lays down some principles as sound today as then and some with which many will now disagree.

". . . It must be accepted that the first requisite for an engineer . . . is a sound general education . . . a high standard in mathematics (and) also . . . in English and languages . . . We require to produce men who . . . will be . . . broadly educated . . . good citizens . . . (and) thoroughly trained technologists".

". . . There are several changes in the curriculum, which are now opportune, . . . by avoiding crowding . . . (by) the introduction of broader humanistic subjects . . . (by) including . . . a further study of English . . . (by) the introduction of economics, sociology and possibly logic and psychology . . . (and) the inclusion in the last two years of . . . finance, engineering law . . . com-

mercial engineering, industrial management and engineering economics. . ."

Training in Engineering Specialties

Apparently, the idea that more emphasis on the basic studies— mathematics, physics, chemistry, mechanics and the like — was desirable had not then gained much support, since Gen. Mitchell does not refer to it, but he did believe that the universities were going to have to train students in new engineering specialties, in sanitation, transportation, irrigation, water power, aerodynamics, naval architecture, town planning and research. Today the trend is the other way. Most universities concentrate on giving the best possible training in the fundamental sciences and in the broad fields of engineering, leaving to the young graduate himself and to his employer the task of specialized development.

It is doubtful if Gen. Mitchell's remarks created much of a stir in the academic world. They were no better and no worse than one would expect of a dean who was addressing the teaching staff, student body and graduates of his own alma mater — we're as good as anybody else, if not a little better.

A. D. Ferguson, A.M.E.I.C., took two pages to describe an instrument he had invented to measure rail wear by reproducing on paper the profile of a rail head. This was used in making an appraisal of the Winnipeg Electric Railway for the Manitoba Public Utilities Commission.

Prof. A. R. Grieg, A.M.E.I.C., of the University of Saskatchewan, had a short and simple paper on straw gas, then attracting some attention in the West. His conclusions were not promising; it took nearly all the gas produced to carbonize the straw to make it.

Federal Highway Aid

Canada's first venture into federal highway aid was noted and the regulations under which it would be extended to the provinces were published. A. W. Campbell, M.E.I.C., was the commissioner. This scheme was dropped after a few years and the Federal Government took no more general interest in highways until the recent Trans-Canada Highway act was passed.

Turning to our own affairs, the call was sent out for the annual professional meeting, to be held at headquarters and to be "the greatest and most enjoyable . . . yet held in Canada". Its location gives some idea of the attendance expected. Granted that headquarters was less congested then than it is now, it could accommodate only a very limited number.

J. Grant McGregor, A.M.E.I.C., sent in a new scheme of prismoidal corrections for use in calculating earthwork quantities and the editor put it in "Correspondence", perhaps because he had nothing else with which to fill that space.

The December meeting of Council, reported in this *Journal*, was not of shattering importance. The Montreal Branch wanted the meeting hall "improved", in what way was not specified. The Peterborough Branch opposed the formation of a Canadian society of electrical engineers and was thanked by Council for "its loyalty to the profession". Council supported the suggestion of the Toronto Branch that the chairman of the Temiskaming and Northern Ontario Railway Board should be an engineer. A reorganization of the Kingston Branch was approved.

Branch Activities

Branch reports got a large share — 10 pages — of this *Journal*. The Halifax Branch spent some time discussing a possible Halifax-Dartmouth bridge, a project that took until today to realize. Even in 1920 a good deal of promotional work had already been done. At a Montreal Branch meeting, W. F. Tye, M.E.I.C., spoke on Canada's railway situation, then a pressing problem. He was solidly opposed to Government ownership and thought that the only solution was an "immediate and decided increase in freight rates". He may have been right, but we all know what happened, since we all help to pay the bill.

The Ontario Provincial Division was busy explaining the Institute's legislative proposals to engineers not members of the Institute. The Toronto Branch reported on its elections. The Niagara Peninsula Branch was still struggling with the question of engineers' salaries. It also asked permission to hold a professional meeting in Niagara Falls in 1920, possibly with the A.I.Ch.E.

The Border Cities, Peterborough and Kingston Branches had nothing to report, but elections and routine affairs. At the Calgary Branch, a member criticised Council for not "pressing this matter (legislation) as they should have done" and got unanimous passage of a resolution urging speedy action. The Saskatchewan Branch was deep in the discussion of a water supply from the Saskatchewan River for Moose Jaw,

(*Continued on page 56*)

Elections and Transfers

At the meeting of Council held at Headquarters, on Friday, December 17, 1954, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

J. C. V. Bishop, *Mont Joli*
F. de Schulthess, *Montreal*
T. A. Dumas, *London*
E. I. H. Ings, *Edmonton*
S. T. Lindsell, *Toronto*
D. K. Logie, *Member*
A. F. Staig, *Toronto*
F. B. Raymer, *Pt. Colborne*
L. F. Train, *Toronto*

Juniors:

D. A. Wills, *Vancouver*
A. R. Wilson, *Southport, Eng.*
J. H. Boyce, *Sydney*
J. F. Gagnon, *Montreal*
J. D. Lambert, *Montreal*

Transferred from the class of Junior to that of Member:

C. J. Garland, *Ottawa*
R. W. Moulton, *Halifax*
J. F. Perrier, *Murray Hill, N.J.*

The following Students were admitted:

University of Ottawa

R. Alary
G. Lapensee
F. Amyotte
G. Archambault
J. E. Auger
S. Bednarski
J. M. Belanger
A. T. Brennan
W. L. Brisson
P. Britt
D. A. Caletti
W. Chi-Loong
P. Champagne
G. De Champlain
J. Cheng
G. E. Chenier
R. Clouthier
C. E. Coupal
E. B. R. Dalphy
M. C. D'Aoust
J. C. Daze
P. De La Franier
R. A. Desmarais
A. Burke Doran
J. E. Gagnon
R. A. Gelineau
J. J. B. Goudreau
R. G. Hedge
J. P. Howell
H. Kong
A. Labarge
F. Lacourciere
R. Lafleche
M. Laforest
P. G. Landolt
G. F. Lapointe
R. V. Lauzon
L. P. Lemay
K. Li
J. Liff
F. Lyra
A. Martineau
J. M. Nugent
R. O'Brien
T. Pace
J. A. Paquin
G. M. Ranger
J. Rathwell
R. Raymond
G. Renaud
E. G. Roy
M. St. Amour
A. F. Sabbagh
J. H. G. Sanche
A. Sauve
B. Seguin
G. Seguin
J. R. Seguin
J. M. Simard
R. P. Sylvestre
C. Theberge
J. N. Tremblay
R. J. Tremblay
R. T. C. Tsul
G. N. Vetsos
R. A. Vezina
G. Yelle

Nova Scotia Technical College

J. R. Bentley — J. J. C. Picot
A. G. Hart — R. B. Swansburg
D. G. Lordly — D. E. Webster
G. D. M. McKay — G. B. Weld

University of Alberta

A. G. Dale — A. Letwin
K. A. Dane — G. C. Nelson
D. E. Lee

University of Toronto

J. G. Forster — R. E. M. Marks
W. Knapp — W. L. Sharpe
M. A. Laughton — W. Suboch

McGill University

Y. D. J. Delisle — R. J. Melanson
R. G. F. Desjardins — R. A. Morrison
S. H. Dingman — B. J. Palfreeman
H. B. Goldman — D. W. Rae
J. H. Y. Larocque — C. D. Wilson

University of New Brunswick

G. C. Burtt

Queen's University

J. A. Wylie

Applications through Associations:

ALBERTA

Junior to Member:
W. J. Francl

SASKATCHEWAN

Member:
J. B. Cummings

Students:

L. G. Andrego — R. J. Fleming
G. E. Bates — H. G. Kindred
E. H. Birnie — J. L. Labossiere
B. K. Braaten — H. S. Macdonald
W. J. Brice — J. T. McManus
T. A. Buckle — D. G. Matheson
A. R. Crawford — L. E. Parker
R. F. Critchley — E. E. Pelens
D. D. Davison — E. Safronek
K. W. Domier — E. M. Toth
R. S. Elliott

Junior to Member:

C. A. Braaten — R. E. Pelkey

NOVA SCOTIA

Junior to Member:
W. B. Shanahan

Addresses Wanted

The records office at E.I.C. Headquarters requests information about the present addresses of the following members with whom it has lost contact. The last known location of each is listed, and any current information will assist in making membership records complete

Students

Alain, Paul, Quebec, P.Que.
Allen, D. E. M., Montreal, P.Que.
Anderson, E. Edward, Montreal, P.Que.
Ashbaugh, P. G., Tillsonburg, Ont.
Ayoung-chee, S. M., Montreal, P.Que.
Barker, Norman, Montreal, P.Que.
Belanger, Fernand, Quebec, P.Que.
Belanger, Gilles, Quebec, P.Que.
Beliveau, Paul, Montreal, P.Que.
Bell, A. W., Ottawa, Ont.
Belle-Isle, Francois, Kingston, Ont.
Berkes, Michael, Montreal, P.Que.
Bertrand, Denis A., Montreal, P.Que.
Bhasin, P., Montreal, P.Que.
Biron, Paul, Montreal, P.Que.
Blair, Gordon Harold, Peterborough, Ont.
Blanchard, Rene, Rosemount, P.Que.
Bland, R. C. J., South Slocan, B.C.
Boily, Joachim, Quebec, P.Que.
Boisvert, Celestin, Drummondville, P.Que.
Boudreau, Lucien, Quebec, P.Que.
Bouliane, J., Quebec, P.Que.
Boyer, S. Y., Montreal, P.Que.
Braams, J. H., Skino Lake, B.C.
Breton, Y. A., Montreal, P.Que.
Brown, Kenneth Wilbur, Kingston, Ont.
Bruce, Ian B., Montreal, P.Que.
Campbell, David H., Kingston, Ont
Carther, E. P., Winnipeg, Man.
Chabot, Henri, Montreal, P.Que.
Charest, Raymond, Montreal, P.Que
Charron, Jean M., Quebec, P.Que.
Clement, W. P., Copper Cliff, Ont.
Cole, Nathaniel, St. John's, Newfoundland.
Corbeil, Joseph Henry, Ottawa, Ont.
Cote, Gilles, Quebec, P.Que.
Cousineau, Georges, Ste-Anne de Bellevue, P.Que.
Coutu, J. Leo, Montreal, P.Que.
Crittenden, R. S., Fredericton, N.B
Cuevas, H., Montreal, P.Que.
Czolij, Jerry, Lachine, P.Que.
Dahan, Paul, Ottawa, Ont.
Delaet, Christian H. J., Calgary, Alta.
Desgagne, Claude, Quebec, P.Que.
Desjardins, Yvon, Montreal, P.Que.
De Varennes, Maurice, Ottawa, Ont.
Dimas, T., Westmount, P.Que.
Dimitracopoulos, P. C., Montreal, P.Que.
Dionne, Patrice, Quebec, P.Que.
Donovan, Donald J., Quebec, P.Que.
Dorval, Jean, Cap-de-la-Madeleine, P.Que.
Dupont, L. G., Quebec, P.Que.
Economou, C., Montreal, P.Que.
Estlick, Paul T., Kingston, Ont.
Fennell, William R., Winnipeg, Man.
Fernandez, Guillermo, Guatemala.
Fournier, Gerard, Quebec, P.Que.
Fournier, Oskar, Montreal, P.Que.
Fulford, George, Ottawa, Ont.
Furst, Max, Montreal, P.Que.
Gagnon, Geaton, Sillery, P.Que.
Gaudreault, Roch, Quebec, P.Que.
Gentles, Earl R., Montreal, P.Que.
Gilbert, Raymond, Quebec, P.Que.
Grenkie, Donald G., Saskatoon, Sask.
Guerin, R. M., St. Sacrement, P.Que.
Helm, Gordon A., Montreal, P.Que.
Henriksen, Terje, Chicoutimi, P.Que.
Hertel, T. K., Edmonton, Alta.
Hinse, Guy, Quebec, P.Que.
Horne, Cyril, Pointe aux Trembles, P.Que.
Hotte, Claude, Montreal, P.Que.
Hotte, Jacques, Montreal, P.Que.
Houde, Jean-Guy, Montreal, P.Que.
Hudon, Jean Marc, Montreal, P.Que.
Issaris, Nick, Montreal, P.Que.
Iwanciw, Michael, Ottawa, Ont.
Jason, M., Montreal, P.Que.
Kane, Alphonsus J., Montreal, P.Que
Kennedy, D. R., Saskatoon, Sask.
Kennedy, N. G., Toronto, Ont.
Kennedy, Wm. Spankie, Montreal, P.Que.
Kleniewski, Christian M., Montreal, P.Que.
Kopczynski, Piotr, Montreal, P.Que
Koshurba, John, Hamilton, Ont.
Lafkas, C., Montreal, P.Que.
Lake, Seymour, Montreal, P.Que.
Laliberte, Maurice, Quebec, P.Que.
Lanctot, Jean-Paul, Montreal, P.Que.
Langballe, Peter Brock, Montreal, P.Que.
Lapierre, Norman, Quebec, P.Que.
Laprade, Arthur, Mason, P.Que.
La Rovgery, Yves, Montreal, P.Que.
Law, Douglas A., Kingston, Ont.
Lebeuf, Yvan, Montreal, P.Que.
Leclerc, G. L., Fredericton, N.B.
L'Esperence, J. R., Quebec, P.Que.
Lynch, F. E., Montreal West, P.Que.
Maier, L. F., Edmonton, Alta.
Main, Charles J., Winnipeg, Man.
Malo, P. E., Westview, B.C.
Malone, William V., Holyoke, Mass., U.S.A.
Marcon, Lino J., Kingston, Ont.
Marcotte, N., Quebec, P.Que.
Markland, Kenneth A., Vancouver, B.C.
Marmen, Raymond, Quebec, P.Que.
Martz, Bernard A., Verdun, P.Que.
McColm, John B., Kingston, Ont.
McDonald, Vernon, Vancouver, B.C.
McDougall, J. D., Kingston, Ont.
McGinnis, Cliff, Vancouver, B.C.
McRae, D. H., Kingston, Ont.
Meadley, R. F., Montreal, P.Que.
Mervyn, Grant, Kingston, Ont.
Mulas, J. L., Ottawa, Ont.
Murchie, A. D., London, Ont.
Naylor, J. A., Saskatoon, Sask.
Nelson, G. C., Kingston, Ont.
Neron, Raymond, Montreal, P.Que.
Newhook, A. J. A., St. John's, Nfld.
Newton, William R., Winnipeg, Man.
Noel, Marcel, Lauzon, P.Que.
Norman, Robt. L., Sarnia, Ont.
Norris, Albert, Ottawa, Ont.
O'Brien, W. S., Westmount, P.Que.
Pandelidis, S., Montreal, P.Que.
Parent, Claude, Montreal, P.Que.
Parnamagi, Askel, Kingston, Ont.
Patterson, F. W., Vancouver, B.C
Pearce, Tom, W., Kingston, Ont.
Pei, D. C. T., Montreal, P.Que.
Pham, Nam, Montreal, P.Que.
Polnicky, Edmund, Ottawa, Ont.
Poulin, Richard, Quebec, P.Que.
Proulx, Florian, Ottawa, Ont.
Quenneville, Alexis, Montreal, P.Que.
Quesnel, L. G., Montreal, P.Que.
Rainville, Fernand, Quebec, P.Que.
Ray, Tom, Kingston, Ont.
Robinson, C. W., Vancouver, B.C.
Robinson, R. A. W., Deep River, Ont.
Rosenfield, Lawrence, Toronto, Ont.
Ross, Douglas E., Kingston, Ont.
Rouleau, J. J., Montreal, P.Que.
Roy, Bertrand, Quebec, P.Que.
Samson, P. J., Montreal, P.Que.
Sanscartier, Gerard, Gatineau Mills, P.Que.
Santerre, Gerard, Quebec, P.Que.
Schmidt, J. J., Regina, Sask.
Schroeder, E. F., Saskatoon, Sask.
Seguin, Emilien, Quebec, P.Que.
Sicard, Gilles, Montreal, P.Que.
Sirois, Alfred, Quebec, P.Que.
Starr, L., Vancouver, B.C.
Stewart, F. G., London, Ont.
Sylte, L. H., Vancouver, B.C.
Theberge, Claude, Ottawa, Ont.
Themelis, V., Montreal, P.Que.
Thivierge, Jacques, Quebec, P.Que.
Tremblay, Marcel, Montreal, P.Que.
Van Der Meyden, P., Fredericton, N.B.
Watson, C. R. G., Montreal, P.Que.
Wild, George, Kingston, Ont.
Wilder, F. J. C., Montreal, P.Que.
Windser, W. P., Vancouver, B.C.
Withers, Ramsey M., Toronto, Ont.
Yoneda, R., Saskatoon, Sask.
Zaionchkovsky, A., Vancouver, B.C

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

Close to five hundred professional engineers living in and around Ottawa were addressed on December 1st by J. Herbert Smith, of Toronto, and R. F. Shaw, of Montreal, the immediate past-presidents of the Ontario Association and the Quebec Corporation respectively.

The chairman of this highly successful gathering in the Chateau Laurier was Dr. Alex. E. MacRae, of Ottawa.

Government vs. Industry for Engineering Manpower

Mr. Smith emphasized the fact that Government, be it municipal, provincial or federal, must compete with industry for its share of available engineering manpower. He pointed out that in 1931 the ratio of the number of engineers to the total Canadian work force was 1 to 304. By 1951 it had dropped to 1 to 178 and the ratio is continuing to drop. His address also included a review of the work of the Association and the growing magnitude of its activities and responsibilities. Reference was made to the work of Dominion Council of Professional Engineers and the programs of the Dominion Council committee on unity within the profession in Canada. Mr. Smith is chairman of this committee and spoke of the deep interest in the subject which has been very evident to the committee in its study of a formula for unity.

Engineering Progress and Potential

Mr. Shaw gave some arresting figures on Canadian engineering progress and potential. He reviewed the various technical and professional organizations in Canada which centered about the work of engineers and stressed that the desired co-ordination of engineering groups is designed to encourage the autonomy and strength of technical and professional bodies rather than to weaken them.

"We can and must achieve national unity of purpose without undermining the rights and vigors of the member bodies," stated Mr. Shaw. He added that the proposed united organization would enable the economical co-ordination of professional groups on a national level. It would not inherit the legal functions now given to the provincial associations by legislation.

News of the Members

H. Fealdman, has been appointed assistant general manager of the Ontario Road Builders Association of Toronto.

A graduate in engineering of Cambridge University England, he was engaged in industrial consulting and research engineering before coming to Canada. Much of his research work has been in the structural research department of the Hydro-Electric Power Commission of Ontario in Toronto, where his interests were centred on the development of pre-stressed concrete.

Mr. Fealdman was secretary of the organizing committee of the Canadian Conference on Prestressed Concrete, held in Toronto in January 1954. At that conference he presented a paper on "An Introduction to the Theory of Prestressed Concrete".

Russell M. Way, president of R. M. Way & Co. Ltd., Toronto consulting engineers, has announced the appointment of **G. R. Beavers,** as chief mechanical engineer; **R. N. Craig,** as mechanical engineer, and **D. B. Angus,** as assistant metallurgical engineer with the organization.

Both Mr. Beavers and Mr. Craig were until recently, associated with A. D. Margison and Associates Ltd., of Toronto. Mr. Angus was previously connected with Eldorado Mining and Refinery Ltd., as assistant manager and mill superintendent of the Port Radium operation.

W. Elmer Wright, of Port Credit, Ontario, has been appointed supervisor of the Executive and Professional Section of the Toronto office of the National Employment Service, located at 118 Richmond Street West, Toronto. Formerly he was employment advisor for youth for the Ontario Region of the Unemployment Insurance Commission.

A graduate in electrical engineering of the University of Toronto in 1925, he later did post-graduate work in psychology in the United States.

He is vice-chairman of the Toronto Township Hydro Commission, president of the Central Ontario District of the Ontario Municipal Electric Association and secretary of the Credit Valley Conservation Authority.

F. W. Stott, who for many years was Hamilton sales office manager for the C. A. Dunham Co. Ltd., has resigned that position to devote his time to consulting engineering practice.

Mr. Stott joined the Dunham Company in 1923 following his graduation in mechanical engineering at the University of Toronto. After two years at the head office he was transferred to the Toronto sales branch and later established the Hamilton district sales office.

Is Honoured on Retirement

On his retirement as assistant Dominion geodesist, Cecil H. Ney, of Ottawa, was honored on December 1st by his fellow workers of the Geodetic Survey.

On graduation in civil engineering at the University of Toronto, Mr. Ney served overseas as a pilot in the Royal Flying Corps in World War I. After his discharge from the RFC he joined the staff of the Geodetic Survey and has been with that branch of the government service ever since.

Mr. Ney was the first member of the Geodetic Survey staff to be assigned as a scientist to sail on the "Nascopie" on her annual arctic patrol. He is credited with the most northerly precise astronomic determinations ever made by the Survey. He also carried out surveys to establish the northern limit of the Alberta-Saskatchewan boundary, British

Columbia's northern boundary, and the Ontario-Manitoba boundary.

In 1945 Mr. Ney was awarded the gold medal of the Professional Institute of the Public Service of Canada for his contribution to wartime mapping of aviation routes in the arctic. For his work in this connection he also received the M.B.E. in 1946.

Officers of the Newly-formed London Subsection of the A.I.E.E.

R. M. Laurie, manager of the Western Region Ontario Hydro, London, is chairman of the newly-formed London subsection of the American Institute of Electrical Engineers. Committee members are W. H. Hopper, of English Electric Co. Ltd., Prof. L. S. Lauchland, of the University of Western Ontario; T. H. Lewis, of Ontario Hydro; W. H. Meikle, of Taylor Electric Manufacturing Co.; and Fred Macenko of General Motors Diesel of Canada. The secretary-treasurer is L. P. Atkins of Ontario Hydro.

The new London organization is a sub-section of the Hamilton Section A.I.E.E. and the 1954-55 season's program has been planned with varied subjects in the fields of transportation, communication, atomic energy and power.

Changes at Hydro

Recent changes have been announced in the Generating Department of the Hydro-Electric Power Commission of Ontario, one of the eight departments of the engineering division. The changes in question affect O. E. Johnston, P.Eng., R. C. McMordie, P.Eng., and J. S. Crerar, P.Eng.

O. E. Johnston has been appointed assistant generation engineer, reporting directly to the generation engineer E. T. Ireson, P.Eng. He has been with this department since graduation from Toronto University and has held various responsible positions in the department. Until his recent promotion he was project engineer of Sir Adam Beck Niagara Generation Station No. 2.

R. C. McMordie, a member of Council of the Association, has been made senior project engineer in charge of the project section of the Generation Department. In this capacity he is responsible for the overall engineering coordination of hydro-electric generating projects. Prior to the change Mr. McMordie was head of the Program Planning and Control Department.

J. S. Crerar, P.Eng., becomes senior design engineer in charge of all engineering design of hydro-electric generating stations, exclusive of electrical and architectural features. He was project engineer of the Des Joachims Generating station on the Ottawa River and more recently project engineer of the St. Lawrence Power Project.

Elected Fellows

William G. Richardson and W. A. Nichols, both of Ottawa have been honored by election as Fellows of the Institute of Radio Engineers.

Mr. Richardson is director of engineering of the Canadian Broadcasting Corporation and received his award for his contribution to radio and television broadcasting.

Mr. Nichols, who is assistant chief engineer of CBC, was honored for contributions to the construction of the national radio system.

Obituary

Word has been received of the death of Malcolm Black, at Kirkland Lake on November 7th. A Scotsman by birth, Mr. Black came to Northern Ontario in 1906 and worked in the mines and mills at Cobalt, Porcupine, Timmins and Kirkland Lake. In 1928 he joined Wright-Hargreaves Mines and held the appointment of mill superintendent until his death. He was recognized as an expert in his field and had had a number of papers published in technical periodicals. Andrew B. Black of Cobalt, Ontario, is a son of the late Malcolm Black.

Manitoba

Western Canada Tour of E.I.C. President

Mr. D. M. Stephens, president of the Engineering Institute of Canada and member of council of the Association of Professional Engineers of Manitoba, has recently completed a tour of Western Canada. A brief description of the general thoughts expressed by Mr. Stephens is as follows:

After treating with the economic development of Canada and the continual broadening of the economy through resources development projects over the last quarter century and particularly during the past ten years, Mr. Stephens expressed some concern about the comparatively small number of Canadian youth who are being trained in the engineering fields. After emphasizing the role which the engineer must play in the physical aspects of nation building and industrial development, he compared the annual rate of engineering graduations in Canada with corresponding figures relating to the United States and the Soviet Union. He pointed out that on the average in recent years the United States has been training approximately 29,000 engineering graduates a year while Russia has been training upwards of 39,000 engineering graduates a year, this particularly in view of the fact that so much of the development of Canada lay in the future. He left his listeners with the following thought: "What responsibility have we as a profession to do something about this?"

Mr. Stephens also impressed upon the student societies whom he had the pleasure of addressing, the vital part they must play in the future of the country. He pointed out that the present generation of engineers is completing work started by previous generations and initiating other developments which they are unable to complete and which will become the responsibility of the engineering student.

On his speaking trip Mr. Stephens visited the following places and addressed the following bodies:

November 23: At the Bessborough Hotel in Saskatoon he addressed the Saskatchewan branch of the EIC and members of the Association of Professional Engineers of Saskatchewan and their wives.

November 23: At the University of Saskatchewan, the Engineering Society.

November 24: At the University of Alberta in Edmonton, the Engineering Society.

November 26: At Lethbridge, the district meeting of the Alberta Association of Professional Engineers.

November 28: Informal luncheon in Nelson, B.C., with members of the B.C. branch of the E.I.C and their wives.

November 29 At Trail, BC, in the evening, the Joint Technical Societies including the Engineering Institute of Canada, the Canadian Institute of Mining & Metallurgy, and the Canadian Institute of Chemistry.

December 1: (Noon) At the University of British Columbia, the Engineering Society.

December 1: (Evening) At Vancouver, the B.C. branch of the E.I.C.

December 2: At Chiliwack, B.C., visited with the Royal Canadian Engineers and participated in the ceremony of placing a wreath on the cenotaph

December 4: During the annual meeting of the B.C. Association of Professional Engineers, Mr. Stephens was guest speaker at a luncheon.

Saskatchewan

E.I.C. President Visits Saskatoon Engineers

Dr. D. M. Shephens, president, and Dr. L. Austin Wright, general secretary of the Engineering Institute of Canada spent a busy two days in Saskatoon on November 22 and 23. Activities included attending a buffet supper in the president's honour, addressing all third and fourth year engineering students and meeting with the executive of the Student Engineering Society at the University of Saskatchewan, sitting in on a Council meeting of the Association of Professional Engineers of Saskatchewan, and interviews with local press and radio representatives.

The buffet supper was held Monday evening in the Terrace Lounge of the Bessborough Hotel with 67 members and their ladies present. Mr. G. N. Munro, president of the Association acted as chairman. Special guests included Dean J. W. T. Spinks, past-president of the Canadian Institute of Chemistry and Alderman A. Flavelle representing the City of Saskatoon.

Dr. Stephen's address made particular reference to Canadian engineering developments and the continued shortage of engineering graduates. Dr. Wright also spoke, reporting on the progress being made towards a confederation of The Dominion Council of Professional Engineers and the Engineering Institute of Canada.

M. Kamen-Kaye Accepts New York Post

Maurice Kamen-Kaye, principal geologist with the Saskatchewan Department of Mineral Resources since Jan. 1,

1954, has resigned that post to join Conorada Petroleum Corp. at its New York headquarters.

Mr. Kamen-Kaye will leave the department Dec. 15 to take up his new duties which will include supervision and appraisal of company controlled acreage in several foreign countries.

Mr. Kamen-Kaye came to Regina in 1950 on a six month consultant contract with the Sohio Petroleum Co. group. Following this he joined Canadian Devonian Petroleums Ltd. in a similar capacity and while there organized that company's geological department. He then carried on a geological consultant practice in Regina for clients in Saskatchewan, Alberta and the United States.

He is a graduate of the School of Mines, London, England and has spent 24 years in the oil business. Mr. Kamen-Kaye holds his bachelor of science degree, his A.R.C.S. diploma in chemistry and his A.R.S.M. diploma in oil technology. He was registered a professional engineer in Saskatchewan and became a Member of The Engineering Institute of Canada in 1953.

Clipsham Appointed

W. B. Clipsham, chief engineer of the Saskatchewan Power Corporation, has been appointed acting general manager of the Corporation to succeed J. W. Tomlinson, Public Works Minister J. A. Darling announced recently.

Mr. Tomlinson has resigned to accept a position with Trans Canada Pipelines Ltd.

Mr. Darling said Mr. Clipsham had been asked to assume management immediately pending appointment of a permanent general manager because of the need to maintain continuity of management in the provincial utility.

Mr. Clipsham graduated in electrical engineering from the University of Toronto in 1925 and worked for electrical firms and for the Pennsylvania Railroad before joining the transmission staff of the Ontario Hydro Electric Power Commission where he served 18 years. In 1948, he joined the S.P.C. staff as chief engineer.

Mr. Clipsham is a member of The Association of Professional Engineers of Saskatchewan and The Engineering Institute of Canada.

K. R. Pattison Succeeds D. A. R. McCannel as Regina's City Engineer

K. R. Pattison, Regina assistant city engineer, has been appointed city engineer in succession to D. A. R. McCannel who will retire May 10, 1955 after being on the city staff over 42 years. Mr. Pattison's new appointment will take effect from Jan. 1, 1955. From then until May, Mr. McCannel will act in an advisory and consulting capacity.

The new city engineer graduated in civil engineering from the University of Saskatchewan in 1942. Following his graduation, Mr. Pattison worked for one and a half years on the Alaska Highway with the public roads administration department on survey, bridge and road design. In 1944 he joined the R.C.A.F. and after discharge was employed for a year as an instructor in civil engineering at the University of Saskatchewan. Mr. Pattison came to Regina in May 1945 and was engaged as sewer engineer until May 1950, when he was appointed to his present position of assistant city engineer.

He is a registered member of the Association of Professional Engineers of Saskatchewan and the Engineering Institute of Canada.

British Columbia

Association Convention

There are now more registered professional engineers in the Province than ever before, it was reported at the two day convention of the Association of Professional Engineers of B.C. which ended Saturday night, Dec. 4, in Vancouver. Membership in the Association is at a peak total of 3,404, including 1,544 professional engineers, 1,268 engineers-in-training and 592 engineering pupils. In addition there are 135 professional engineers from outside the province practising in B.C. under temporary licence from the Association.

Dr. H. C. Gunning, Dean of the Faculty of Applied Science of the University of British Columbia will succeed Charles Bentall, of Vancouver, as president of the Association for 1955, and J. E. Liersch, vice-president of the Powell River Co. will be the new vice-president. Elected as members of Council were: F. R. Killam, F. R. Phillips, M. A. Thomas, all of Vancouver, and R. E. Potter, of Victoria. A feature of the two day convention was the presentation of awards to eleven prize winners and certificates of registration to twenty-three new professional engineers. Eugene Butkov of Calgary, received the Association Gold Medal for the student with the most outstanding record in the graduating year of Applied Science at U.B.C. Mr. G. M. Letson, presented the Letson Memorial Prize for the best thesis in support of an application for registration in mechanical engineering to G. W. McLeod, assistant engineer for the Alaska Pine & Cellulose Co. at Woodfibre, B.C.

Undergrad Prizes

Engineering undergraduates at the University of B.C. who received prizes from the Association were: R. Affleck (Victoria), R. G. Johnson (Nelson), E. W. Mountjoy (Calgary), D. W. Nyberg (Rossland), R. M. Brown (North Vancouver), and G. C. Oates, R. A. Sterne and R. G. Maranda (Vancouver).

Employment

In a report on the employment service of the B.C. Engineering Society it was disclosed that in the past six months 181 employment applications for engineering positions had been removed from the active list and that 25 vacancies are currently open. There is, however, at the moment a surplus of applicants in the mechanical and civil engineering branches.

Confederation

Co-operation between professional societies, which is particularly close in B.C., was exemplified by the choice of Dr. D. M. Stephens, president of the Engineering Institute of Canada, as guest speaker at the annual luncheon. Referring to the very topical question of the hoped for confederation of technical and professional societies, he assured his listeners that the E.I.C. would speak in negotiation only for its own members, and listen closely to the opinions and desires of other groups.

Life Membership

A. Vilstrup has been granted Life Membership in the Association of Professional Engineers of B.C. He is a founder member and past president of the Association.

Mr. Vilstrup was born 70 years ago in Denmark, and came to Canada in 1911 to work on the B.C. Electric power development at Lake Buntzen. When he left the company to join the Public Utilities Commission in 1949 he was superintendent of generating and substations. From 1951 until his recent retirement he was Chief Electrical Engineer for the B.C. International Engineering Company.

THIRTY-FIVE YEARS AGO

(*Continued from page 52*)

Regina and places south of these. Many schemes had been suggested, but "the amount of water necessary at present (would) hardly (warrant) the cost of construction". The Vancouver and Victoria Branches reported the formation of joint committees of their own members and of other engineers to press for legislation in British Columbia. A draft bill had been prepared and was to be presented to the provincial legislature at its next sitting.

January's obituaries recorded the untimely death by drowning at Sebec Lake, Me., of Stephen P. Brown, M.E.I.C., engineer in charge of the Mount Royal Tunnel in Montreal from 1912 to its completion. Mr. Brown had made himself very much persona grata to Canadian engineers during his stay in this country and had been active in Institute affairs.

Some positions were available at miniscule salaries, a junior draftsman at $100-$110 a month and two steamship inspectors at $2,700 a year rising to $3,240 after three years, for example.

All in all, this *Journal* seems to have appeared at a time when nobody was much excited about anything. Perhaps the activities over legislation and salaries had used up most of the Institute's steam.

Personals

News of the Personal Activities of Members of the Institute

Professor L. P. Bonneau, M.E.I.C., will head the newly formed mechanical engineering department of Laval University's faculty of science in Quebec. Until the formation of the new department, students could follow the first three years only of the five-year course of mechanical engineering and were obliged to continue their course of studies at other universities. The first graduates of this new department will receive their degrees in May, 1956.

Prof. L. P. Bonneau, M.E.I.C.

Professor Bonneau graduated from Laval University in 1942. After six years' association with Canadian Johns-Manville Co. Ltd., he returned to Laval, first as a lecturer in applied mechanics, and later in applied thermodynamics. He was named assistant secretary of the faculty in 1949, and professor of applied thermodynamics in 1954. He represented Laval University with the group of professors which toured England in 1950 in connection with the Athlone Fellowships.

Professor Bonneau is a member of the Board of Examiners of the Corporation of Professional Engineers of Quebec, and is active on other committees of the Corporation. He has also served on the executive of the Quebec branch of the Engineering Institute for a number of years.

F. G. East, M.E.I.C., vice-president and general manager of Hamilton Gear and Machine Co. Ltd. of Toronto, has been awarded one of the 1954 Machine Tool Awards presented by the American Society of Mechanical Engineers for the best two original papers submitted by its members on a general subject of machine tool design.

Mr. East has been with Hamilton Gear and Machine Co. Ltd. since 1924. His first three years of work involved the design of gears and gear drives, while the next three years were occupied with the design and production of speed reduction units with the necessary production jigs, fixtures, and tooling, as well as the setting up of procedures in connection with these operations.

From 1928 until 1931 he was in charge of the design of worm gear speed reducers and special gear units. As assistant to the chief engineer, which position he held until 1939, he was responsible for the design of all standard worm herringbone, motorized, and special gear units, and also supervised the construction of special machine tools for the company plant.

During World War II Mr. East had the vital task of handling production of military tank transmissions, designing special tools, jigs, and gauges, along with the machine tools necessary for their production.

Born in Toronto in 1908, he was educated in the public and technical schools in that city and specialized in machine design in his preparatory study.

He joined the A.S.M.E. in 1930 and has served as chairman of the Ontario Section as well as a member for many years of the executive and other local committees of the Society.

He is a member and serves on various technical committees of the Association of Professional Engineers of Ontario, the Canadian Standards Association, the American Standards Association, the American Society for Metals, and the American Gear Manufacturers Association.

Major-General H. F. G. Letson, C.B., C.B.E., M.C., E.D., M.E.I.C., former commander of the Canadian Army staff in Washington, and adjutant general in the Department of National Defence headquarters in Ottawa, has been appointed adviser to the chief of the general staff at Ottawa in Canadian Army (militia) matters. General Letson previously had been a member of the special committee appointed on the recommendation of the Conference of Defence Associations to investigate and report on the Canadian Reserve Army. Among the many responsibilities pertaining to his new appointment, General Letson is to find ways of creating a greater public interest in the activities of Canada's militia. This will involve the promotion of more enlistments of Canada's young men and also endeavouring to interest more professional men in making their services available to the appropriate branches of the Canadian Militia.

Lieutenant Colonel W. S. Hunt, M.E.I.C., former staff officer in Ottawa, is now attached to the Canadian Army staff in Washington, D.C.

A chemical engineering graduate of McGill University of 1936, Col. Hunt returned from overseas duty in 1945 to accept an appointment to Canadian staff college at R.M.C. Two years later he became commanding officer of the R.C.E.M.E. school at Barriefield, Ont. He received the staff appointment in Ottawa in 1950.

A. F. Paget, M.E.I.C., formerly deputy comptroller of the water rights branch of the British Columbia Department of Lands and Forests, has been appointed comptroller to succeed the late E. H. Tredcroft.

A. F. Paget, M.E.I.C.

Mr. Paget was associated with Canadian Pacific Railways from 1923 until 1931, and in 1935 he was appointed superintendent and manager for Keremeos irrigation district where he remained until 1941. He served for four years with the Royal Canadian Engineers as works officer and district engineer officer. During 1946-1947 he was assistant city engineer and building inspector for the City of Vernon, after which he joined the water rights branch of the Department of Lands and Forests as assistant engineer. He became district engineer at Kelowna, B.C., previous to his appointment as chief engineer of the branch.

A member of the Association of Professional Engineers, Mr. Paget is also a member of the Western Snow Conference and is serving on several government boards including the Dominion-Provincial Board of the Fraser River Basin, the Dominion-Provincial Co-ordinating Committee and the Columbia Basin Board.

A. H. Mingail, M.E.I.C., has joined the engineering department of Robertson-Irwin Limited in Hamilton.

A 1942 graduate in electrical engineer-

ng of the University of Calcutta, Mr. Mingail was previously associated with the Verity works of the Massey-Harris Company in Brantford, and with the planning, estimating and control department of the India General Navigation and Railway Co. Ltd. in Calcutta.

T. W. Birt, M.E.I.C., has been appointed assistant manager of operations for the Winnipeg Electric Company in Winnipeg. He was previously manager of the contract department.

Mr. Birt, a graduate in electrical engineering of the University of Manitoba of 1938, served as wing commander with the Royal Canadian Air Force from 1941 until 1945.

R. J. Cupit, M.E.I.C., formerly chief engineer with the machine division of Northwest Industries Ltd. in Edmonton, has joined Standard Iron and Engineering Works Ltd. in Edmonton as contract engineer on plate and tank work.

A mechanical engineering graduate of Derby Technical College, class of 1946, Mr. Cupit was a former design engineer with Dominion Bridge Co. Ltd. in Montreal.

W. S. Allen, M.E.I.C., has been transferred by Racey, MacCallum and Associates Limited from Montreal to Toronto.

Mr. Allen received his B.Sc. degree in civil engineering from Queen's University, Belfast, in 1943.

P. A. E. Hess, M.E.I.C., formerly construction project engineer with the Hydro-Electric Power Commission of Ontario, has been appointed chief engineer with Don Mills Developments Limited in Don Mills, Ont.

Mr. Hess is a member of the Institution of Civil Engineers and the Institution of Mechanical Engineers.

J. W. Suthren, M.E.I.C., has been promoted from the position of works engineer to that of assistant works manager in the plastics department of Canadian Industries (1954) Limited in Edmonton.

Mr. Suthren, a 1936 mechanical engineering graduate of McGill University, has been associated with Canadian Industries Limited in Brownsburg, Que., Montreal, Hamilton and Edmonton.

Benoit Baribeau, M.E.I.C., formerly with Surveyer, Nenniger and Chenevert in Montmorency, Que., is now associated with Defence Construction Limited in Montreal.

Mr. Baribeau received his B.A.Sc. degree in civil engineering from Ecole Polytechnique in 1943.

Elie I. Rubinsky, M.E.I.C., is district engineer with Raymond Concrete Pile Co. Ltd. in Montreal. Previous to joining the company he was associated with T.M.C. Canada Ltd. in Ottawa.

Mr. Rubinsky received his B.Sc. degree in civil engineering from the University of Beirut in 1947 and his M.Sc. degree from Harvard University in 1951.

J. H. Hole, M.E.I.C., has been transferred by Canadian General Electric Company Limited from Calgary to Montreal where he is manager of utility, marine and transportation sales. While in Calgary he was manager of the Alberta district apparatus division.

Mr. Hole is a 1938 electrical engineering graduate of the University of Alberta.

P. C. Perry, M.E.I.C., has retired from his position as district engineer of Canadian National Railways in Saskatoon and is now residing in South Burnaby, B.C.

Mr. Perry has been associated with the company since 1920, previous to which he served as resident engineer with the Grand Trunk Pacific Railway in various capacities since 1906.

J. G. Dickinson, M.E.I.C., is manager of marketing research with Northern Electric Co. Ltd. in Montreal.

A 1946 electrical engineering graduate of the University of Manitoba, Mr. Dickinson was formerly manager of the company's power apparatus sales in Winnipeg.

Joseph Brown, M.E.I.C., has been transferred to Imperial Chemical Industries of Canada Limited in Kingston from Canadian Industries Limited in Copper Cliff, Ont., where he served as works manager.

Mr. Brown is a 1943 mechanical engineering graduate of Detroit University.

John W. Demcoe, M.E.I.C., has been appointed operation assistant with Canadian National Railways in Montreal.

A 1939 graduate of the University of

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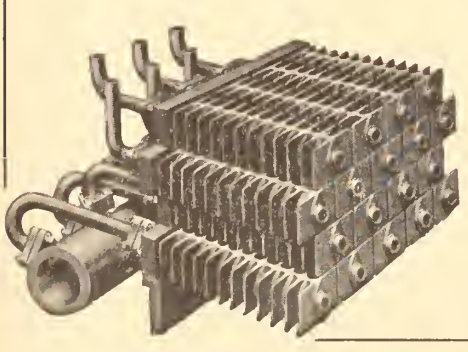

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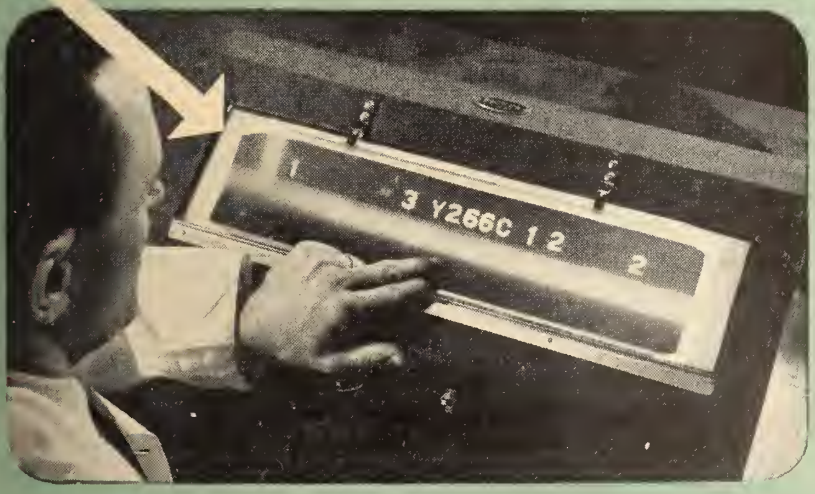

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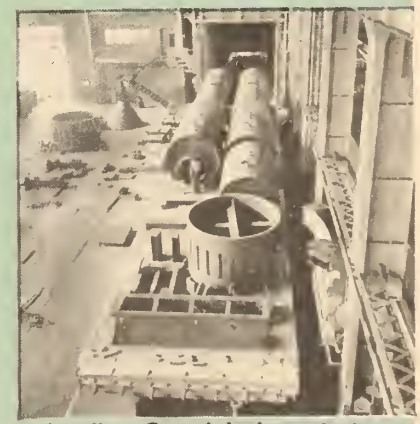

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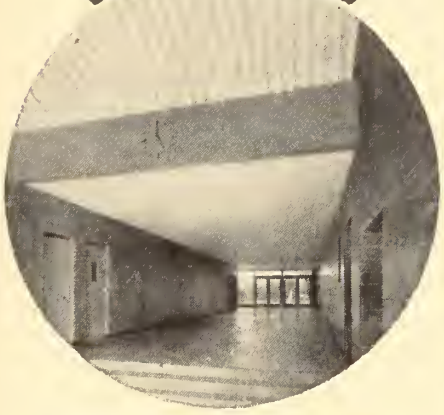

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Manitoba in civil engineering, Mr. Demcoe has been in the company's service since August, 1939, first as structural draughtsman in Toronto, then as instrumentman there. In 1942 he was appointed assistant engineer at the Toronto Terminals, and in 1944 at London, Ont. The following year he was named division engineer at Toronto Terminals and in 1946, engineer, maintenance of way, in Toronto.

Mr. Demcoe became superintendent at Hornpayne, Ont. in 1951 and at Montreal in 1953.

Previous to joining the company he was employed with the Ontario Department of Northern Development, the Department of Highways, and Bankfield Consolidated Gold Mines Ltd.

He is a member of the Association of Professional Engineers of Ontario, and of the American Railway Engineering Association.

Ernest E. Goldsmith, M.E.I.C., is on the staff of Carleton College as assistant professor of engineering.

A South African by birth, Mr. Goldsmith has been employed in South African gold mines, with Aluminum Company of Canada Ltd. as electrical engineer, and with Phillips Electrical Company in Montreal as electrical engineer in the sales division. From 1941 until 1950 he lectured on electrical engineering at the University of Witwatersrand in Johannesburg.

Mr. Goldsmith received his engineering degree from the Berlin Technical University in 1933. He is an associate member of the Institution of Electrical Engineers of Great Britain.

Remus Rodaru, M.E.I.C., former managing director of the Cardinal Engineering and Machinery Company in Montreal, has been appointed field manager and petroleum consulting engineer for Oka Oil Limited.

Formerly industrial division manager of Volcano Limited in Montreal and Ste. Hyacinthe, Que., Mr. Rodaru was for many years chief engineer for two important Rumanian oil fields where he gained wide experience in exploration, wellsite engineering, production and field management.

He gradnated in mining engineering from the Berlin-Charlottenburg Technical College in 1926.

Major J. W. MacNaughton, M.E.I.C., is now attending the R.C.A.F. Staff College in Toronto. He was previously stationed at Western Command headquarters in Edmonton.

Major MacNaughton received his B.Eng. degree in mechanical engineering from McGill University in 1941.

M. L. Coulson, M.E.I.C., is town engineer at Jasper Place, Alta.

A graduate in civil engineering of the University of Alberta, class of 1951, Mr. Coulson was previously project engineer with R. M. Hardy and associates, consulting engineers in Edmonton.

S. H. Hawkins, M.E.I.C., is on leave of absence from Defence Construction Limited to fill the position of project engineer on the P.F.R.A. Red Deer River project.

Resident engineer for Defence Construction Limited, Mr. Hawkins was associated for many years with the irrigation department of the Alberta Department of the Interior. He was district engineer for P.F.R.A. at Eastend, Sask. and Swift Current, Sask., and project engineer on irrigation work in Calgary previous to his appointment to Defence Construction Limited.

Robert Gordon Baird, M.E.I.C., has been appointed chief engineer of N. Slater Company Limited.

A graduate in electrical engineering of the University of New Brunswick, class of 1942, Mr. Baird was previously associated as engineer with the New Brunswick Electric Power Commission.

He is a member of the Association of Professional Engineers of Ontario.

T. J. Carbone, M.E.I.C., has recently resigned his position as municipal engineer for the Township of McKim (Sudbury) and has joined Johnson Bros. Co. Ltd. of Brantford, Ont. as chief engineer.

A 1934 civil engineering graduate of the University of Toronto, he was for some time chief engineer with Buffalo-Ankerite Gold Mines Ltd. in the Porcupine area.

W. Smith, M.E.I.C., formerly associated with Newfoundland Light & Power Co. Ltd. in Corner Brook, has been appointed commercial supervisor for the Edmonton district of Calgary Power Limited.

Mr. Smith was division manager of the Newfoundland company and had been employed previously with the National Light & Power Company, Moose Jaw, and with the Yellowknife Electric & Power Company, Yellowknife.

John Frisch, M.E.I.C., formerly of the Canadian International Paper Company in Hawkesbury, Ont., is now on the staff of Defence Construction (1951) Limited in Ottawa.

Mr. Frisch is a mechanical engineering gradnate of the Technical Institute of Horten, Norway, class of 1906.

Dr. William J. Gall, M.E.I.C., has resigned from the Aluminum Company of Canada, Limited, to accept the position of assistant to the general manager of Commercial Leaseholds Limited in Hamilton, specialists in the design, engineering and construction of indnstrial buildings.

A chemical engineering graduate of the University of Toronto, class of 1946, Dr. Gall was awarded the degree of doctor of natural sciences by the Swiss Federal Institute of Technology in 1950. Previous to joining the Aluminum Company in 1953 he was for three years scientific officer with the UNESCO secretariat.

Captain J. A. McKinnon, R.C.E.M.E., M.E.I.C., is associated with H.M.C. Dockyard at Esquimalt, B.C., where he is employed as an electrical draughtsman.

A graduate in electrical engineering of the University of Saskatchewan, class of 1949, Mr. McKinnon was formerly stationed at 214 Base Workshop in Vanconver.

E. R. Logie, M.E.I.C., has retired from the Quebec North Shore and Labrador Railway in Seven Islands, Que.

Previous to joining the Qnebec North Shore and Labrador Railway in 1951, Mr. Logie was chief engineer in the central region of Canadian National Railways in Toronto.

T. B. Webster, M.E.I.C., formerly design engineer in the engineering department

of Howard Smith Paper Mills Limited, has been transferred to Donnacona Paper Company Limited where he is now serving as assistant mill engineer.

He is a graduate in mechanical engineering of Queen's University, class of 1944.

Robert B. Walker, M.E.I.C., has been appointed factory engineer of B.A. Shawinigan Limited in Montreal.

A native of Buckingham, Mr. Walker received his general schooling there and at Glebe Collegiate, Ottawa, after which he obtained his B.Sc. degree in electrical engineering from Queen's University in 1949.

After two years with the Canadian General Electric Company, he joined Shawinigan Chemicals Limited in the mechanical maintenance division in 1951. In November, 1952 he was appointed mechanical supervisor in Montreal East.

Mr. Walker is a member of the Corporation of Professional Engineers of Quebec.

G. W. Flewelling, M.E.I.C., is officer commanding trade training for airframe and aero engine mechanics at the R.C.A.F. station in Camp Borden. He was formerly aeronautical engineering officer at Goose Bay, and officer in charge of servicing at Dorval.

Mr. Flewelling graduated in mechanical engineering from McGill University in 1950.

Jean Thibaudeau, JR.E.I.C., previously employed by the North Shore Construction Company, has joined the staff of the Mannix Construction Company in Cornwall, Ont.

Mr. Thibaudeau received his mining engineering degree from Ecole Polytechnique in 1948.

J. L. Greer, JR.E.I.C., has been transferred by Foundation Company of Canada Limited from Murdochville, Que., to Deep River, Ont.

Mr. Greer is a 1948 mechanical engineering graduate of the University of Saskatchewan.

W. C. Watt, JR.E.I.C., a 1948 gradnate in electrical engineering of the University of New Brunswick, has been transferred by the Shawinigan Water and Power Company from Shawinigan Falls to Three Rivers, Que.

Thomas G. Tustin, JR.E.I.C., has joined the St. Lawrence Seaway Authority as soils mechanics engineer.

A civil engineering graduate of the University of Alberta in 1948, Mr Tustin was previously associated with P.F.R.A.

John B. Carruthers, JR.E.I.C., formerly with the John Bertram & Sons Company in Dundas, Ont., has joined the electronics division of Canadian Westinghouse Co. Ltd. in Hamilton as manufacturing engineer.

Mr. Carruthers graduated in mechanical engineering from McGill University in 1948.

John L. McVittie, JR.E.I.C., has joined Manderbach Construction Company in Glendale, Cal., as estimator. He was previously associated as estimator with Pentagon Construction Co. Ltd. in Montreal.

Mr. McVittie received his B.Eng. degree in civil engineering from McGill University in 1949.

W. F. Patterson, JR.E.I.C., has been

transferred from Montreal to Toronto by Aluminum Company of Canada Limited as Ontario representative of the chemical sales division.

Mr. Patterson joined the Aluminum Company following his graduation in Chemical engineering from the University of Toronto in 1949.

S. P. Slinn, JR.E.I.C., a 1949 engineering graduate of the University of British Columbia, has been appointed manager of the Calgary office of H. F. Clarke & Company. He was formerly attached to the Royal Canadian Air Force in Trenton and Montreal.

Hans Schaeffer, JR.E.I.C., who graduated in 1949 in engineering from the Technical University of Vienna, is on the staff of Brett & Ouellette, consulting civil engineers in Montreal. He was previously office engineer with Wiggs, Walford, Frost & Lindsay, consulting engineers of Montreal.

W. A. Anderton, JR.E.I.C., has joined the naval research establishment of the Defence Research Board in Halifax. He was formerly associated with the Department of National Health and Welfare in St. Catharines, Ont.

Mr. Anderton graduated in chemical engineering from the University of Toronto in 1950.

Oliver C. Norris-Elye, JR.E.I.C., has been transferred as sales engineer by Canadian General Electric Company Limited from the Peterborough office to the apparatus division in Winnipeg.

Mr. Norris-Elye has served with the Royal Canadian Navy and with A. V. Roe Canada Ltd. since his graduation in electrical engineering from the University of Manitoba in 1950.

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Alex W. Rae, JR.E.I.C., has been transferred by General Foods Limited from Toronto to Montreal as project engineer.

A graduate of the Nova Scotia Technical College in mechanical engineering in 1949, Mr. Rae was previously associated with Engineering Industries Co. Ltd. as chief engineer.

P. Marcel Morency, JR.E.I.C., has been appointed eastern district engineer by Canada Wire and Cable Company Limited in Montreal.

P. Marcel Morency, Jr.E.I.C.

Mr. Morency joined the company upon graduation in electrical engineering from Laval University in 1950. In 1952 he was transferred from Toronto to Montreal and was subsequently named acting supervising engineer on the company's Rimouski cable project.

René Martineau, M.E.I.C., is president of Martineau & Associates Inc., a general contracting firm which he recently established with his associates in St. Laurent, Que. The new company is specializing in prestressed concrete work.

Before forming this company, Mr. Martineau was associated with The Key Construction Limited and Preload Company of Canada Limited of Montreal. He is a 1950 civil engineering graduate of Ecole Polytechnique.

John G. Melvin, JR.E.I.C., a 1950 mechanical engineering graduate of McGill University, has joined the staff of Atomic Energy of Canada Limited in Deep River, Ont. He was previously associated with Shell Oil Co. of Canada Ltd., as assistant preventive maintenance engineer in Montreal East.

P. C. Thompson, JR.E.I.C., is apparatus service engineer on the staff of the Ottawa district office of Canadian General Electric Co. Ltd.

Mr. Thompson received his electrical engineering degree from Queen's University in 1950.

Gudni Gunnarsson, JR.E.I.C., has been named plant superintendent of The Coldwater Seafood Corporation in Nanticoke, Maryland. He was previously associated with the Atlantic Fisheries Experimental Station in Halifax.

Mr. Gunnarsson received his B.Eng. degree in chemical engineering from McGill University in 1950, and his M.Sc. degree from the same university in 1952.

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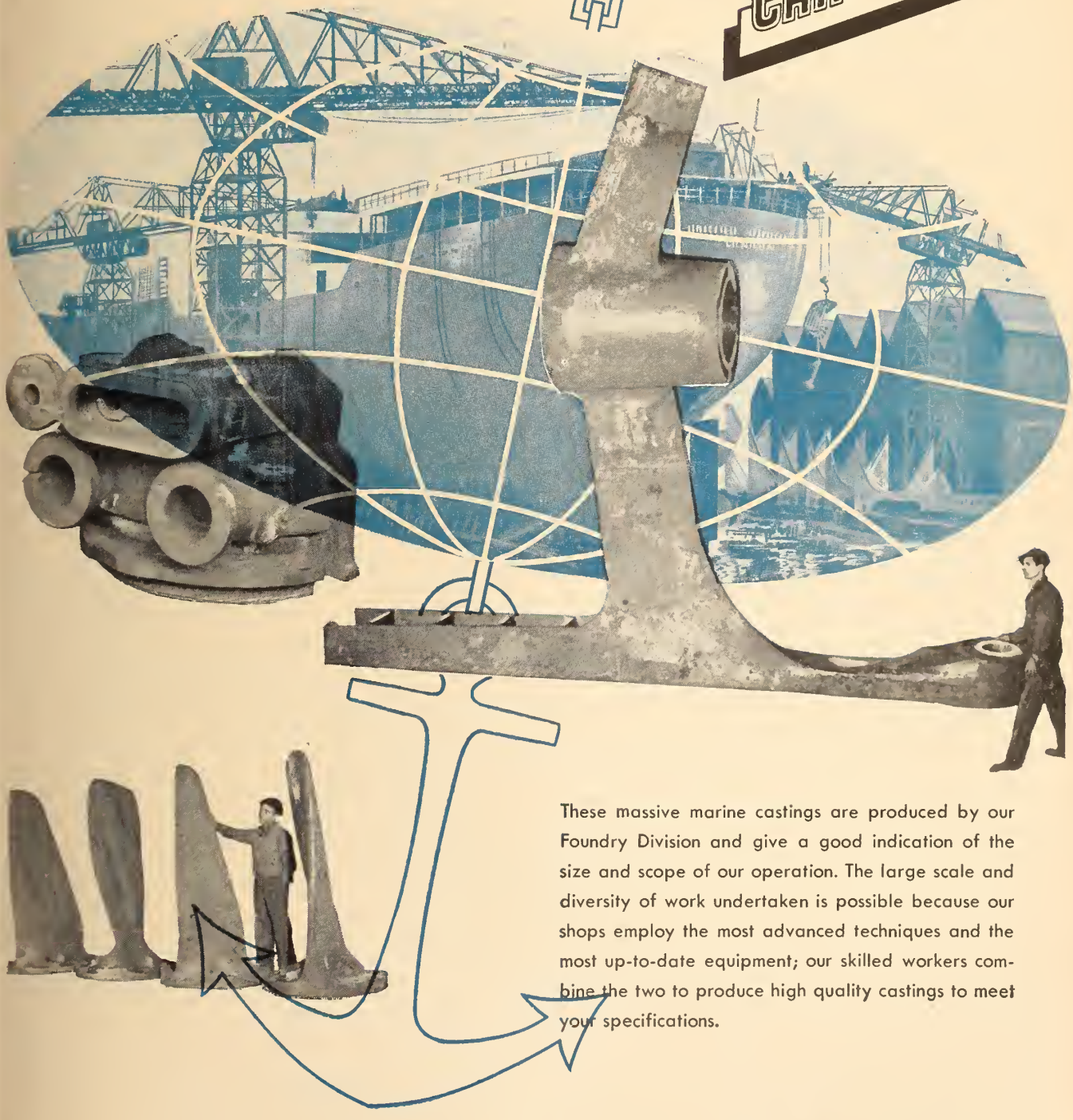

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V. R. Bowen, JR.E.I.C., has been appointed design engineer by Baker Perkins Inc. in Saginaw, Mich.

A 1950 graduate in mechanical engineering of the University of Toronto, Mr. Bowen was formerly engineering assistant with Canadian Industries Limited in Maitland, Ont.

J. F. Whitehead, JR.E.I.C., who received his B.A.Sc. degree in chemical engineering from the University of Toronto in 1950, is now associated with Gypsum Lime and Alabastine Company Canada Ltd. in Caledonia, Ont.

Previous to joining the company he was process control laboratory foreman with Canadian Industries Limited in Shawinigan Falls, Que.

J. V. Mole, JR.E.I.C., formerly on the staff of A. V. Roe Canada Ltd. in Malton, Ont., has joined the engineering department of Trans-Canada Air Lines at Dorval, Que.

Mr. Mole is a 1950 graduate of the University of Manitoba in electrical engineering.

A. P. Qually, JR.E.I.C., is now associated with J. M. J. Dyson & Company in Stannington, England. He has been technical engineer on the staff of Canadian SKF in Toronto since his graduation in mechanical engineering from the University of Toronto in 1950.

Gordon D. Campbell, JR.E.I.C., is now attending Purdue University where he is studying toward his Ph.D. degree in civil engineering under the auspices of the International Road Federation fellowship which was awarded to him by the Canadian Good Roads Association.

A civil engineering graduate of the University of Manitoba, class of 1951, Mr. Campbell was formerly on the staff of the Trans-Canada highway division of the Department of Public Works in Ottawa.

A. M. Parent, JR.E.I.C., is apparatus sales engineer with Bepco Canada Limited in Toronto.

Upon graduation in electrical engineering from the University of Manitoba in 1951, he completed the Canadian Westinghouse Co. Ltd. student training program, and afterwards joined Provincial Engineering Ltd. as a construction engineer. He entered Bepco Canada Limited a year later.

David G. Hunt, JR.E.I.C., is associated with the British Non-Ferrous Metals Research Association in London, England.

He is a graduate in engineering physics of the University of British Columbia in 1951.

D. J. Ross, JR.E.I.C., a 1951 graduate in civil engineering of McGill University, is on the staff of the Interprovincial Pipe Line Company in Glenboro, Man.

Gordon J. Stonehouse, JR.E.I.C., formerly designing engineer, signals, of the Grand Trunk Western Railroad Company in Detroit, has been promoted to the position of signal engineer.

A graduate in electrical engineering of the University of Manitoba, class of 1951, he was formerly associated with Canadian National Railways in Manitoba.

J. Relich, JR.E.I.C., has recently joined the staff of the technical department of Aluminum Company of Canada, Ltd. in Arvida.

A graduate of the Polish University College in chemical engineering in 1951, he was previously associated with Gypsum Lime and Alabastine Company Ltd. in Caledonia, Ont. and with Brunner Mond Canada Ltd. in Amherstburg.

B. Gardave, JR.E.I.C., has been appointed assistant professor on the staff of the school of commerce of the University of Alberta.

A B.Eng. graduate of McGill University, class of 1951, and a M.B.A. graduate of Harvard, class of 1953, Mr. Gardave was previously marketing assistant in the equipment division of Rogers Majestic Electronics Ltd. in Toronto.

J. J. P. Roberton, JR.E.I.C., has been transferred by the Canadian Pratt. & Whitney Aircraft Company in Longueuil, Que., to Woodridge, N.J. as the company's representative at the Wright Aeronautical License division.

He is a graduate in mechanical engineering of McGill University, class of 1951.

H. A. Dare, JR.E.I.C., has been transferred by Aluminum Company of Canada Ltd. from Sprostons (Jamaica) Ltd. in Shooters Hill, Jamaica, to the head office in Montreal where he will be employed in cost estimating and cost analysis.

Mr. Dare graduated in civil engineering from the University of British Columbia in 1951 and shortly afterwards became associated with Sprostons Ltd. in Mandeville, Jamaica.

Douglas Brouse, JR.E.I.C., who has been assistant city engineer in Guelph for the past three years, is now associated with the G. M. Guest contracting firm in Toronto.

Mr. Brouse, a 1951 graduate of Queen's University in civil engineering, joined the Guelph city engineering staff immediately afterwards.

Selby H. Noel, JR.E.I.C., formerly with Canadian National Railways in Moncton, N.B., has been transferred to the Newfoundland district. In his new position he is assistant mechanical engineer, motive power and car equipment department, in St. John's.

Mr. Noel is a 1952 mechanical engineering graduate of the Nova Scotia Technical College.

Walter G. Lunick, JR.E.I.C., is employed in industrial engineering formation for the Luxite Lingerie of Canada Ltd. factory in London, Ont.

A graduate in mechanical engineering of the University of Montreal, class of 1952, he was previously time study methods engineer with Canadian Acme Screw & Gear Products, Toronto.

Eric W. Spurrell, JR.E.I.C., has joined Montreal Engineering Co. Ltd. in Montreal. He has been recently associated with the Department of Transport in Ottawa.

Mr. Spurrell is a 1952 electrical engineering graduate of the Nova Scotia Technical College.

D. Bishop, JR.E.I.C., has been transferred from Shawinigan Falls to Beauharnois by Aluminum Company of Canada Ltd. where he has been appointed supervisor of the potrooms.

Mr. Bishop graduated in 1952 from the University of Toronto in electrical engineering.

A. Keith Dixon, JR.E.I.C., of the circuit breaker engine department of English Co. Ltd. in St. Catharines, has been awarded a diploma in business management by LaSalle Extension University of Chicago. He is a 1952 gold medal graduate in electrical engineering of the University of Manitoba, and has been with English Electric Co. Ltd. since that time.

S. R. Leavitt, S.E.I.C., a 1954 chemical engineering graduate of McGill University, is employed as staff engineer in the reduction division of Aluminum Company of Canada Limited at Shawinigan Falls.

H. B. Kolm, S.E.I.C., is on the teaching staff of the mechanical engineering department of the Massachusetts Institute of Technology, and is at the same time studying toward a master of science degree.

Mr. Kolm graduated from the Nova Scotia Technical College in mechanical engineering in 1953.

David Margolese, S.E.I.C., who received his B.Sc. degree in civil engineering from the University of Manitoba in 1953, is on the staff of the Department of Highways in Swift Current, Sask.

J. R. Raymond, S.E.I.C., is planning engineer in the department of development of the Municipality of the Township of Toronto, and is also secretary-treasurer of the Industrial Commission.

A 1953 civil engineering graduate of the University of Toronto, Mr. Raymond was previously with the Department of Development in Cooksville, Ont.

Alexander Gordon Macdonald, S.E.I.C., a 1953 graduate in electrical engineering of McGill University, has joined the staff of Harrington Tool and Die Co. Ltd. in Lachine, Que.

J. G. B. Iliffe, S.E.I.C., has been on the staff of the production division of the Winnipeg Hydro-Electric System since his graduation in electrical engineering from the University of Manitoba in 1953.

E. J. Klein, S.E.I.C., a 1953 graduate in electrical engineering of the University of Manitoba, has joined Cotter Bros. Limited, engineering contractors in Winnipeg where he is specializing in industrial design, layouts and estimates.

He was previously electrical engineer with Canadian National Railways in Winnipeg.

Jean-Aimé Desjardins, S.E.I.C., a 1954 civil engineering graduate of McGill University, has been appointed assistant engineer by the City of Hull, Que.

B. Gjervan, S.E.I.C., has been transferred as assistant civil engineer from Burnaby, B.C., to Regina by The Fluor Corporation of Canada Limited. Previous to joining the company, he was associated with Northern Construction and J. W. Stewart Limited in Trail, B.C.

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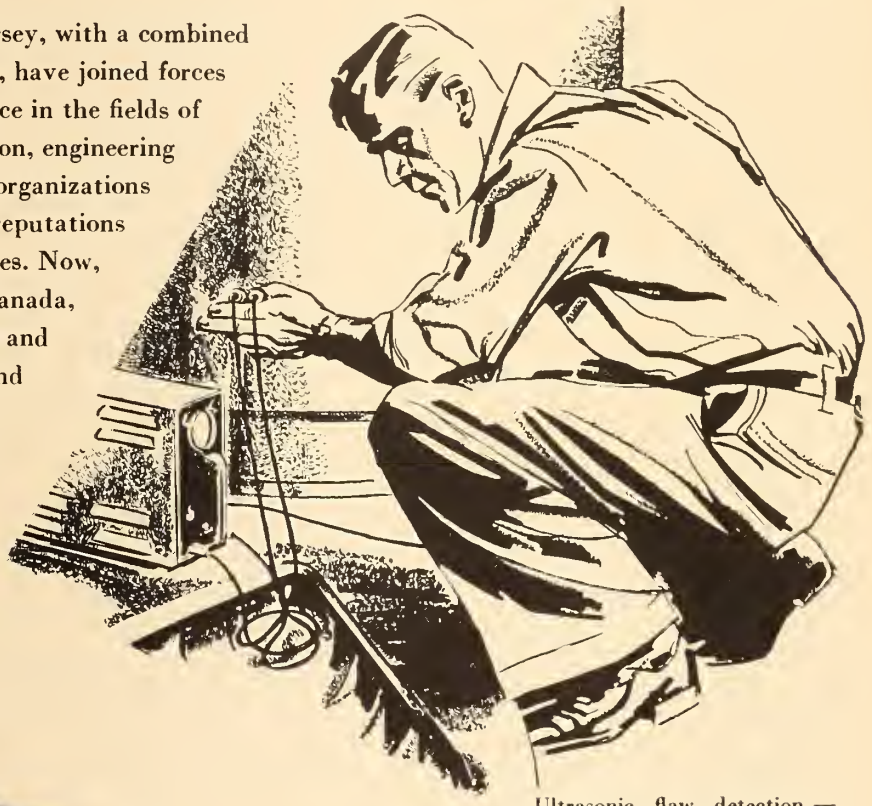

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Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Wallace Rupert Turnbull, Hon.M.E.I.C., internationally known scientist, inventor and pioneer in aeronautics, passed away in the Saint John, N.B. General Hospital on November 26, 1954.

Mr. Turnbull was born in Rothesay, N.B., in 1870. He attended the Grammar School in Saint John, N.B., and graduated with an M.E. degree in electrical engineering from Cornell University in 1893. After two years' post-graduate work at Cornell and at the University of Berlin, he was employed as research engineer with General Electric Company Limited in Harrison, N.J., from 1896 until 1901. During this period he frequently corresponded with Dr. Samuel Langley who first formulated the theory of flight, with Otto Lilienthal who experimented with gliders in 1896, and with Gustav Eiffel who built the first wind tunnel.

W. R. Turnbull, Hon.M.E.I.C.

In 1902 Mr. Turnbull's interest in the subject of "heavier-than-air" flight led him to resign his position and to establish his own laboratory in a 24 x 28-foot barn in Rothesay, N.B. Here 14 years of brilliant progress in the field of aeronautical research won him recognition as a pioneer in this new science. From an old packing case he built the first wind tunnel in Canada in 1902, using it for tests on the properties of aerofoils. Passing on to experiments with scow type hydroplanes driven by air propellers, he constructed a 375-foot experimental track for testing airscrews in the open — the first in aviation history in which power absorbed by the airscrew was compared with the power delivered. The results, published in the *Scientific American* on April 3, 1909, won him a bronze medal and a fellowship in the Royal Aeronautical Society. He was one of three or four fellows of the Society in Canada, and the only medallist.

In 1914 he closed his laboratory and went to Britain where he engaged in the design of various wartime devices such as air propellers, bomb sights, and torpedo screens. Returning to Canada in 1918, he continued his work on the development of a controllable pitch propeller, begun in 1916 while he was overseas. Because his first idea of mechanical brake control, attempted in 1923, turned out to be impractical, he sought a solution for changing the pitch of the blades by an electrical control. A second model working on this principle was developed and built by Canadian Vickers Limited and was successfully tested at Camp Borden in 1927. Patents on the Turnbull controllable pitch propeller were taken out in Britain by the Bristol Aeroplane Company, and in America by the Curtis Wright Corporation. Today every propeller type aircraft aloft uses this control device — a small metal cylinder at the hub of the blades — for changing the pitch of the blades.

He also conducted research on wing surfaces, patenting the double curvature wing surface. But his greatest contribution to flying, according to the experts, lies in the field of pure science, rather than in his inventions. For example, his two fundamental laws of aerodynamics put forward in 1912 completely changed the youthful air science upon their publication. He gave the world new data on the principles of the flying machine, on the lift of a wing, on drag forces, and on centre of pressure. Another discovery in the realm of pure science was announced in 1911. His "Laws of Airscrews," published in the *Aeronautical Journal* of January of that year, announced the discovery of the now well-known laws of air propellers.

During his four years in Britain, he observed with great interest three small mills that operated with power produced from the tides. He read all available reports on proposals for large tidal plants in the Bristol Channel, Menai Straits, and Chichester Harbour. Wondering if this were the perfect answer to the shortage of water power in the Maritime Provinces, on his return to Canada in 1918 he set to work at once on a plan for harnessing the tides of the Bay of Fundy at the confluence of the Petitcodiac and the Memramcook Rivers where they enter Shepody Bay. He presented a paper on this subject before a general professional meeting of the Engineering Institute of Canada at Saint John in September, 1919. Published in the October *Journal* of that same year, the paper won widespread attention.

Apart from his independent research, Mr. Turnbull was consulting engineer and director of the Petitcodiac Tidal Power Company, director of the Turnbull Real Estate Company, president for ten years of the board of the Turnbull Home for Incurables, and an active worker in the Red Cross. In his laboratory his work schedule was geared to 14 hours a day, and even in recent years, he averaged eight hours of work daily.

In 1942 he was awarded a doctorate of science by the University of New Brunswick, and one year later his first controlled-pitch propeller model was given a permanent home in the National Aeronautical Museum in Ottawa, after being on display at the Science Museum in London, England.

Mr. Turnbull joined the Engineering Institute of Canada as a Member in 1944. He was elected to Honorary Membership in 1951.

John Armistead Wilson, C.B.E., M.E.I.C., former director of air services of the Department of Transport, and regarded by many as "the father of civil aviation in Canada," passed away suddenly on October 10, 1954.

Mr. Wilson was born at Broughty

J. A. Wilson, M.E.I.C.

Ferry, near Dundee, Scotland, on November 2, 1879. He was educated at the Dundee High School, the University College and St. Andrew's University, after which he served four years' engineering apprenticeship with Jas. Carmichael and Sons Limited, engineers and boilermakers in Dundee.

In 1900 he became associated with Fairbairn Macphersons Limited in Leeds, England, and the following year was appointed engineer at the Union Standard Mills of Bird and Company in Calcutta, India.

He came to Canada in 1905 and for the next two years was assistant engineer on the construction of the Canada Cement plant at Exshaw, Alta. He was next appointed assistant engineer on the reconstruction of the cement works in Hull, Que. In 1908 he entered private business, and two years later was appointed director of stores and contracts in the newly-formed Department of Naval Services. From 1910 until 1918 he was a lieutenant and later, adjutant of the Governor General's Foot Guards. In 1918 he was appointed assistant deputy minister of Naval Service with special direction of organization of the Royal Canadian Naval Air Service and construction of naval air bases at Dartmouth and Sydney, N.S.

At the request of the minister of reconstruction in February, 1919, Mr. Wilson drafted the Air Board Act (now the Aeronautics Act), the original statute providing for the administration of aviation, civil and military, in Canada. In June of that year he was appointed a member of the original Air Board.

From 1920 until 1923 Mr. Wilson served as secretary of the Air Board with supervision of civil aviation. Then followed his appointment as secretary and assistant director of the Royal Canadian Air Force, with duties which also included the same civil aviation functions. In 1929 he was named controller of civil aviation in the Department of National Defence and later in the Department of Transport.

Mr. Wilson was appointed one of the government directors of the board of Trans-Canada Air Lines in 1937. In February, 1941 he was named director of air services with the responsibility of all civil aviation, aviation radio and meteorological services. He was appointed a member of the Canadian delegation to the International Conference on Civil Aviation in Chicago in 1944, and the following year visited Australia and New Zealand at the invitation of these governments to inspect air bases, aircraft factories and radio and meteorological stations in both countries. He retired from active work in 1945.

An appraisal of his role as a builder of Canadian airways was given by a national magazine in 1945:

"With foresight and dogged determination, from the end of World War I and through the lean years of depression, the years when the world wouldn't admit what Germany was up to, J. A. Wilson pushed and shoved and tugged . . . always to further the air development of Canada. . . . In the Trans-Canada Air Lines, the Commonwealth Air Training Scheme and the Northwest Staging Route, in the Ferry Command routes through Goose and Gander, Canada and the United Nations cashed in on his long view and his unswerving diligence."

Mr. Wilson was awarded the Julian C. Smith Medal of the Engineering Institute of Canada "for services in the development of Canada" in 1944, and the McKee Trans-Canada Trophy "for meritorious service in the development of Canadian aviation" in 1945. In 1945, also, he was created a Commander of the Order of the British Empire for "services in Canada's aviation war effort" and in 1948 he was awarded the Medal of Liberation by King Haakon VI of Norway.

Mr. Wilson was a past-president of the Ottawa branch of the Canadian Institute of International Affairs. He was honorary president of the Royal Canadian Flying Clubs Association, and vice-president of the Canadian Geographical Society.

He joined the Engineering Institute as an Associate Member in 1910, transferring to Member in 1936. In January, 1947, he attained Life Membership in the Institute.

Kenneth Lockhart Dawson, M.E.I.C., statistical officer with the Nova Scotia Light and Power Company, passed away at the Victoria General Hospital in Halifax on November 18, 1954.

Mr. Dawson was born in Halifax on January 7, 1893. After completing arts and commercial courses at Mount Allison University, he became associated with the Canadian Pacific Railway Company in Calgary and West Canadian Collieries, Limited in Blairmore, Alta. During the summer months of 1913 and 1914 he was employed by the Frank and Grassy Mountain Railroad, and J. S. Metcalf Company Limited in Montreal. In the summer 1916 he became instrumentman and draughtsman with consulting engineer W. E. Barrett on the construction of the new gas works for the Nova Scotia Tramways and Power Company in Halifax. He received his civil engineering degree from the Nova Scotia Technical College in 1917 and that year joined Nova Scotia Light and Power Company Limited as assistant superintendent of the gas department.

As assistant superintendent of the company's gas department, Mr. Dawson was in charge of starting and operating the equipment for working up tar and ammonia by-products; for installing a new system of plant records, and for developing accurate plans of gas mains and services. In 1919 he was appointed assistant superintendent of the gas department in charge of gas works operation and maintenance, and in 1925 he was named superintendent of the gas department. Three years later he became sales manager in addition to his position of department superintendent. At the time of his death he was statistical officer for the company.

Mr. Dawson was a past-president and honorary member of the Canadian Gas Association. He served as chairman of the Engine Operators' Board under the Department of Labour and wrote the Engine Operators' Act and Regulations. He was a member of the Association of Professional Engineers of Nova Scotia; and in March, 1954, was one of nine in the United States and Canada to attend a meeting of the statistical branch of the Edison Electric Institute in New York.

Mr. Dawson was an active member of the Engineering Institute. He served as secretary of the Halifax Branch for several years, and represented that branch on the Council in 1927. He was awarded the Plummer Medal of the Institute for his paper, "Notes on Removal of Carbon-Sulphur Compounds from Coal Gas by Oil Washing," which he delivered at the annual general and professional meeting in Montreal on February 16, 1928.

He joined the Engineering Institute as a Junior Member in 1919, becoming an Associate Member in 1921, and a Member in 1929.

Heber P. Sisson, AFFIL.E.I.C., former assistant division engineer with the Ontario Department of Highways in Port Arthur, Ont., passed away suddenly on October 7, 1954.

Mr. Sisson was born at Bethany, Ont., on December 20, 1883. He received his early education at the Port Hope High School, and completed his highway engineering training through private study. After a brief teaching career, he joined the Department of Public Works in 1908, and from that time until 1922 was overseer in charge of roads and bridges. He was then placed in full charge of bridge work for the Department's Thunder Bay district. When the Departments of Public Works and Northern Development were amalgamated in 1923, Mr. Sisson was appointed inspector of roads and bridges for the districts of Port Arthur and Fort William.

The Department of Highways took over the Department of Northern Development several years later and Mr. Sisson was made assistant division engineer, which post he held until his retirement in the spring of 1954.

During the past few years Mr. Sisson's work was mainly devoted to bridges and public parks. He supervised the building of Bailey bridges across the Steele River and Little Pic River between Terrace Bay and Marathon.

Mr. Sisson was a member of the Association of Professional Engineers of Ontario, and of the Quarter Century Club, Civil Service Employees. He was a charter member of the Thunder Bay District Municipal League, and a member of the Thunder Bay Historical Society.

He joined the Engineering Institute as an Affiliate Member in 1936.

Leo Robitaille, JR.E.I.C., office engineer with Geo. Demers, construction engineers, in Quebec City, passed away in September, 1953.

Born in Quebec City on January 20, 1926, Mr. Robitaille received his general schooling at Ste. Anne de la Pocatière and at Laval University where he received his B.A. degree. Upon completion of two years of study at the school of science at Laval, he entered Ecole Polytechnique where he obtained his B.A.Sc. degree in civil engineering in 1951.

Previous to graduation, Mr. Robitaille served with the Royal Canadian Engineers as a lieutenant. In 1948 he was assistant engineer with McNamara (Cartier) Construction Company, and in 1949 was associated with the Department of Mines.

Upon receiving his degree in engineering, he joined the staff of Geo Demers.

Mr. Robitaille joined the Engineering Institute as a Student in 1950 and transferred to Junior Member in 1953.

Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS VACANT

CHEMICAL

GRADUATE CHEMICAL ENGINEER from Canadian University required by manufacturer of organic chemical products. Attractive opening in new project located in Ontario. Seven years of practical experience production and process development is required. File No. 4900-V.

CHEMICAL ENGINEER or chemist with experience in analysis of metals. Working knowledge of spectographic techniques and practical physical chemistry preferred. Qualified to set up and operate laboratory for control of foundry analysis. File No. 5026-V.

TWO SALES ENGINEERS wanted with plant maintenance experience to sell corrosion resistant cements, coatings, pipes, tanks, etc. We prefer chemical engineers and require one each for Quebec and Ontario. Salary and expenses plus profit sharing. File No. 5071-V.

INTERNATIONAL MANUFACTURER expanding its research facilities in Canada requires a competent paper engineer for research and development work on pulp, fine papers, paper specialties and shipping containers. This position with a future is open only to graduate chemical engineers from a recognized university who have at least three years industrial experience in pulp and paper. Remuneration will be negotiated. Replies will be given all applicants who send a complete resume of their educational background, work ability, personal data and references and a recent photograph. File No. 5083-V.

CHEMICAL ENGINEER or chemist, required preferably with experience in paint printing inks, rubber or plastics industries. To sell chemicals, oils and colours in Toronto district. Apply fully in writing to file No. 5084-V.

CIVIL

CIVIL ENGINEER required for power department of large industrial concern. Duties include office duties and occasionally field work not necessarily in Canada, in the field of hydro-electric power investigations and development. Applicants must have had fifteen years previous experience. Fluency in French or Spanish in addition to English essential. File No. 4997-V.

ASSISTANT MUNICIPAL engineer for the Town of Pointe Claire, P.Q. Population 12,000. Preferably with experience in maintenance and construction of streets surface water drainage, sewage and watermains. Applicants will require to state qualifications and salary expected. File No. 4999-V.

YOUNG CIVIL ENGINEER required with 3 years or so experience in construction, to supervise service station construction. Location Ontario. File No. 5003-V.

CONSTRUCTION ENGINEER to act as general superintendent for a rapidly expanding organization of general contractors in Toronto. Minimum 10 years outside experience as general superintendent. Main requisite practical experience. This position is that of assistant to general manager, and carries excellent salary and opportunity for right man. Please reply in confidence stating age, marital status, previous employer and references. File No. 5005-V.

THE CITY OF HAMILTON requires an assistant engineer. Must be a professional engineer holding a degree of civil engineering as recognized under the Professional Engineers Act of Ontario. Applicant should have a minimum of ten years experience in the design, construction and supervision of engineering projects particularly as related to a large municipality. Will be required to assist and to work in close co-ordination with the city engineer. This position offers an attractive salary, future security and an opportunity for advancement. Reply stating age, experience, education, and relevant information. File No. 5009-V.

PROFESSIONAL ENGINEER for position of manager of moderate sized construction company. Broad experience in estimating, construction and installation supervision essential. Age in mid forties to work from Toronto office serving mining and newsprint industries across Canada. File No. 5010-V.

RECENT GRADUATE CIVIL engineer required in the track section of a large transportation company in Montreal. File No. 5011-V.

STRUCTURAL DESIGN ENGINEER $6,420 to $7,200 department of Public Works, Ottawa. Details and application forms at nearest Civil Service Commission Office, Post Office or National Employment Office. Quote Competition 54-1259. File No. 5015-V.

GRADUATE CIVIL ENGINEER for responsible duties in connection with hydraulic research on a large, outdoor erodible-bed tidal river model of the Fraser River estuary on the campus of the University of British Columbia. Must be able to carry out tests, analyze results and prepare engineering reports. Problems deal mainly with river regulations and the maintenance of navigable channels. Reply stating age, experience, education, salary expected. File No. 5017-V.

CIVIL ENGINEER required by pulp and paper company situated in the Maritime Provinces. He will be in charge of lay-out in the field and also design and draughting in the office. File No. 5053-V.

CIVIL ENGINEERS are required for assignment in numerous fields including structural design, hydraulics, hydrometrics, public health engineering, highway construction, general engineering, surveying. Civil Service Commission, Ottawa, File No. 5066-V.

SENIOR STRUCTURAL ENGINEER. Rapidly expanding structural consulting firm offers excellent opportunities to experienced senior and intermediate engineers who must have first class qualifications, references and a high degree of intelligence. There are responsible positions offering excellent remuneration to capable and ambitious persons. Those confident of their ability should reply. File No. 5069-V.

ELECTRICAL

AN OTTAWA ORGANIZATION requires research engineers to investigate problems in the practical application of electric thermal aircraft de-icing. This will include tests in flight and in icing tunnels, and the development of heater pads, and control in co-operation with aircraft firms. University graduation in electrical engineering with experience in aeronautical engineering and preferably in aircraft electric design and development is required. Flying experience is desirable. Salary up to $5,750. per annum depending on qualifications. Apply by letter and enclose resume of qualifications and experience. File No. 4996-V.

ELECTRICAL ENGINEER required by an Eastern Township paper mill. Recent graduate for layout work, procurement and installation of apparatus for paper mill under supervision of superintendent, apply stating age, qualifications and experience. File No. 5019-V.

GRADUATE ELECTRICAL ENGINEER to work in electrical department of paper mill in the Province of Quebec as assistant to the electrical superintendent. Paper mill experience desirable but not prerequisite. Applicant to write giving age, education, experience and salary requirements. File No. 5027-V.

ELECTRICAL SALES ENGINEER required by manufacturer of switchboards high and low tension, panelboards, bus ways and switches to cover Toronto district. Opportunity for the right man to become district sales manager. File No. 5031-V.

YOUNG ELECTRICAL ENGINEER to be employed as sales engineer in the storage battery division of manufacturer located in Montreal. File No. 5038-V.

TWO COMPETENT EXPERIENCED GRADUATE electrical engineers with approximately 10 years experience U.S. or Canadian public utilities, in design, operation and maintenance of distribution facilities in established rapidly growing utility located South America. Reply giving resume education, experience, and personal data. File No. 5041-V.

ELECTRICAL ENGINEER required as

National Research Council, Canada

DIVISION OF BUILDING RESEARCH

Applications are invited from

CIVIL AND MECHANICAL ENGINEERS

preferably with a few years of relevant experience and with good academic records for positions as

RESEARCH OFFICERS

for work in the following fields:

CONSTRUCTION

To work on the dissemination of technical information to the construction industry and to study in the field new materials and techniques as used in construction. The ability to write clear reports to bridge the gap between research and industry is important.

HOUSING

To undertake studies leading to the specification and assessment of materials and components for application in housing. Opportunities for study of the technical aspects of house construction will be provided.

Salary will depend on training and experience. Applications with full details of education and experience should be sent to the:

Employment Officer,
National Research Council,
Ottawa 2, Canada.

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junior or assistant distribution engineer. Graduate with at least 3 years field experience, operating U.S. or Canadian public utility. Permanent position with long established consulting organization New York. Some travel Latin America necessary in future. Knowledge of Spanish or Portuguese useful. Salary commensurate with experience. Reply giving age, education experience and personal particulars. File No. 5042-V.

FIVE JUNIOR ELECTRIC ENGINEERS required by Western Utility. Two engineers for hydro-generating stations, one engineer for communications and relay and plant metering, one engineer for sub-station and local distribution systems, and one engineer for system planning and design division. File No. 5044-V.

ELECTRICAL ENGINEER required by transformer manufacturing company in Manitoba. Applicants should have a degree in electrical engineering preferably from a Canadian University, be interested in design work and have worked for a utility or manufacturing company for one or two years. Reply giving details of experience, age, qualifications and proposed salary. File No. 5048-V.

ELECTRICAL DEVELOPMENT engineers to work on aircraft electrical systems, ignition units, DC generators, rotary converters and various small aircraft electrical apparatus. Require a degree in electrical engineering or equivalent plus two to 4 years industrial experience preferably in aircraft field for expansion programme of light engineering company manufacturing aircraft engine components, located in Ontario. Reply giving full particulars, stating approximate salary required. File No. 5051-V.

ELECTRICAL DESIGN ENGINEERS to do layout of aircraft electrical machines from design data and to produce wiring diagrams to design AC and DC generators and motors, regulators and protective devices. Require a degree in electrical engineering or equivalent plus 2 to 4 years industrial experience preferably in aircraft field, for expansion programme of light engineering company manufacturing aircraft engine components. Location Ontario. Reply with full particulars, stating approximate starting salary. File No. 5051-V.

AN ELECTRICAL ENGINEER required to design telephone cable. Prefer an experienced man but will be pleased to review applications from anyone interested in learning this field. Permanent position and salary will depend upon experience and qualifications. Location Ontario. File No. 5052-V.

ELECTRICAL ENGINEER required in Edmonton, Alberta, who has graduated from a recognized Canadian university, and who has 3-10 years industrial experience in a chemical plant or refinery. He will deal mostly in equipment used in the manufacture of petro chemicals and synthetic fibres. Duties will include design, layout and estimating. File No. 5057-V.

JUNIOR ELECTRONIC DESIGN ENGINEER, required by electronic tube manufacturer to design cathode ray and receiving tube testing and allied equipment. Location Toronto. File No. 5063-V.

ELECTRICAL ENGINEER preferably 25-35 years of age, with some sales experience required as sales engineer for industrial motive power battery line with long established reputable firm. Good salary and prospects for promotion. Duties will involve some travelling. All applicants should state qualifications and salary expected. File No. 5064-V.

EASTERN ONTARIO UTILITY, requires graduate electrical engineer to fill the position of distribution engineer. Duties to include distribution planning and layout for improvement of voltage conditions and expansion of present system. Design and layout of substations and assist in supervision of operating force. Applicant preferably should have one or two years electrical distribution experience. Write giving age, education, personal particulars and salary desired. File No. 5065-V.

ELECTRICAL ENGINEERS are required to fill over 50 positions, particularly in the electronics field, for work involving the design and development of communications equipment. Requirements also exist for those interested in electrical machinery, lighting and distribution systems. Civil Service Commission, Ottawa. File No. 5066-V.

ELECTRICAL SALES ENGINEER for Toronto office, leading U.K. manufacturer electrical plant. Must have minimum five years sales experience. Age under 39 years. File No. 5067-V.

ELECTRONICS ENGINEERS required by large manufacturing firm with plants in Eastern Ontario and the Montreal area. Positions available in the development of communications equipment or field maintenance engineering. Out-of-town trips of short duration required on some assignments. Reply in confidence including age, education, experience and salary requirements. File No. 5070-V.

SENIOR ENGINEER required by prominent manufacturer for sales, liaison, and technical administration in connection with guided missiles, radar and fire control projects. This is a responsible position for which considerable technical experience in electronics or electrical engineering as well as proven administrative ability are necessary. Opportunity for advancement is unequalled and depends solely on ability. File No. 5073-V.

TWO JUNIOR ELECTRIC ENGINEERS are required by a prominent mobile communications manufacturer located in Toronto. Both must be graduates in communications or general electronics option and have had about one year's experience in the electronic field preferably in the radio communications branch. One is required to work on production engineering in a technical liaison capacity. The other opening is for an application engineer in the systems development group. Reply giving full personal resume, experience, education and salary desired to File No. 5075-V.

ELECTRICAL ENGINEER required by repair shop in Quebec City. Repairs on electric motors, construction work, selling motors and controls, ball bearings, drives, belts, industrial hoses and electrical tools. Position offers, after some experience, management of whole firm. Must be bilingual. File No. 5077-V.

TWO ELECTRONIC ENGINEERS required in Toronto. Applicants should be graduate electrical engineers or physicists, with two or three years experience in design of electronic circuits. File No. 5085-V.

ELECTRICAL ENGINEER with 2 to 3 years experience, required for sales department of Toronto switchgear specialist. Knowledge of switchgear application desirable. File No. 5088-V.

MECHANICAL

SENIOR MECHANICAL ENGINEER. Salary up to $3,200. Department of Public

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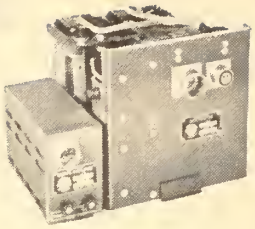
RESEARCH ENGINEER

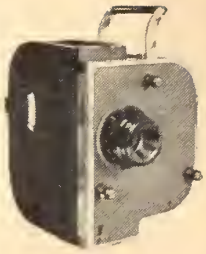
The National Research Council, Ottawa, Canada, requires a university graduate to investigate problems in aircraft icing. Duties will include tests in flight as well as in icing tunnels and development work in co-operation with commercial aircraft firms. Experience in Aeronautical engineering problems and aircraft performance is desirable. Initial salary in the range $3750 to $5750 per annum depending on qualifications. Apply by letter to the Employment Officer, National Research Council, Ottawa, Canada, giving full details of education and experience.

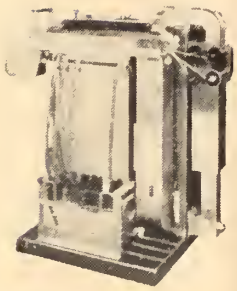
Geophysical Exploration Equipment

Microwave Siting Equipment



Computers



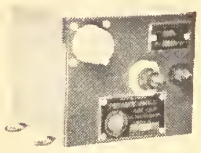


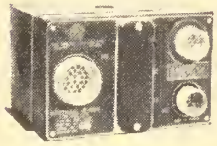
Photographic Equipment

A PROGRESSIVE CANADIAN ENGINEERING AND PRODUCTION FIRM OFFERS

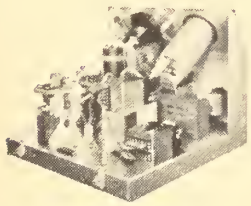
OPPORTUNITIES FOR SENIOR ENGINEERS

and Technicians

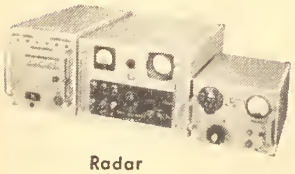




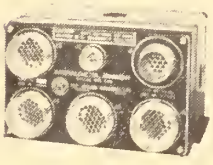
De-Icing Detection and Control



Test Equipment



Radar



Armament Intervalometer

The steady expansion of PSC Applied Research Limited has created permanent positions for senior engineers experienced in electro-mechanical, electronic, servo-controlled and computing instrumentation, in the following grades:

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Works, Ottawa. Details and application forms at nearest Civil Service Commission Office, Post Office or National Employment Office. Quote No. 54-1211. File No. 4993-V.

AN OTTAWA ORGANIZATION requires hydraulic engineers to undertake in the hydraulics laboratory research work in either fundamental or applied studies. Fundamental work is in the field of open channel flow, wave motion, sediment transport and allied subjects. Applied studies include the development work of river regulation, harbour development and hydraulic structures — locks, dams, breakwaters and similar installations. A master of science degree with specialization in hydraulics of fluid mechanics is required. Hydraulic laboratory work is desirable but not essential. Salary up to $5750 per annum depending on qualifications. Apply by letter and enclose

FIRM IN MONTREAL requires high calibre personnel to fill the following executive positions. Sales manager with sound engineering background and experience in the conveyor industry. Ability to negotiate at high level. Chief engineer with wide experience on design and layout of all types of heavy material handling plant. First class knowledge of bulk handling necessary. Generous salary and commission in both cases. File No. 5020-V.

MECHANICAL ENGINEER required by long established Montreal manufacturing firm to take over duties of plant engineer. Duties involve usual plant maintenance, machine shop, etc., also product development and tool design. Applicant must be English speaking and preferably between the ages of 25-35. Position offers good future and carries usual benefits including pension plan. Please reply in detail stating experience, education, etc. All replies received will be kept in confidence. File No. 5036-V.

ASSISTANT PLANT ENGINEER required for manufacturing plant located on the lower mainland of B.C. Good opportunity for an aggressive man. Duties to consist of plant layout, process improvement, materials handling, machinery and equipment replacement and related duties. Prefer applicant with one or two years experience after graduation. All replies will be kept in strict confidence. File No. 5035-V.

GRADUATE MECHANICAL ENGINEER required to work on steam power plant design. Applicant must have at least five years experience on the design and layout of modern high pressure, high temperature control stations. The company is now actively engaged in extensive plant extensions of 25 and 45MW size, the latter 900 lbs. on a long term basis. Opportunity is offered for advancement in both technical and executive lines of public utility work.

CAREERS FOR SCIENTISTS AND ENGINEERS WITH THE DEFENCE RESEARCH BOARD

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BIOLOGICAL AND SOCIAL SCIENTISTS

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PERSONNEL RESEARCH • ENVIRONMENTAL PROTECTION

● **THERE IS ALSO A REQUIREMENT FOR TRAINED SCIENTISTS FOR WORK IN OPERATIONAL RESEARCH AND SCIENTIFIC INFORMATION**

QUALIFICATIONS: Applications are invited from Canadian citizens or British subjects, graduates with a good academic record in science or engineering from a recognized university, preferably with post-graduate training proven scientific ability. Experience desirable.

SALARIES: Salaries will be commensurate with qualifications and experience.

EMPLOYMENT CONDITIONS and BENEFITS: Modern, well-equipped laboratories provide excellent facilities and working conditions. Benefits include a five-day week, generous provision for vacation and sick leave, medical-hospital insurance plans and an excellent pension scheme.

HOW TO APPLY: Write, outlining your qualifications and experience, to:—

DIRECTOR OF RESEARCH PERSONNEL, DEFENCE RESEARCH BOARD, "A" BUILDING, NATIONAL DEFENCE HEADQUARTERS, OTTAWA, ONTARIO.

a resume of qualifications and experience. File No. 5006-V.

TWO GRADUATE MECHANICAL or electrical engineers. One as plant engineer in a small Ontario town. The other for technical and administrative work in the office of the chief engineer of the company in Montreal. File No. 5012-V.

GRADUATE MECHANICAL ENGINEER interested in a career in Latin America with a Canadian owned electric light and power utility company located in Maracaibo, Venezuela. Age limit 30 years and should have 5 years experience in a steam electric generating station. Immediate prospects for promotion to assistant production superintendent and ultimately to executive position if qualified. File No. 5013-V.

SALES ENGINEER with steam plant experience wanted as executive of a new Canadian company to sell, service and assemble combustion controls and industrial instruments in Ontario and Quebec, for well known American manufacturer. Must be native Canadian and a graduate of a Canadian engineering university. File No. 5018-V.

DETAIL AND ASSEMBLY tool designers required for extensive aircraft program. Experience desired: 10 years experience in sheet metal fabrication industry with five years on aircraft tool design. Location Ontario. File No. 5031-V.

WELL KNOWN MANUFACTURING FIRM requires the services of a fully qualified industrial engineer to survey and report on manufacturing processes. Must have knowledge and experience of production methods. Knowledge and experience of the modern concept of quality control methods. Apply stating both qualifications and experience in full to File No. 5032-V.

YOUNG GRADUATE MECHANICAL engineer, age 21 to 25, to work in the Toronto area under the supervision of the chief engineer of the pump manufacturing plant. He will act in the capacity of job process engineer, prepare all bills of material, test pumping units and as experience gained, opportunity to learn design. File No. 5033-V.

Salary paid will be according to ability, academic qualifications and experience. Apply giving age, training experience and approximate salary required. Location Maritime Provinces. File No. 5037-V.

MECHANICAL PLANT ENGINEER required by operating division of service organization. University graduate preferred having 5 to 10 years experience in operation and betterment of steam plants operated by U.S. or Canadian public utilities. Location New York, some travel, Spanish desirable but not essential. Reply by letter giving age, education, experience, personal data and minimum salary acceptable. File No. 5043-V.

MECHANICAL ENGINEER required by manufacturer of wire and cables located in Ontario, for plant engineering department. Preferably one who can do machine design work. Permanent position and salary will depend upon experience and qualifications. File No. 5052-V.

MECHANICAL ENGINEER required in Edmonton, Alberta, who has graduated from a recognized Canadian University,

and who has about 3-5 years experience in a chemical plant or refinery. He will deal mostly in equipment used in the manufacture of petro-chemicals and synthetic fibres. Duties will consist of general engineering, which will include design, layout and estimating. File No. 5055-V.

A MECHANICAL ENGINEER is required as maintenance superintendent at a 2,000 bed mental hospital in Weyburn, Sask., operated by the Saskatchewan Department of Public Health. The duties include planning and supervising the maintenance, repair and construction of buildings, grounds, roads, equipment and utilities. The employee would be responsible for the generation of electricity and supply of steam, and the operation of water and sewage systems. Considerable experience in buildings, maintenance and construction desirable. Qualifications should permit registration as a professional engineer. Starting salary $397.00 per month with automatic annual increases to $481.00 per month. Benefits—3 weeks annual sick leave, 3 weeks holiday with pay, excellent superannuation scheme. File No. 5060-V.

MECHANICAL ENGINEER to be service engineer for large manufacturing plant in Eastern Ontario. Work will involve supply, distribution and use of plant services including, steam, water refrigeration, compressed air, vacuum, ventilation and air conditioning. Duties will include control of all services departments and distribution systems, supervision of maintenance of services equipment, and studies, estimates, and reports on services distribution and consumptions. Must be graduate engineer, age 28 to 35, with several years of practical experience with supply of plant services. Must have the ability to take over leadership of a group and be prepared to make his own decisions and be responsible for them. Preferably should also have first class stationary engineer's certificate. Position will be permanent and offers excellent opportunity for advancement to the right man. Applications should contain all necessary personal data, and full information about previous engineering experience. Reply stating experience and other relevant information to File No. 5062-V.

OPPORTUNITIES ARE AVAILABLE to mechanical engineers at Ottawa and other centres across Canada, on assignments involving the design and installation of heating, ventilating and refrigeration equipment; the design and construction of power house equipment, dry-docks, lift and swing bridges; research on stress analysis and fatigue properties of metals as well as on thermodynamics and gas dynamics. Civil Service Commission, Ottawa. File No. 5066-V.

GRADUATE MECHANICAL ENGINEER, with 3-5 years experience to work as project engineer. Located in Head Office in Montreal, but may be called upon to travel to plants in Eastern Canada. He will be responsible for design and installation of a wide variety of industrial equipment and processes and for new plants or additions to existing plants as they expand. Training will be provided, so actual experience in this field is an asset but not essential. File No. 5068-V.

TWO MECHANICAL ENGINEERS to work in mechanical goods sales division. The men we are looking for should be recent graduates who have an interest in sales work. Will receive training to become familiar with products and then move to technical sales. They will deal with problems related to products in most of the larger well known industries. Being a large well known firm, we can offer a good future with better-than-average employee benefits. File No. 5068-V.

VACANCIES CREATED BY new developments offer interesting positions for mechanical engineers on Canada's leading design team. Applications from qualified persons are being considered for analytical and applied design work on full systems and flying control systems, including electro-hydraulic servo mechanisms, aircraft experience desirable but not essential. Salary commensurate with experience and ability. Replies held in confidence. Reply by letter in first instance giving resume of education and experience, with salary expected. Location Ontario. File No. 5076-V.

MECHANICAL ENGINEER with five or more years experience in industry, preferably pulp and paper, for duties involving organization of improvements, job schedules, machinery maintenance and some mechanical draughting. File No. 5081-V.

MECHANICAL ENGINEERS

Vacancies created by new developments, offer interesting positions on Canada's leading design team.

Applications from qualified persons are being considered for analytical and applied design work on fuel systems and flying control systems, including electro-hydraulic servo mechanisms.

Aircraft experience desirable but not essential. Salary commensurate with experience and ability.

Replies held in confidence.

Reply by letter in first instance giving resume of education and experience, with salary expected, to

Employment Manager,

A. V. ROE CANADA LTD.

(Aircraft Division)

Malton, Ont.

SPERRY GYROSCOPE COMPANY OF CANADA, LTD.

REQUIRES

ENGINEERS

For development and product design of microwave test equipment, magnetic amplifiers, transistor circuits, fire control systems and other servo-operated instruments for both military and commercial application. The continuing expansion of work in our Engineering Department offers opportunities for both senior and intermediate engineers. Previous experience in manufacturing operations is desirable, and supervisory ability would be an asset. Please write full details to:

Personnel Manager,
P.O. Box 710,
Montreal, Quebec.

MISCELLANEOUS

CONTROL ENGINEER for paper mill and pulp mills situated in urban area in the Province of Quebec. Applicants must be university graduates with a minimum of 3 to 5 years experience. Opportunity for advancement excellent. Salary commensurate with experience. File No. 4992-V.

SENIOR GUN INSPECTOR with salary up to $6,500.00 per annum depending upon qualifications required by inspection service department of National Defence Ottawa. To supervise inspection and proof of light and heavy ordnance equipment in Canada. Details and application forms at Post Office, National Employment Office or Civil Service Commission. Competition No. 54-1212 File No. 4994-V.

ENGINEER REQUIRED FOR a metal working industry in the Ottawa valley to work on the design and maintenance of a variety of machines as well as do general plant engineering. Must have a good fundamental knowledge of machine shop practice and be able to direct the work of machinists through their foreman. Graduation from a recognized Canadian university and a few years experience in a machine shop are requisites for this position. Apply giving full particulars and recent photograph. File No. 5004-V.

RESEARCH CHEMICAL OR MECHANICAL ENGINEER required by pulp and paper research institute of Canada for research in unit operation and chemical reactions involved in new processes for pulp and paper manufacture. Necessary qualifications include a Bachelor's (or higher) degree in chemical or mechanical engineering and 1-5 years of pertinent experience. This offers an opportunity to gain experience in the planning, executing and reporting of engineering research projects. Salary will be commensurate with previous training and experience. Applicants should address a comprehensive resume of qualifications and career. File No. 5007-V.

THE DEFENCE RESEARCH BOARD requires electronics engineers and phy-

THE VANCOUVER BOARD OF SCHOOL TRUSTEES

SCHOOL DISTRICT No. 39

WILL RECEIVE APPLICATIONS FOR THE POSITION OF

Assistant Director of Construction and Maintenance

DUTIES

To assist the Director in:

1. **The Planning and construction of new buildings and the improvement of grounds appertaining thereto.**
2. **The planning and construction of alterations and additions to buildings.**
3. **The maintenance of buildings and grounds.**

QUALIFICATIONS AND EXPERIENCE

1. **Registered Architect or Registered Civil Engineer.**
2. **Proven administrative ability.**
3. **Wide experience in the performance of the types of duties listed above.**

SALARY RANGE

$687 to $824 per month.

Applications must state age, education, experience in detail, marital status, war service, telephone number, and must include a list of names and addresses of persons to whom reference may be made. All applications will be treated in strictest confidence.

Applications should reach the Superintendent of Schools, 1595 W. 10th Ave., Vancouver 9, B.C., not later than February 15, 1955. Kindly mark envelope—"Application—Asst. Director of Construction & Maintenance."

Canvassing by or on behalf of any applicant will disqualify the applicant.

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sicists for employment in Ottawa, Ontario. Duties: for the electronics engineers the work will be in connection with the technical administration of a development programme. The duties will include secretarial committee work contractual negotiations, liaison work, etc. there are vacancies for physicists interested in research and development on the more fundamental aspects of electronic components, e.g. dielectrics and magnetic materials. Qualifications: electronics engineers should have technical experience in the field of electronic components. Salary: starting salaries will be in the range of $3,600-$5,750 depending upon qualifications and experience. Employee benefits: there is generous provision for vacation and sick leave, superannuation and group hospital medical insurance plans, and a five day week. How to apply: application forms will be sent to qualified applicants on receipt of letters outlining qualifications and experience. Please write mentioning 54-DRP-4 to File No. 5008-V.

Aircraft Sales Manager

The Bristol Aeroplane Company of Canada Limited requires an aircraft sales manager for its aircraft division at MacDonald Bros. Aircraft Limited, Winnipeg, Manitoba.

Applicants must have a good aviation background and should not be more than 40 years of age. Preference will be given to those having an aeronautical engineering qualification.

The position is a permanent one and available immediately. The successful candidate will be required to travel extensively in Canada, U.S.A. and the United Kingdom and will be resident in Montreal.

Initial salary will depend on qualification and experience; in addition, the Company provides group pension and insurance plans and other benefits.

Applications (six copies) giving full details of training, qualifications and experience and the names of three persons to whom reference may be made should be sent to the Secretary, The Bristol Aeroplane Company of Canada Limited, Pie IX Boulevard, Montreal North, P.Q. not later than 15th February.

ASSISTANT PROFESSOR of draughting, Royal Military College of Canada, Kingston, Ontario. Salary up to $5,400 per annum. Civil or mechanical engineer preferred. Further information may be obtained by writing the Civil Service Commission, Ottawa. Quote Competition 54-2008. File No. 5014-V.

DESIGN AND DEVELOPMENT engineer required for modern materials handling equipment plant in Western Ontario. Must be prepared to take charge of drawing office and to deal with all matters of design and development appertaining to materials handling equipment. Salary commensurate with responsibility and experience. File No. 5016-V.

PERMANENT STAFF POSITIONS ARE available for 3 graduate engineers in layout and design, maintenance and operating department. Minimum qualifications include graduation from recognized university and 3-10 years experience preferably including alkaline pulping or paper mill design or maintenance. Salary commensurate with experience. Write giving full details of education, age, experience marital status and references. Location Ontario. File No. 5024-V.

VENTILATING SALES ENGINEER required. Young man with experience in ventilation work to manage Montreal office of fan manufacturing company. Unique opportunity for right man. Car supplied. Advise age, experience and particulars. File No. 5028-V.

CHEMICAL OR METALLURGICAL ENGINEER, class '48-'52, sales experience preferred for technical sales with growing industrial division of world-wide organization manufacturing centrifuges, heat exchangers, pumps, vibrating screens for use throughout industry. Location, Ontario or Quebec. File No. 5029-V.

CIVIL OR ELECTRICAL ENGINEER University graduate of two or three years' experience in civil or electrical fields and above average literary ability. Permanent employment in Ottawa with well known industrial association. Pension plan. File No. 5039-V.

SALES ENGINEER not over fifty years of age, living in Montreal area and to be responsible for the province of Quebec. Required to contact industrial, utility, and contracting companies, liberal salary for satisfactory man and excellent opportunity for advancement to executive responsibility. Only highest grade, responsible man of experience, will satisfy our requirement. Montreal interview will be promptly arranged. File No. 5040-V.

SOIL MECHANICS ENGINEER required by Vancouver engineering firm. Post graduate training essential. Two to four years practical experience preferred but not absolutely necessary. Excellent opportunity leading to responsible position for engineer with initiative and personality. Reply stating age, education and experience. File No. 5045-V.

CHIEF DRAUGHTSMAN required. Thoroughly experienced chief draughtsman for structural steel plant. Complete details of educational and employment background and salary required. File No. 5047-V.

ESTIMATOR REQUIRED with experience in the estimating of the fabrication and erection of structural steel. Location Ontario. File No. 5047-V.

DESIGN ENGINEERS wanted by a rapidly expanding firm specializing in prestressed and precast concrete throughout Canada. Several years experience in reinforced concrete is required. Positions offer salary, participation in company's hospitalization and pension plans. Applicants should give full details including age, education, experience, marital status, salary requirements. Personal interview will be arranged with selected applicants. File No. 5049-V.

ESTIMATOR experienced in industrial buildings, bridges and heavy construction required by expanding firm operating throughout Canada. Position offers salary, participation in company's hospitalization and pension plans. Applicants should give full details, including age, education and background, experience, marital status, salary requirements. File No. 5049-V.

SALES ENGINEER for promotion and sales in professional field with background in structures and construction required by firm specializing in prestressed and precast concrete throughout Canada. Position offers salary and commission, participation in company's hospitalization and pension plans. Applicants should give full details including age, education and background, experience, marital status, salary requirements. File No. 5049-V.

TWO MECHANICAL OR ELECTRICAL ENGINEERS required by elevator manufacturer located in Montreal to act as sales and or service engineer. Applicants should be recent graduates, no previous experience necessary. Must be bilingual. Age 30 years or under. File No. 5050-V.

YOUNG ENGINEER or metallurgist with experience in the light metals field, either in a light metals development laboratory or as a technical service representative for a base producer of light metals. Required by large Canadian organization establishing a market for magnesium in Canada to work out of Toronto. After suitable training with parent company he will be given full responsibility and authority to increase the market. Top salary open. File No. 5056-V.

METALLURGICAL ENGINEER for shift production work in non-ferrous smelter. Excellent opportunity for recent metallurgical graduate. Supply full particulars regarding qualifications and salary expected to File No. 5059-V.

SALES ENGINEERS graduates in chemical, electrical, mechanical, mining or metallurgical engineering—between the ages of 25 and 35, with at least 3 years industrial selling experience — required by well-known Montreal manufacturing firm with branches from coast-to-coast selling a wide range of mechanical equipment to the chemical, oil and gas, mining, marine, power, pulp and paper, metal and other industries in Canada. Reply in confidence giving a complete resume of your qualifications and experience. All replies will be acknowledged. File No. 5061-V.

General Manager

Required for the Soskatchewan Power Corporation operating a rapidly expanding province wide electrical utility and an extensive gas utility. Headquarters Regina. Kindly state fully background and experience, including previous training in and knowledge of electrical and gas utilities and industrial and public relations. State also salary expected and date available. Address replies to: A. E. Blakeney, 1730 Scarth Street, Regina, Sask.

MECHANICAL, ELECTRICAL AND CHEMICAL ENGINEERS are required for 35 positions at Ottawa to undergo training in patent law and regulations and then to assure the responsibility for the examination of applications for patents in the field of engineering and for making recommendations for the award or denial of patents. Civil Service Commission, Ottawa. File No. 5066-V.

RESEARCH OFFICERS, graduates in chemical, metallurgical and mining engineering and in engineering physics are needed for both fundamental and applied research at Ottawa and Chalk River, Ontario. Ample opportunity is provided in these posts to present and publish papers and to take part in technical conferences and forums both national and international. File No. 5066-V.

PLANT MAINTENANCE ENGINEER required by large manufacturing firm in Montreal for mechanical-electrical project design, construction and maintenance operations relating to buildings and building equipment. University graduates with some previous experience in plant engineering work preferred. In your reply, please include particulars as to education, age and approximate salary required. File No. 5070-V.

ENGINEERS REQUIRED FOR DEVELOPMENT and product design of microwave test equipment, magnetic amplifiers, transistor circuits, five control systems and other servo operated instruments for both military and commercial application. The continuing expansion of work in our engineering department offers opportunities for both junior and intermediate engineers. Previous experience in manufacturing operations is desirable, and supervisory ability would be an asset. File No. 5072-V.

SENIOR STRESS ENGINEER required in Montreal to undertake work in design department on aircraft landing gears and miscellaneous hydraulic equipment. Although experience on aircraft equipment would be a considerable advantage, we would be prepared to interview any engineer with sufficient background to enable him to pick up the specialized work. File No. 5074-V.

YOUNG CIVIL OR MECHANICAL ENGINEER required by a pulp and paper company in Quebec. Applicant should have a minimum of three years experience in engineering and maintenance preferably in the pulp and paper industry. Applicant should be fluent in either French or English and should be able to get along in both. Replies should outline qualifications, experience, age and salary expected. File No. 5078-V.

THE NATIONAL RESEARCH COUNCIL, Ottawa, requires graduates in engineering physics, mechanical or electrical engineering to work on the design and development of special instrumentation equipment and data processing systems. Three positions are open in the flight research section and one in the high speed aerodynamics lab. This work calls for an imagination and original approach to a large variety of advanced instrumentation and electro mechanical design problems. Initial salary in the range of $3,750-$5,750 per annum depending on qualifications. Apply by letter to the employment officer Sussex Street, Ottawa, Ontario, quoting file ME 361 and listing complete details on education and experience. File No 5080-V.

SASKATCHEWAN DEPARTMENT OF mineral resources require petroleum geologists and petroleum development officers. Salary range $329.—$413. and $326-$397. respectively. Both groups will perform duties in the conservation of oil and gas resources. The geologists duties will be professional level in field and office, the petroleum development officers' will be largely field duties in connection with drilling operations. University graduation required. File No. 5082-V.

AN INTERESTING POSITION is open in our new Research Department. We require a graduate engineer from a recognized university with experience in adhesives, coatings, rubber plastics or related fields. Remuneration will be negotiated. Replies will be given all applicants who send a complete resume of their educational background, work ability, personal data and references, and a recent picture. File No. 5087-V.

ELECTRICAL ENGINEER with 2 to 3 years experience, required for sales department of Toronto switchgear specialist. Knowledge of switchgear application desirable. File No. 5088-V.

CHIEF ENGINEER required by progressive manufacturer supplying equipment to utilities and large industrials. Must have experience and maturity to counsel staff and administer department. Technical background in design and development of electrical filter circuits together with mechanical design experience in manufacturing industry is most desirable. Remuneration commensurate with qualifications. File No. 5089-V.

SITUATIONS WANTED

GRADUATE ENGINEER with six years varied experience in the pulp and paper industry available for position as assistant superintendent in sulphate pulp mill or paper mill. Married, 29 years of age, will locate in United States or Canada. File No. 163-W.

ELECTRICAL ENGINEER, P.Eng., M.E.I.C., B.Sc. (U.N.B., 1937) age 42, married, 1 child, 7 years with large Canadian electrical manufacturer including test course, 2 years switchboard design and 3 years apparatus correspondence sales. Hold technical secondary school teacher's certificate with university and school teaching experience. Heating engineering experience (2 years) in the design of hot water heating systems and service of automatic steam generators. Am seeking a responsible position as industrial training supervisor, power plant engineer or other responsible position. Residing in Toronto and free to accept immediate employment anywhere. File No. 2878-W.

MECHANICAL ENGINEER, Jr.E.I.C., U. of S. 1950, age 27, single. Four years experience in design and layout of steam boiler plants. Have also acted as residential engineer on some installations. Seeking interesting position with possibilities in mechanical or power field. File No. 3495-W.

MECHANICAL ENGINEER, Jr.E.I.C., 1950 graduate, University of Saskatchewan. Excellent practical background combined with sales and administrative ability. Thoroughly familiar with the pulp and paper, automotive and farm implement industries. Able to work well with others. No objection to travel and will accept a position anywhere in Canada or U.S.A. Please reply to File No 3536-W.

ELECTRICAL ENGINEER, B.Eng., McGill, 1950, P.Eng., Jr.E.I.C. C.G.E. Test course. Experience: design; polyphase motor design and application ½ to 600 H.P., industrial; design and construction of distribution, lighting and power installations, power factor correction, frequency conversion, system control, air conditioning and plant engineering work, general; artillery officer overseas in World War II, working knowledge of French, age 35, married, three children. File No. 3859-W.

MECHANICAL ENGINEER (M.E.I.C.) age 36, married. Experience: 2 years designer draftsman, 3 years industrial engineering, methods and production control. Trained in time and motion study and certificate as MTM practitioner. Desires responsible position in industrial engineering methods or plant management. File No. 3900-W.

MECHANICAL ENGINEER, P.Eng., Jr. E.I.C., experienced in machine design and mechanical drafting, seeks part time employment in Calgary, Alberta area. File No. 3902-W.

STRUCTURAL ENGINEER, 36, married, M.E.I.C., P.Eng., B.Sc. Eng., A.M.I.C.S., A.M.I. Struct. E., with extensive experience in design of reinforced concrete, structural steel, and wood structures (schools, factories, hospitals, industrial containers, foundations, office buildings, etc), seeks responsible position in Toronto area. Preferably junior partnership or associateship. File No. 4041-W.

METALLURGICAL ENGINEER, Jr.E.I.C., P.Eng., B.Sc. (Chemistry), B.E., Nova Scotia T.C. 1952. Married, age 32. Experience includes one year as metallurgical chemist in a control lab., one year as assistant welding engineer with a steel fabricator and about one year with a research firm on ore preparation and reduction of ores. Desires technical position with firm located in Toronto area. Available on short notice. File No. 4128-W.

CIVIL ENGINEER, P.Eng., M.E.I.C., desires ½ day employment in Toronto. 19 years experience in architectural, structural and town planning designs. File No. 4182-W.

ELECTRICAL ENGINEER, age 29, with 3 years experience in heavy industry, 2 years in communications, test course graduate, desires responsible work in West, preferably Edmonton area. File No. 4349-W.

ELECTRICAL ENGINEER, B.Eng. (Hons.), M.A.Sc., M.E.I.C., P.Eng., age 36, married and presently completing ninth year as a professor of electrical engineering. Has taught many different courses on senior and graduate levels with emphasis on power. Broad general experience in construction, public utility engineering and as a naval officer. Has done considerable consulting work of a general nature. Seeks appointment which should offer a broad challenge, be conducive to personal growth and in keeping with background preferred. File No. 4402-W.

CIVIL ENGINEER, M.Sc. 1931, Technical University of Warsaw, A.M.I. San.E., M.E.I.C., P.Eng. (Man. & Sask), war veteran, age 49, over 15 years experience in hydraulic works, water supply and sewerage, formerly residing in Great Britain and one and one half years in Canada. At present employed as city assistant engineer. Seeks position with a municipality or firm which offers a good opportunity for advancement. Location secondary, available in one month notice. File No. 4443-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), B.Eng. 1952, age 30, married, with two years of experience on plant maintenance in a chemical plant, also one year's experience in industrial engineering, 3 summers general workshop practice including overhaul of diesel engines. Desires work on plant maintenance or production. File No. 4453-W.

YOUNG ELECTRICAL ENGINEER interested in learning the generation and distribution field with a consulting engineer, contractor or utility. Presently working in a large petrochemical plant on all phases of the electrical system. Will send resume on request. File No. 4510-W.

ELECTRICAL ENGINEER, Power, McGill 1953, S.E.I.C., age 26, married, presently employed. Experience includes Westinghouse Training Course; small motors, switchgear, household appliances. Interested in a permanent position with an opportunity for further professional development in electrical engineering field. Good references. Location Montreal only. File No. 4553-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C., veteran 4 years R.C.N., B.Sc. mechanical engineering, Queen's 1950. Age 34, married, 2 children. Administrative experience obtained in a large chemical plant, engineering and maintenance department, which included 3 years supervising maintenance and 1½ years engineering work on material handling corrosion piping, and packaging problems. Sound practical experience gained when obtained machinist fitter's Journeyman's papers. Desires a challenging responsible position with good opportunities situated in Ontario. File No. 4613-W.

ELECTRICAL ENGINEER, M.Sc., graduate Delft Technological University, Holland, 25 years old, married, specialized in the power side: electric and diesel electric traction, generators, motors, transformers, high and low tension cables and lines, control and protective equipment, experience 8 months. Fluent English, German, French and Dutch. Seeks position in line with his education. Available in 2 weeks anywhere. File No. 4615-W.

CIVIL ENGINEER, Jr.E.I.C., Polytechnique '51, 26, single, 4 years experience with RCAF construction engineering branch, supervision of roads and runways construction, reconstruction of various buildings, experience with all construction trades, inspection of construction sites. One year as resident engineering officer at RCAF unit requiring knowledge of maintenance and operation of diesel engines, air condi-

tioning equipment, refrigeration, municipal engineering and related subjects. Will be ready for employment in April '55. Administrative experience, perfectly bilingual, would feel capable of handling assistant town engineer position for medium size community. Will travel if necessary. File No. 4616-W.

CIVIL ENGINEER, Jr.E.I.C., graduate N.S.T.C., 1952, age 31, married with children, desires position in Maritimes with firm engaged in residential construction and/or community planning. Also interested in inspection services related to the above. Presently employed by research organization in Ontario. Available on reasonable notice to present employer. File No. 4617-W.

ELECTRICAL ENGINEER, (Belfast, N. Ireland, 1949), P.Eng., Jr.E.I.C., graduate I.E.E., age 26, married with 2 children, desires position in Montreal. Experience includes 5 years indentured electrical engineering apprenticeship, 2 years test and inspection engineer, 2 years electrical machine design, 3 years Canadian experience in power lighting and distribution. Available on one month's notice to present employer. File No. 4619-W.

MECHANICAL ENGINEER, M.E.I.C., age 36, British, 2½ years in Canada, seeks immediate employment. 12 years experience in the army and civilian life in mechanical handling and construction equipment. Since arrival in Canada employed as lubrication and maintenance engineer in the pulp and paper industry. Will consider work in any field of mechanical engineering. File No. 4620-W.

MECHANICAL ENGINEER, Swedish Technical Institute, age 38, married. Experience includes 15 years in the oil industry, as project engineer and on the construction of oil plants which includes installation of pipelines, production and methods planning; design and service of burners and equipment for gasoline, fuel oil, butane-propane gas and petroleum industries. One and half years in Canada employed as oil burner mechanic and draughtsman. Seeks opportunity where former experience can be best utilized. Location immaterial. Available immediately. File No. 4625-W.

CIVIL ENGINEER, P.Eng., Jr.E.I.C., 1951 graduate. Seeks part time employment in Montreal. Experience in design of R.C. constructures, field work in construction and general maintenance in chemical processing industry. Some drafting. File No. 4627-W.

ELECTRICAL ENGINEER, M.E.I.C., McGill 1943, married. Experience in electronic communication and power principally in sub-station design. Desire position with responsibility. Speaks French and English fluently. File No. 4628-W.

GRADUATE ENGINEER, 1941, Civil M.E.I.C., age 25, married with family. Considerable experience as job engineer and superintendent. Have a responsible position in a growing construction firm seeking similar position preferably in Ontario. Particulars willingly supplied. File No. 4629-W.

MECHANICAL AND METALLURGICAL ENGINEER, Jr.E.I.C., P.Eng., Dipl. Ing., age 39, married, no children. 10 years experience in various phases of metal fabricating processes: machining, stamping, deep drawing, forging, casting, heat treating, etc. Desires position with a progressive company to take care of all technical problems combined with supervision, cost reduction program, methods improvement and general development of plant facilities. File No. 4632-W.

MECHANICAL ENGINEER, S.E.I.C., B.Engineer with honours McGill 1953. Presently located in Montreal. Thorough background of machine shop experience, production planning and allied engineering office problems. Some experience also in surveying field work. Desires part time employment evenings and Saturdays in draughting, calculating, surveying, tutoring mathematics and sciences or as consultant in production planning and control problems. File No. 4634-W.

MECHANICAL ENGINEER, M.E.I.C., age 34, married. 10 years experience in drafting, piping layouts, estimating, inspection and plant maintenance in petroleum refinery. Desires position in industrial plant or refinery. Location Alberta or British Columbia interior. Available on one month's notice. File No. 4637-W.

CIVIL ENGINEER, P.E., M.E.I.C. Thirty years experience includes natural gas development, gas transmission, distribution design service on customers premises, dehydration, oil fogging, reconditioning. Desires position in industry or consultant. File No. 4638-W.

MECHANICAL ENGINEER, B.E., Saskatchewan 1953, P.Eng. (Ont.). S.E.I.C. Member S.A.E., age 23, married. 1½ years experience in automotive industry including one year training plan, purchasing and material handling. Present duties consist of liaison between management and engineering design sections, planning of new parts depots, floor layouts, equipment purchases and co-ordination of new construction projects giving considerable administrative experience. Desires position in Western Canada with opportunity for advancement. File No. 4639-W.

CONSTRUCTION EXECUTIVE available early Spring. Presently in senior management capacity. Proven record of high profits; able to initiate, organize and administer large volume of business. Mature judgment in financial matters and high level negotiations. Extensive experience in estimating, tendering, costing, and project supervision. Author of technical articles. Age 45, married Professional Engineer (Ontario). M.E.I.C. Would join construction company or allied industry as senior executive investing some capital if required. File No. 4640-W.

ELECTRICAL ENGINEER, U.N.B., 1953; S.E.I.C., Athlone Fellow 1953; age 23, married. Presently in final year of graduate apprenticeship with the British Thomson-Houston Company, Rugby, England; apprenticeship concentrated on light and heavy rotating machinery, control gear, and electronic control equipment. Additional experience (including summer work) in switchgear, protective relaying, transformer testing, power transmission problems, and drafting; senior thesis "Symmetrical Component Analysis". Seek position concerning power system engineering in any part of Canada or abroad. Available for work in October, 1955. File No. 4641-W.

CHEMICAL ENGINEER, B.Sc. (Ch.E.), M.E.I.C., M.A.I.Ch.E., 42, single, Canadian and U.S. resident; equal knowledge of English and German; experience: 12 years consisting of research and development in fuel technology, and process and project engineer in petroleum refinery engineering. Desires overseas assignment in petroleum refinery process or project engineering. Available immediately. File No. 4642-W.

CIVIL ENGINEER, Jr.E.I.C., B.Sc. (C.E.) Sask. 1953, age 25, single, presently employed in design, estimating and supervising of construction of irrigation projects, seeks new position. Preference for city engineering department or consulting firm engaged in municipal work. Preferable, but not necessarily, Western Canada. File No. 4643-W.

ENGINEERING AND BUSINESS MANAGEMENT background. Jr.E.I.C., Queen's civil, 1952. Will graduate from Harvard Graduate Business School in June 1955, after training in labour relations, control, finance, production and marketing. Work experience includes construction engineering, surveying and mapping work and one summer preparing reports on capital expenditures for a large utility. Job objective is responsible work in the producing department of a manufacturing, construction, mining or transportation organization. Size of company is not paramount. File No. 4644-W.

STRUCTURAL AND CIVIL ENGINEER, Jr.E.I.C., P.Eng., European university graduate in structural engineering (1947), age 34, family, 6 years Canadian experience mainly in field work and supervision on industrial and residential construction projects, also as office engineer and designer. Seeks permanent position in line with education and experience with a well established firm in Southern Ontario, preferably Toronto. Willing to accept the position of a Junior designer where hard work and ability would lead to greater responsibility and advancement. Available on short notice. References. File No. 4645-W.

MECHANICAL ENGINEER, B.Sc. (M.E.) honours, Manitoba 1949, P.Eng., Jr. E.I.C. age 28, experience heating and ventilation, mechanical power transmission, power plant, design, drafting and construction supervision. Desires position design and development, plant engineering or consulting. Hard worker, conscientious. Preferably Niagara or Southern Ontario. File No. 4646-W.

ELECTRICAL ENGINEER, B.Sc. (Eng.) London University, England 1950. Single, age 36. Experienced public utility also applications and development of protective relays with well known British manufacturers. Seeks position anywhere in Canada, public utility preferred. File No. 4647-W.

Student Summer Employment

Companies desiring the services of engineering students and students requiring engineering employment during the summer months are invited to make their requirements known NOW.

Employers:

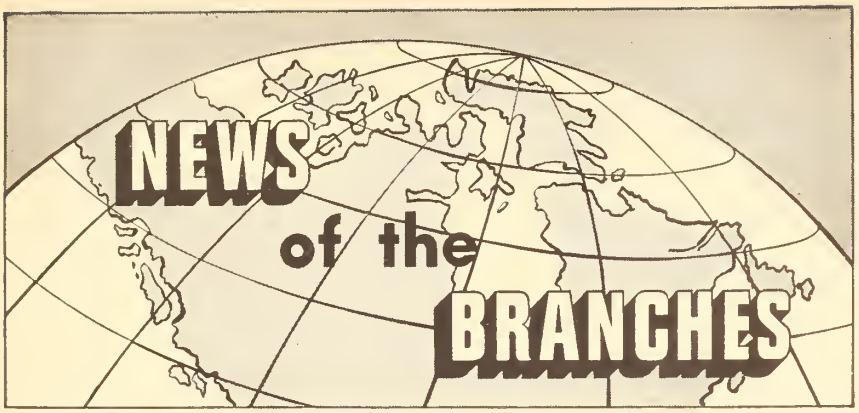
Send particulars of vacancies, locations, salaries and name of company official to be contacted.

Students:

Send details of former experience, type of work and location desired. State dates of availability.

Address all correspondence to:

Employment Service, The Engineering Institute of Canada,
2050 Mansfield Street, Montreal, 2, Que.



Activities of the Forty-seven Branches of the Institute and abstracts of papers presented at their meetings

Fredricton

I. M. Beattie, M.E.I.C.,
Secretary-Treasurer

N. E. Donahoe, S.E.I.C.,
Branch News Editor

"Up-River" Dinner Meeting

On Sunday, November 21, 1954, more than forty engineers met at Suzanne's Cafe, Grand Falls for the annual "up-river" dinner meeting of the Fredericton Branch. The New Brunswick Electric Power Commission, Dept. of Highways, Fraser Companies, Dept. of Public Works, Camp Gagetown Project and the University of New Brunswick Faculty were represented. Also there were several guests from Loring (formerly Limestone) Air Base in Maine.

After dinner, the meeting was opened by Mr. Tweedale, president of the Fredericton Branch. Mr. Tweedale discussed with those members who are unable to attend regular meetings because of their location in the province, the possibility of obtaining more value for their membership under the proposed unity plan. He also proposed that they inquire into the possibility of their meeting with Maine engineers.

Mr. Tweedale announced the appointment of Mr. D. McN. Lowe to a position on the executive to replace Mr. H. Marshal who is away on course.

Engineering Education

Following the business meeting, Mr. Don Forbes introduced the guest speaker, Mr. W. Birchard. Mr. Birchard, a graduate of Queen's University, is chairman of Educational Research of the Canadian Pulp and Paper Association. Mr. Birchard gave a very interesting talk on engineering education, more specifically of mechanical engineering.

In his talk, Mr. Birchard stressed the importance of the basic education of the student saying that, in his opinion, not enough importance is placed on primary education. He discussed the courses required and the order in which they should be taken. He particularly felt that the student should get more experience in his field than under the present system. To accomplish this, the course should not only offer more lab trips and shop work but also if possible, encourage the students to do summer work as apprentices under the guidance of established industries. The students and industries would both benefit by this system.

Mr. R. C. March thanked the speaker and the group separated; some to inspect the Tobique Narrows Power Project and others to visit the Grand Falls Power Dam.

Hamilton

N. A. Parry, Jr.E.I.C.,
Secretary-Treasurer

F. Gue, Jr.E.I.C.,
Branch News Editor

"Northern Development"

On Thursday evening, Nov. 18, the Hamilton Branch heard Mr. George Gathercole, Provincial Economist and Assistant Comptroller of Finances, Department of Planning and Development, Government of Ontario, whose topic was "Some Economic Aspects of Ontario's Northern Development."

Opening with the arresting fact that Northern Ontario, with fewer than 600,000 inhabitants, produces about $1.5 billion in mine, mill, and forest output per year, Mr. Gathercole proceeded to outline some of the economic factors which have governed this progress in the past and will bear upon it in the future. He pointed out that intelligent government planning had combined with the personal and financial boldness of many individuals to produce the well-established grid of primary industry now operating in this region. Going back past the turn of the century to the time when nickel was a troublesome impurity in ores, and well-qualified advisers to overseas governments felt that their then known iron resources were comfortable for all foreseeable requirements, Mr. Gathercole brought his listeners swiftly through the key events of the years to the faster paced and less complacent 1950's, in which uranium and taconite are the magic words in Ontario's still-rich northland. Looking to the future, the speaker gave his opinion that continued healthy growth of the area will depend upon the governments of the future maintaining the favorable commercial climate which has been established by the governments of past years.

Mr. Gathercole was introduced by W. E. Brown, and thanked by Frank Milne.

Kitchener

J. F. Runge, M.E.I.C.,
Secretary-Treasurer

J. L. Fair, M.E.I.C.,
Branch News Editor

November Meeting

The second technical meeting of the season was held in the Officers' Mess, Knollwood Park, Kitchener. Mr. Harry Wilton of the Minneapolis Honeywell Regulator Company of Canada addressed the meeting on the subject "Instrumentation Comes of Age". The speaker sketched the growth of instrumentation over the last fifteen years, pointing out that progress had been dependent on the improvements in the speed and accuracy of the various elements in the instrumentation, and a proper understanding of the processes it was desired to control.

Instrumentation Illustrated

By means of numerous diagrams Mr. Wilton explained the effect of various process characteristics on the behaviour of a control system, and illustrated some of the problems arising from the inherent characteristics of the instruments themselves. Noting the very great activity in this field today, the trends likely in the near future discussed and related to the development of the completely automatic factory in which even many accounting functions will be performed in response to the stimuli of the instrumentation.

An interesting discussion period followed the address and the meeting was adjourned for refreshments.

Lakehead

G. E. Cook, M.E.I.C.,
Secretary-Treasurer

H. Penner, Jr.E.I.C.,
Branch News Editor

Opening Meeting

The opening meeting of the Lakehead Branch of the 1954-5 season took place on October 27, at the Fort William Armouries, Officers Mess. Mr. Frank Ayers took over in his new capacity as chairman. He announced something of an innovation in the matter of program arrangements. Since the position of program chairman has in past years been somewhat demanding of one person's time and energies, the position has been abolished. Instead each member of the executive will take care of the arrangements for a single program. Mr. D. B. McKillop was in charge of arrangements for the first program.

Mr. Hartvik Os of C. D. Howe Company Limited, consulting engineers, presented a paper on "The Design and Construction of the Extension of the CNR Ore Dock at Port Arthur". Mr. H. Halvorsen, construction superintendent of Pentagon Construction, general contractors on construction of the Ore Dock, showed a film taken during the construction of the dock.

Members were informed that a trip to the Lawrence Corporation Paper Mill at Red Rock is in the planning stage.

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Lethbridge

R. D. Hall, Jr.E.I.C.,
Secretary-Treasurer

W. O. Mills,
Branch News Editor

Fifty-five members and guests were present for the first regular meeting of the 34th year of the Lethbridge Branch. Mr. Ted Lawrence, incoming president, moved votes of thanks to the last executive for an outstanding year and to this year's program committee for their excellent work in commencing the year's activities with a field trip to the Tiber Dam in Montana in September, and for the interesting future scheduled programs. Mr. A. L. H. Somerville introduced and welcomed the guests and extended a vote of thanks to Mr. and Mrs. Brown who are commencing another year of dinner music for the meetings. Community singing was led by Mr. George S. Brown, Sr. The speaker, Mr. Paul Lusser, was introduced by Mr. Doug Hall and thanked by Mr. Herb Jamieson.

The Gas Turbine

A gas turbine commenced power production in the Canadian Utilities Ltd. Plant at Vermillion, Alberta in early October, thus introducing a very promising new field of prime movers to the Canadian economy.

Although now common in aircraft, the gas turbine is little known by the public in its industrial application, which Mr. Lusser traced from first patents in 1791 to installation and operation of such modern plants as a 27,000 kw. power plant in Switzerland.

Advantages such as inherent simplicity, its wide field of cheap fuels, from heavy residuals such as Bunker C oil to various gases such as natural, small cooling requirements, short starting times compared to steam, wide flexibility of installation and practically unlimited field of applications are constantly bringing these units to the foreground in the modern engineer's considerations of power suppliers for such units as generators, pumps, blowers, compressors or plants for ships, aircraft, locomotives and even automobiles.

Units produced for Arabia which require no cooling water at all would indicate a practical plant for sub-zero or arid zones, especially when coupled with an increase of up to 30% in efficiency, obtainable with low intake air temperatures. This is shown in the data Mr Lusser supplied on the Vermillion unit.

At 0° F. ambient temperature, the rated output at the alternator terminals is 7350 kw. with fuel consumption of 18.45 cu. ft. per klw.
At 80° ambient temperature, the rated output is only 5900 kw. with an increase in fuel consumption to 21.15 cu. ft. per kwh.
Speed 3600 rpm.
Atmospheric air consumed at full load is around 130,000 cu. ft. per min. or about 165 lbs. per second.
Compression ratio is 4.7 to 1.
Fuel is natural gas.
Temperature at Turbine Inlet is 1165° F.
Alternator rating at p.f. 0.8 is 8750 kva.
Alternator voltage is 4160 volts, 60 cycles.

Observations during tests indicated

that both guaranteed output and efficiency are not only being reached but exceeded.

Summing up, Mr. Lusser stated that the characteristic qualities of gas turbines would appear to offer ideal opportunities for their application under Canadian conditions. Large sources of natural gas and indigenous fuel oils are available. Cold winters coupled with increased power demands enhance the value of the gas turbines additional output and improved efficiency at low air temperatures. Its freedom from water requirements alone is attractive for many communities.

While the Vermillion Gas Turbine is today the first and only one in Canada, we may expect that before long there will be others across the country to justify the pioneering spirit of Canadian Utilities Ltd.

Montreal

R. J. Harvey, M.E.I.C.,
Secretary-Treasurer

J. A. Paget, M.E.I.C.,
Publicity Chairman

An Engineer Looks At Operations Research

Business executives can improve the accuracy, effect and timing of their decisions by basing them on fact, rather than on emotion and inspiration, J. Edgar Dion, consulting management engineer, told the Montreal Branch of the Engineering Institute of Canada on October 19.

This service to all those in business and industry who must make decisions and constantly improve the efficiency of their operations is most effectively rendered through 'Operations Research'.

Operations Research developed during the Second World War as scientists and mathematicians faced problems of logistics and strategy, and which Mr. Dion called "an extension of good basic management engineering".

Operations Research offers solutions to problems which previously have been considered beyond the realm of simple direct answers, he said, and allows "a great storehouse of human knowledge" to be used successfully in situations which previously have been considered too chaotic, too random, too complex or too uncertain for any other treatment than unaided intuitions and judgment.

Most executives intuitively use a bit of this method in coming to decisions, although they may not recognize it as such. However if they acquainted themselves with the formal 'Operations Research' approach they could take great advantage of it to improve the accuracy and ease in the decisions they must make.

The system provides a means whereby pertinent information may be distilled, decisions reached and actions taken from facts in a consistent and logical manner.

There is nothing vague or imaginative about Operations Research, Mr. Dion stressed. The analysis that it produces and the results arrived at are hard-boiled, the answer is firm and may be documented. Business and industrial leaders would be well advised to learn something more about the technique of Operations Research. If they don't, they are going to lose out competitively to those who do use it.

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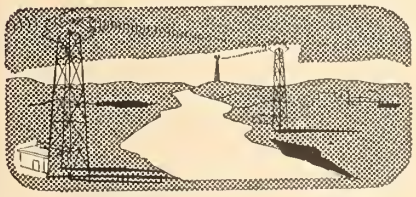
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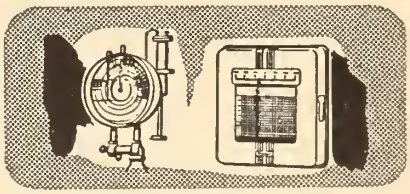
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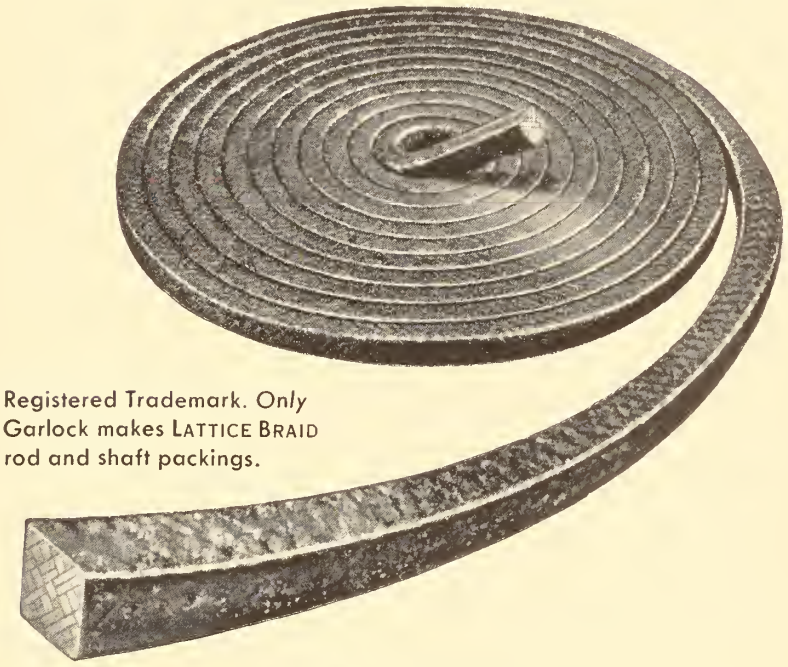

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Operations Research is now being used by all the Armed Services in Canada, Britain and the United States, and many of the most progressive companies in these countries.

Many universities in the United States are now giving seminar courses in Operations Research, Mr. Dion declared, and some Canadian universities will no doubt follow shortly.

London

D. M. JENKINS, M.E.I.C.,
Secretary-Treasurer

C. H. OSBORNE, JR.E.I.C.,
Branch News Editor

"Town Planning"

The London branch commenced fall meetings in October. It should be mentioned that a very successful trip to the Sir Adam Beck No. 2 Hydro Development at Niagara closed the activities of this Branch over the summer holiday period.

The speaker for the October meeting was Mr. Allan J. Barker, Director of the London and Suburban Planning Board. The speech about "Town Planning" as it applies to London was very enlightening. With the aid of slides Mr. Barker illustrated some of the work and some of the accomplishments of the Planning Board. Planning in this area is being guided by an extremely capable man.

A.I.E.E. Invited

Members of the newly formed branch of the A.I.E.E. were invited to the November meeting in which Mr. J. J. Carson of the Hydro Electric Power Commission of Ontario spoke about the problem of "Man Power Development". Mr. Carson stated that after the last war the H.E.P.C., along with many other big organizations, found themselves with the task of a large percentage of management replacements. These companies lacked men that had been trained to step into the top positions of the company. To meet this problem, qualified men had to be brought from outside the company and a program created to quickly train their men for management positions. Now the H.E.P.C. are doing extensive planning to develop and prepare its man power for vacancies to be filled and new positions that will be created with the program of company expansion. Mr. Carson is well qualified to speak on this subject and he received a big ovation for his extremely interesting speech.

Niagara Peninsula

C. E. WILLIAMSON, JR.E.I.C.,
Secretary-Treasurer

Engineers' Ball

Over 200 professional engineers and their friends made a huge success of the first Annual Professional Engineers' Ball held at the Sheraton-Brock in Niagara Falls on October 15.

It was sponsored by the Niagara Chapters of the Association of Professional Engineers of Ontario and the Engineering Institute of Canada. Distinguished guests included Col. W. L. Sagar, Col. T. M. Medland, and Mr. T. C. Keefer, of the Association and Mr. P. E. Buss of the Institute.

Chairman for the evening was Mr. J. E. Quist, president Niagara Chapter

A.P.E.O. who was assisted by Mr. C. H. Killoran, vice-chairman, Niagara Peninsula Branch, E.I.C.

Mr. C. H. Watson was the committee chairman.

Dinner music was played by pianist Mrs. Marion Swanson.

Dance music was under the direction of Babe Newman.

Sarnia

R. A. McGeachy, M.E.I.C.,
Secretary-Treasurer

C. N. Lund, Jr.E.I.C.,
Publicity Chairman

Kitimat Project

The Sarnia Branch met on September 16 to hear Mr. John Anderson, from the Aluminum Company of Canada's district office in Windsor. Mr. Anderson described the power development phase of the West Coast Aluminum project, including the damming of the Nechako River and the tunnel to the power house at Kemano. The power is then transmitted to Kitimat, where alumina imported from Jamaica is converted to metallic aluminum. By processing the bauxite to alumina before shipment to Canada, considerable savings are realized.

The construction engineers were faced with many difficulties, but have managed to overcome them all. As a result the plant is now in production. Alcan's pioneering at Kitimat has attracted other prospective industries, including pulp and paper and liquid air.

Mr. Anderson illustrated his talk with a colour movie "Man with a Thousand Hands", produced by International Harvester Company to depict the progress on the job.

Joint Dinner Meeting

Each year the Sarnia Branches of the Chemical Institute and the Engineering Institute try to hold two joint meetings. On Thursday, October 7, the E.I.C. was host for a joint meeting which was attended by 150 members of the two organizations.

The guest speaker was Mr. J. R. Montague, director of engineering for the Hydro-Electric Power Commission of Ontario. Mr. Montague described the development of the power phases of the St. Lawrence Seaway project. By the use of slides, the speaker told how studies of models of the river were used to estimate the flows to be expected, and to obtain basic data for the design of the dams and generation equipment.

Education in Ontario

A dinner meeting was held by the Sarnia Branch, on Tuesday, November 9, in the Terrace Room of the Colonial Hotel. The Branch was pleased to have as their guest speaker Dr. W. J. Dunlop, Minister of Education for Ontario.

Dr. Dunlop described the rapid expansion of the education system in Ontario, where one million pupils are expected to be enrolled by January, 1955. This required the construction of about 2,000 new class rooms, and the demand for teachers has far exceeded the supply. Emergency measures such as the training of Grade 12 graduates for public school posts have proved successful. It has also been necessary to hire teachers from Great Britain, over 100 having been imported. In some municipalities the Province is paying up to 90 per cent of the cost of education, though this is usually not mentioned by the local governments!

Concerning recent controversies regarding school programs, the speaker said that fundamental subjects such as reading, writing and arithmetic in public schools; and English, mathematics, science and geography in high schools are being stressed. Easing these courses would have disastrous consequences and in some cases, evidence is being found of this lack when students reach the university level.

Sudbury

A. D. Finlayson, Jr.E.I.C.,
Secretary-Treasurer

A. Eldridge, M.E.I.C.,
Branch News Editor

Industrial Fire Safety

The Sudbury Branch met on Thursday, Nov. 3, at the Sudbury Granite

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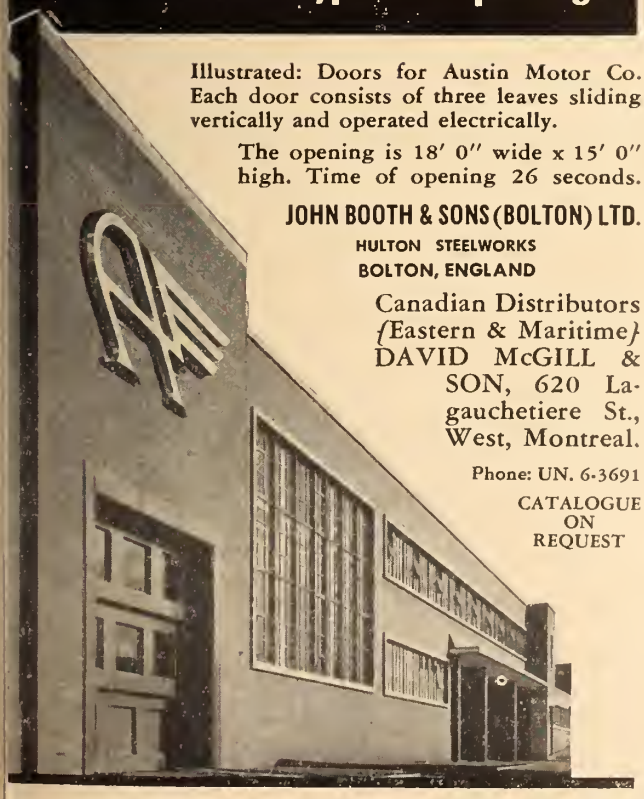

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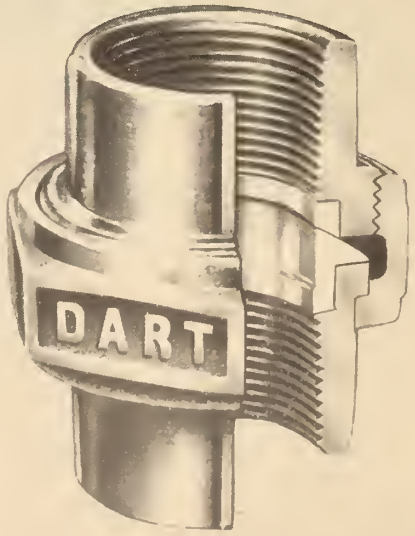

Two Bronze Seats Ground to a True Ball Joint

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TORONTO CANADA

Club. P. E. Kent of the Ontario Fire Marshal's Office in Toronto was introduced by Bob Crawford and spoke on "Industrial Fire Safety". This subject is important to industry because of the many losses which can result from a fire and which are not covered by insurance.

Fire Safety

Planning for fire safety, must go into the original plans of a plant and safety features should be ready at the same time that a process is to be run in. If possible, a plant should be separated into sections. As much space as possible should be left between buildings which in turn should be kept down to a minimum size. Personnel should be familiar with extinguishers and all must know what to do in case of fire. A fire in the new, large area, one storey factories is very hard to control. For these buildings, automatic protective systems should be provided.

Fire Prevention

The most common cause of industrial fires is the careless use of cigarettes and matches. Other causes are electricity and friction. Personnel in the petroleum industry are very fire conscious and consequently there are very few fires in this industry.

The speaker then described the fire at the General Motors hydromatic plant which was the largest plant fire ever to occur on this continent. The fire was started in drip pans, by an oxygen acetylene torch. The pans were not protected by an automatic system The fire was originally under control but extinguishers ran out and there was no fire brigade to take over. This fire will remain as an example for industry in the future.

The meeting was then shown the film, "Prevention of Industrial Fires" and the speaker was thanked by George Charlap.

Toronto

L. F. Bresolin, Jr.E.I.C.,
Secretary-Treasurer

H. Fealdman, Jr.E.I.C.,
Branch News Editor

Fundamental Research and Its Application

A panel discussion was held on Thursday, November 4 last, to discuss the Width of the Gap Between Fundamental Research and Its Application.

The members of the panel were:

Panel Moderator: Dr. H. H. Speakman, Director, Ontario Research Foundation.

Panel Members: Dr. E. W. R. Steacie, President, National Research Council; Dr. W. H. Watson, University of Toronto; Dr. K. C. Fisher, University of Toronto; Dr. Arthur Porter, Ferranti Electric; Mr. Roy W. Emery, Consulting Engineer; Dr. R. K. Larmour, Maple Leaf Milling Co.

A most lively meeting resulted, especially as most of the audience joined in the discussion. The talk wandered from such subjects as atomic energy, to commercial practices in the industrial field, and all present voted the meeting as one of the most enjoyable they had ever attended.

Winnipeg

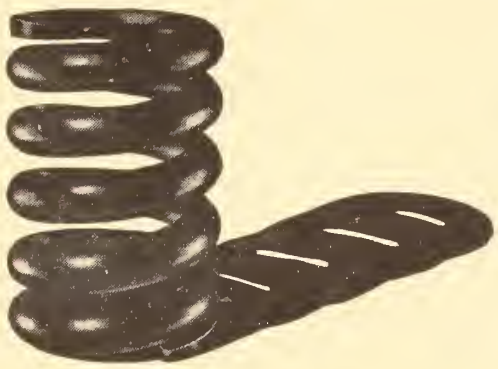
C. S. Landon, M.E.I.C.,
Secretary-Treasurer

W. V. Morris, M.E.I.C.,
Branch News Editor

M. Coyne

At a meeting held on October 21, under the chairmanship of J. Hoogstraten, some sixty members of the Winnipeg Branch were privileged to be addressed by M. Andre Coyne, from Paris, France, speaking on the subject "Twenty-five Years Designing and Building Dams". An engineer of wide experience, having built over seventy dams in the past quarter century, and having been consulting engineer to most of the technical agencies of the French Government as well as agencies in several other countries, M. Coyne fascinated the Winnipeg audience by his descriptions and slides of many of his projects.

Notably of interest were pictures and a short movie film of the "ski-jump" type of spillway, in which the energy



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of the discharging water is dissipated by air friction as the water is shot high in the air, to fall harmlessly to the tail race far downstream of the structure. M. Coyne was the first engineer to use such a spillway, and its successful operation made it the forerunner of many later spillways of the same type.

Startling to many of the audience, accustomed to the relatively heavy gravity type of dam section prevalent on this continent, were the remarkably slender sections achieved by using the arch principle. M. Coyne showed several photographs and drawings of this type of structure, with its gracefully curving shape. As he was careful to point out, however, such structures would not be suggested by him if they were to be built on the North American continent. In Europe, where labour costs are low relative to material costs, the saving in material effected by the additional work of forming and finishing the arch is economically justified. On this continent, where labour is expensive, it is more economical to expend material in order to save labour. Hence the use here of gravity, rock-fill, and earth-fill dams instead of the beautiful, but labour consuming arches.

M. Coyne also showed some examples of pre-stressing applied to dams. By using vertical cables anchored into the rock of the foundation, an additional compression is induced, which in effect adds an artificial load to the dam, thereby increasing the stability of the structure. This method was also applied by M. Coyne to dams already constructed, whose stability was in doubt.

Following M. Coyne's talk, the meeting was opened for questions, and the keen interest of the Branch members which had been evidenced by their attention to the speaker, was further attested by the discussion which followed. M. Coyne, in the discussion, reiterated his earlier statement that dams such as he had shown in his slides would not be recommended on this continent, emphasizing that each project must be conceived in the light of the economic, sociological, and cultural characteristics of the locality, and not just in the light of the topographic and physiographic features of the site.

The engineers of Manitoba and their ladies tendered a dinner in honour of the president of the Institute, D. M. Stephens, on October 15, in the Fort Garry Hotel in Winnipeg.

A presentation of a water colour painting was made to Mr. Stephens by C. A. Antenbring. The picture portrays the flow of the water through the channel between the cofferdams at Pine Falls in 1950 during the construction of the power station on the Winnipeg River. The painting was obtained through the courtesy of H. Bird of Bird Construction and was painted by Miss Barbara Cook.

Premier D. L. Campbell and Hon. J. S. McDiarmid, lieutenant-governor of Manitoba attended the dinner and both spoke briefly during the ceremonies. There were 130 in attendance at the cocktail hour and dinner, sponsored by the Winnipeg Branch of the Institute.

Electrical Section

B. F. Webster, M.E.I.C.,
Reporter, Electric Section

Annual Dinner and Dance

Approximately 240 members, their wives, and guests, attended the Annual Dinner and Dance of the Electrical Section of the Engineering Institute of Canada in Winnipeg on Friday, November 19, at the Marlborough Hotel.

Those who attended were welcomed by Professor N. Williams, as chairman, who then introduced the head table guests to wit: Mr. and Mrs. R. T. Harland, Mr. and Mrs. S. Barkwell, Mr. and Mrs. P. Shane, Dr. and Mrs. E. P. Featherstonhaugh, Dean and Mrs. A. E Macdonald, Dr. L. Austin Wright, Professor and Mrs. N. Williams, Dr. and Mrs. D. M. Stephens, Dean and Mrs. N. V. Scarfe.

The toast to the ladies was given by Mr. D. Hunter and ably responded to by Mrs. H. L. Briggs. The guest speaker was introduced by R. T. Harland. The guest speaker, Dean N. V. Scarfe, Dean of the Faculty of Education, University of Manitoba, gave an interesting and witty talk but finished on a more serious note with a challenge to engineers to become aware that technological advances should be associated with the necessary and required cultural changes. Mr. P. Shane thanked the speaker. Dr. D. M. Stephens, president of the Engineering Institute of Canada, extended good wishes from the other branches in the country to the section and its members.

Dancing started immediately after dinner in the Marlborough Blue Room and at the same time those in attendance enjoyed the refreshments as well as the satirical mural drawn by Les Barrett in the Marlborough Hall.

Montreal Branch

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BOOK REVIEW

The applications of results of research. Vera Connell, comp. and ed. New York, Academic, 1954. 212 pp., $5.00 (U.S.).

The book is based on a report prepared by Vera Connell and presented to the 1952 British Commonwealth Scientific Conference held in Australia, and deals with the methods used by the various countries represented at the conference for translating the results of scientific research into industrial practice. It deals primarily with the problem in relation to official and government sponsored institutions.

The first forty pages describe the problem in general and review the various methods used in making the results of scientific research known to those who can benefit by their application.

The rest of the book of 207 pages consists of several appendices which list and discuss the government research institutions throughout the Commonwealth. A short discussion of the methods used by TVA and the Regional Laboratories of the U.S. Department of Agriculture is also included.

A large sum of the taxpayers' money is today spent on research in government laboratories and the subject of how to pass the information obtained in this research on to those who can and should benefit from it in industry and agriculture is of vital importance. Without subsequent application of the results of research, the money spent on research is wasted.

The British Commonwealth Scientific Offices have, therefore, rendered a real service in having the book prepared and made generally available.

It will prove of interest to those who are concerned with the problems of application of research and with the transmission of scientific information.

A. H. Andersen,
Technical Director,
Shawinigan Chemicals Ltd.

BOOK NOTES

Prepared by the Library
The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Automatic selling. G. R. Schreiber. New York, Wiley, 1954. 195 pp., $5.00.

While this book may be of limited interest to readers of the Journal, it offers a detailed account of an industry which has not been widely publicized. The development of the automatic selling, or vending, business is traced by the author, the editor of Vend magazine, who also predicts the future of the industry.

The author presents various questions affecting automatic selling, including the market available, legislation affecting this method of selling, its limitations and possibilities, styles of machine, and cost. The book has many facts and figures, some in the form of charts and graphs, to illustrate every aspect of automatic merchandizing.

Blast cleaning manual. Society of automotive engineers. New York, The Society, 1954. 54 pp., figs., pa., $4.00 (U.S.).

The purpose, history, present status, and secondary effects of blast cleaning are given at the beginning of the manual, followed by data on such blasting machines as air blast units, airless blast units and wet blasting machines. It also gives information on blasting abrasives, recommended cleaning practices, production procedures, inspection, shot and grit specifications, life testing machines of four types, shot acceptance testing method and measuring shot-blasting machine efficiency.

This handbook will provide data for engineers, management, and shop personnel who want specific advice on the blast-cleaning process.

Centralization and decentralization in industrial relations. Helen Baker and R. R. France. Princeton, University. Industrial relations section, 1954. 218 pp., $4.00 (U.S.).

The question of centralization and decentralization in large industrial concerns which may have branches separated by thousands of miles is a very vital one today. This book presents the results of a survey made by qualified people of this problem as it affects industrial relations.

The authors first give a background picture of management attitudes toward centralization and decentralization, and of the organizational structure as it was found in the studies made of the multiplant companies selected for the survey.

The next section deals with the general responsibility for the industrial relations function including coordination and control. The responsibility for decisions on specific sub-functions is then described. These cover man-power utilization, wages and hours of work, and employee security programs.

The effect of the level of decision making on labour and personnel relations is discussed in the last chapters and a summary of the survey is presented.

The electrical engineer's reference book, 7th ed. E. Molloy, M. G. Say, and R. C. Walker, eds. Toronto, British Book Service, 1954. irreg. paging, diagrs., $12.00.

This new edition has kept abreast of developments in the field of electrical engineering and includes new British Standards where they apply. Some of the new sub-sections are: generators for steam and gas turbine drive, and for hydro-electric plant; power station batteries; diesel power plant; surge protection; controlled expansion alloys; argon shielded welding.

The subjects which this reference work covers are too numerous to list but they include technical data on cables and wires, switchgear, wiring, illumination, welding, electric traction, electronics, automatic control, electricity in mines, agriculture, aircraft and automobiles; education; electrical literature; rules, regulations, and supply data.

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Short subject bibliographies are compiled on request. When placing these requests, please give as much detail and background information as possible.

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Crystal rectifiers and transistors. M. G. Say, ed. Toronto, British Book Service, 1954. 170 pp., figs., $3.60.

Some of the information in this book is based on research done by companies in both the United States and Britain. It deals first with the development and preparation of germanium and silicon crystals, and their properties. The types of crystal rectifiers and transistors which have been recently developed are described, followed by details of the apparatus required for testing transistors.

The applications of crystal rectifiers and transistors, including sound detection and noise limiting, spot limiting, oscillators and amplifiers, and experimental circuits, are covered in the last chapter.

The fundamentals of electric log interpretation. M. R. J. Wyllie. New York, Academic, 1954. 126 pp., figs., $3.60 (U.S.).

The theory underlying the electric log measurement of spontaneous currents in boreholes and of the electrical resistivity of the formations penetrated by the borehole is presented in this work. It does not describe interpretation procedures and techniques in any detail, but does discuss interpretation charts and point out how they should be used, for example in calculating interstitial water resistivity. The author also shows how to interpret logs made by focused current devices and outlines the possibilities offered by devices with shallow penetration of current. The last section of the book presents rules of interpretation for contact logging devices.

Horizon mining. C. G. Fritzsche and E. L. J. Potts. Toronto, Nelson, 1954. 614 pp., illus., $15.00.

The author is a German professor who has written this as a textbook for British mining engineers who are now making more use of this type of coal mining.

We find a detailed treatment of the planning and development of a coal mining system employing at least two levels, with separate levels for haulage and ventilation. The book has six divisions and each is well illustrated. The first deals with the general principles of the horizon and semi-horizon mining systems, followed by a section on strata control and subsidence. In the chapter on development in stone there is a discussion of driving level cross-measure drifts, support of main roadways, construction of underground chambers and sinking of staple shafts. The last three sections cover development in coal, transport and ventilation.

An appendix, prepared with the assistance of the National Coal Board, describes several projects undertaken in British coal fields.

How to use test probes. A. A. Ghirardi and R. G. Middleton. New York, Rider, 1954. 172 pp., illus., $2.90 (U.S.).

Written for service technicians and beginners this manual is especially useful in TV receiver servicing. It describes the function and basic theory of operation underlying all types of probes and the correct methods of using them to obtain their maximum amount of service.

The testing devices which are covered here are resistive high-voltage d-c probes, capacitance-divider high-voltage a-c probes, resistive circuit-isolation probe, compensated r-c and cathode-follower circuit-isolation probes, rectifying probes for the VTVM, and, finally, demodulator probes.

Molesworth's handbook of engineering formulae and data, 34th ed. A. P. Thurston, ed. Toronto, British Book Service, 1953. 1672 pp., diagrs., tables, $5.60.

This revised and re-illustrated handbook is divided into sections on general matters; civil and general engineering; mechanical engineering; and electrical engineering. A system of main and sub-divisioning for easy reference has been introduced and information of mainly historic interest has been omitted. Each section contains a large number of tables which condense a great deal of data.

The General section contains mathematical tables, standards, workshop practice and material on explosives among other information. The other three sections are very comprehensive and provide a ready reference tool for engineers and consultants.

Newnes engineer's reference book, 6th ed. F. J. Camm, ed. Toronto, British Book Service, 1954. 1970 pp., diagrs., $12.00.

The new material which has been added in this edition includes transformer and coke formulae, metric tables, unified screw thread tables, and watchmakers measurements.

The information contained in this reference work applies to mechanical, civil, structural, automobile, and aeronautical engineering. It will also be used by designers, works managers, toolmakers, fitters, die-casters, wire workers, heating and ventilating engineers, electro-platers, welders, and time and motion study engineers.

The book is fully indexed and cross-referenced so that the best use may be made of the material. Many tables, diagrams, and formulae add to its importance.

***Norwegian-English technical dictionary.** John Ansteinsson. Trondheim, Bruns Bockhandels, New York, Kraus, 1954. 327 pp., $7.75 (U.S.).

This is a concise dictionary of the more important words used in English and American scientific and technical literature. It has been compiled primarily for translators engaged in translating Norwegian articles into English and for Norwegians studying in the United States.

Obtaining and interpreting test scope traces. J. F. Rider. New York, Rider, 1954. 186 pp., illus., $2.40 (U.S.).

The use of the cathode-ray oscilloscope in the fields of TV receivers, AM-FM radio receivers, audio amplifiers, power supplies, amateur transmitters, and test equipment is covered in this handbook.

The first seven chapters give a non-mathematical explanation of the shapes of commonly encountered waveforms and examples of their actual appearance. Scope control is then discussed, followed by a chapter on the causes underlying deteriorated voltage waveforms, with illustrations of each kind. The last chapters describes test setups for different kinds of scope observations.

No attempt is made to present trouble-shooting procedures.

On the sensations of tone as a physiological basis for the theory of music. H. L. F. Helmholtz. New York, Dover, 1954. 576 pp., illus., $4.95 (U.S.).

Reprinted more than 90 years after its first publication, Helmholtz's book is still fundamental reading for work in physiological acoustics. It contains a comprehensive analysis of musical sounds, covering them from the physical, psychological, physiological and aesthetic viewpoints.

The book covers such phases of musical acoustics as vibrations, resonance, structure of the ear, the qualities of tone, combinational and deep tones, beats of the upper partial tones, chords, principles of musical style, the system of keys, discords and the laws of progression of parts. The appendices also contain information on

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such subjects as the theory of pipes, the motion of plucked strings and experiments in the composition of vowels.

Picture book of TV troubles, v. 1 Horizontal AFC-oscillator circuits. John F. Rider laboratories staff. New York, Rider, 1954. 80 pp., illus., pa., $1.35 (U.S.).

This is the first in a series of manuals on TV receiver faults. It covers the four most common types of afc-oscillator circuits, giving a representative schematic diagram with the important normal waveforms and then presenting the various faults which have been found in each circuit. Abnormal picture tube patterns and abnormal waveforms are shown and compared with their normal counterparts.

Power system transients. E. O. Taylor, ed. Toronto, British Book Service, 1954. 176 pp., figs., $3.60.

Each section of this symposium has been prepared by a leading British electrical engineer to make it a reliable reference work for power system engineers, transmission engineers and designers of transformers, switchgear and protective gear.

The results of research and experimental work on voltage and current surges on transmission lines or in transformer and control equipment connected to the lines are presented in six sections. These cover the causes of transients; effects of transients on plant; protection against voltage transients; measurement of transients; impulse testing of power transformers; and calculation of transients.

Production engineering: jig and tool design, 5th ed. E. J. H. Jones. Toronto, British Book Service, 1954 (c. 1948). 324 pp., illus., $3.00.

The new edition of this comprehensive work will be interesting to at least two general classes of readers—the production engineer in charge of the tooling department of a plant, and the designer of tools, jigs and fixtures. Because of the great increase in new designs of machine tools the production engineer must be alert to recognize their full potentiality in his own organization.

The chapters in this book cover the use, design and manufacture of tools and jigs. The first part deals with such general matters as fits and tolerances, gauges, cutting-tool materials, multiple and consecutive tooling and tool calculation. More specific chapters then cover drill jigs, milling fixtures, broaches, grinding fixtures and grinding-wheel form-crushing, boring bars, and air-operated fixtures. A new chapter in the fifth edition describes negative rake machining.

The designs of the jigs and fixtures described in this book are related to the most economical form for the production of varying quantities of an article, and this fact will be appreciated by production managers.

The repair of the small electric motor. Karl Wilkinson. Toronto, British Book Service, 1954. 180 pp., diagrs., $3.50.

This is a practical, not a theoretical, manual on the maintenance and overhaul of electric motors up to 1 hp., excluding major repairs and actual rewinding. These standard types have been selected and their usual troubles discussed: the single-phase motor; the automatic switch; the rotor and stator winding; three-ϕ motors; repulsion, repulsion induction, and repulsion-start, induction-run motors; d-c. motors. The author also covers the reassembling, testing, and fitting of new bearings, small electric tools and connections for small motors.

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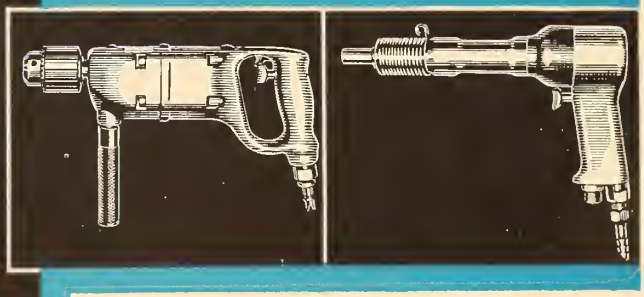

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***The scientific basis of road design.** F. L. D. Woolterton. Toronto, Macmillan, 1954. 364 pp., figs., $11.75. (Roadmaker's Library, volume XIV).

The greater part of this book is a study of soil properties, soil constants, and soil phenomena, including classification, chemistry and physics, electrochemistry, volume changes, and selection of materials. The last third covers design of subgrades and embankments, base courses, shoulders, and surface courses with their associated structures. Emphasis is on use of local soils for the construction of low-cost roads. References are listed after each chapter.

***Steam, air, and gas power,** 5th ed. W. H. Severns, H. E. Degler, J. C. Miles. New York, Wiley, 1954. 502 pp., illus., $6.50.

Basic information on heat-power theory, equipment, and practice for a first course in the subject is provided in this standard text. In revising the book the authors have reduced material on steam engines to one chapter and have modernized treatment of auxiliaries and equipment. There is a new chapter on refrigeration, and new material on centrifugal and axial-flow fans, oils and gases, and gas turbines.

Strategy for the West. John Slessor. Toronto, British Book Service, 1954. 162 pp., $2.25.

This book will be of general interest to those interested in the question of national armament and the balance of power in the world. The author presents his theory of what a "world war" means today when nuclear and thermonuclear weapons may force nations to live together in a more or less peaceful way.

The manner of dealing with communism abroad and at home is discussed, as well as the role of the United Nations, in keeping Russia confined to certain limits. A new concept of the importance of the airforce, army and navy is presented by the author who is a marshal of the R.A.F.

The last section, which discusses the European Defence Community and N.A.T.O., is especially interesting in view of recent developments in Europe.

***Strength and resistance of metals.** J. M. Lessells. New York, Wiley, 1954. 450 pp., illus., $10.00.

Essentially an enlargement of Part II of Applied Elasticity by Timoshenko and the present author, this volume for advanced students and engineers centers on the behavior of steel under stress, but considers also non-ferrous alloys and cast iron in cases where their behavior differs from steel. Individual chapters treat tension, overstrain, tensile properties at high temperatures, mechanical wear, etc., and three chapters are devoted to fatigue and fatigue failures. Bibliographical footnotes are included.

A treatise on applied hydraulics, 4th ed., rev. and enl. Herbert Addison. Toronto, British Book Service, 1954. 724 pp., illus., $9.65.

This is a general book on the principles of hydraulic engineering. In this edition a brief collection of biographical notes on some of the leaders in the field of hydraulics has been added, and the subject matter has been revised.

Part I deals with fundamental principles and discusses liquids at rest and in motion; flow through orifices, over weirs, through closed conduits and along open channels; dynamic pressure of liquids; radial and rotary motion of liquids.

The practical applications contained in Part II include pipes and pipe systems, control of water in open channels, hydraulic turbines, pumping machinery, hydraulic transmission and storage of energy, and hydraulic measurements.

A sixteen-page bibliography is an important feature of this reference book.

BOOKS RECEIVED

A bibliography of atomic power and related topics for the non-specialist. Chalk River, Atomic energy of Canada ltd., 1954. 87 pp. (Publication No. 114).

Basic naval architecture, 2nd ed. K. C. Barnaby. Toronto, McGraw-Hill, 1954. 460 pp., figs., tables, $8.75.

Calculation, design and testing of reinforced concrete, 2nd ed. K. L. Rao. Toronto, Pitman, 1953. 424 pp., figs., 35/-.

Choosing electric cables. C. C. Barnes. Manchester, Emmott, 1954. 40 pp., 3/6. (Mechanical world monograph, No. 67).

Empire and commonwealth year book, 1954-55. R. S. Russell, ed. London, Newman Neame, 1954. 529 pp., 45/-.

Engineering dynamics. v. 3. Steam turbines; v. 4. Internal combustion engines. C. B. Biezeno and R. Grammel. London, Blackie, 1954. v. 3., 264 pp., figs., 40/-; v. 4., 282 pp., figs., 50/-.

Engineering units and the Stroud convention. F. W. Thorne and A. C. Walshaw. London, Blackie, 1954. 29 pp., 3/6.

Handbook of hydraulics. H. W. King. 4th ed. rev. by E. F. Baxter. Toronto, McGraw-Hill, 1954. irreg. paging, figs., tables, $9.75.

Hiring practices and labor competition. R. A. Lester. Princeton University, Industrial relations section, 1954. 108 pp., $2.50 (U.S.).

Metals properties. Handbook. American society of mechanical engineers, ed. by S. L. Hoyt. Toronto, McGraw-Hill, 1954. 433 pp., tables, $13.50.

The physics of particle size analysis. A conference . . . held . . . April, 1954. London, Institute of physics, 1954. 218 pp., illus.

Nickel in iron and steel. A. M. Hall. New York, Wiley, 1954. 595 pp., figs., tables, $10.00.

Non-ferrous foundry metallurgy. A. J. Murphy, ed. Toronto, McGraw-Hill, 1954. 497 pp., illus., $15.50.

Operations research. Bibliography. Cleveland, Public library, 1954. 4 pp., $0.25.

Practical gear design. D. W. Dudley. Toronto, McGraw-Hill, 1954. 335 pp., illus., $8.50.

Principles of mass and flow production. F. G. Woollard. London, Iliffe, for Mechanical handling, 1954. 195 pp., illus., 25/-.

Quantum mechanics. F. Mandl. Toronto, Butterworth, 1954. 232 pp., $5.80.

Soil mechanics in road construction. C. F. Armstrong. Toronto, Macmillan, 1950. 215 pp., illus., $5.75.

Strength of materials, 2nd ed. Joseph Marin and J. A. Sauer. Toronto, Macmillan, 1954. 518 pp., figs., $6.75.

Titanium and titanium alloys. J. L. Everhart. New York, Reinhold, 1954. 184 pp., $3.00 (U.S.).

Welding for engineers. Harry Udin, E. R. Funk and John Wulff. New York, Wiley, 1954. 430 pp., figs., $7.50.

World list of abbreviations of scientific, technological and commercial organizations. F. A. Buttress. London, Hill, 1954. 261 pp., 18/-.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

American society for testing materials. Special technical publications:

No. 156—Symposium on dynamic testing of soils. No. 161—Symposium on temperature stability of electrical insulating materials. No. 167—Symposium on diesel fuels.

American water works association. Tentative specifications:

AWWA B702-54T—Sodium silicofluoride.

Association of consulting management engineers:

How the management consulting profession serves American business.

Association of short-circuit testing authorities. Publications:

ASTA no. 15—Rules for the unit testing of circuit-breakers for making-capacity and breaking-capacity.

British electricity authority:

Sixth report and accounts, 1953-4.

Canada. Department of agriculture. Prairie farm rehabilitation administration. Design bulletins:

No. 2—Hydraulic design of outlet transition and stilling basin for single barreled conduits.

Canada. Dominion bureau of statistics:

Construction in Canada, 1952-1954.

Canada. National research council.

Thirty-seventh annual report, 1953-54.

Canada. National research council. Associate committee on soil and snow mechanics. Technical memorandum:

No. 29—Construction and maintenance of roads over peat, by F. B. Dryburgh and E. R. McKillop.

Canadian electrical association:

Sixty-fourth annual convention, 1954, proceedings.

Royal institute of technology, Stockholm. Transactions:

No. 84—Lateral stability of bridge arches braced with transverse bars, by Lars Ostlund.

Smithsonian institution. Publications:

No. 4153—The push-button factory, by F. K. Shallenberger.

Underwriters' Laboratories of Canada. Standards:

C58—Proposed revision of standard for underground storage tanks for hazardous liquids.

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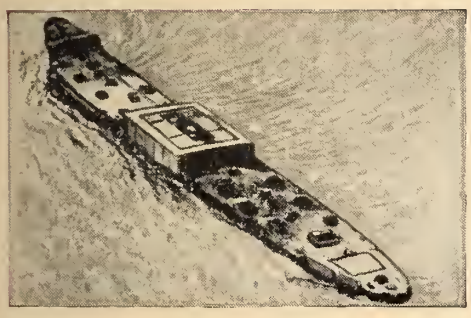

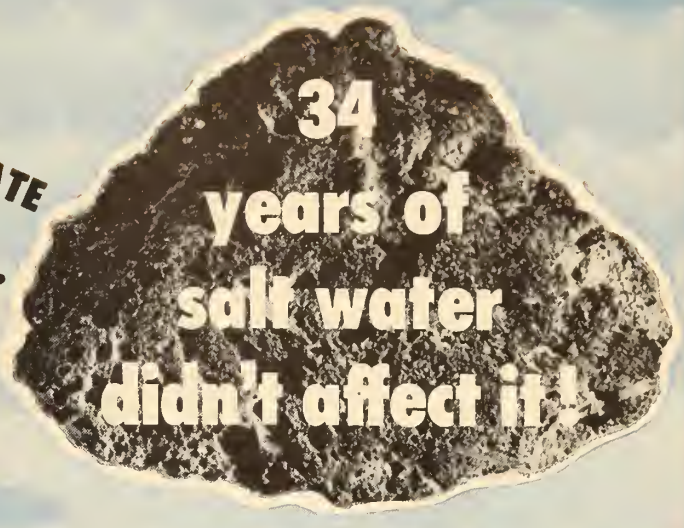

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United States. National bureau of standards. Applied mathematics series:

No. 32—Table of sine and cosine integrals for arguments from 10 to 100. No. 34—Table of the gamma function for complex arguments. No. 39—Contributions to the solution of systems of linear equations and the determination of eigenvalues.

United States. National bureau of standards. Miscellaneous publications.

No. 212—Report of the 39th national conference on weights and measures, 1954.

United States. Highway research board:

Thirty-third annual meeting, 1954, proceedings.

NEW PERIODICALS IN THE LIBRARY IN 1954

Members may borrow any but the current issue of the periodicals listed below.

Automation. Monthly. $10.00 p.a. v. 1., n. 1., August 1954. Pub. by Penton Pub. Co., Cleveland 13, Ohio.

Bulletin CIB. Bimonthly. Pub. by The International council for building research studies and documentation, Diergaardesingel 75, Rotterdam.

Chartered mechanical engineer. Monthly. $15.00 p.a. Pub. by the Institution of mechanical engineers, Storey's Gate, St. James's Park, London, S.W. 1.

Control engineering. Monthly. $4.00 p.a. v. 1., no. 1, Sept. 1954. Pub. by McGraw-Hill Pub. Co., 330 W. 42nd St,, New York 36.

Corrosion prevention and control. Monthly. $5.00 p.a. Holland House, 140 Cromwell Road, London, S.W. 7.

Institution of mining engineers· Transactions. Monthly. 15/- per no. Pub. by the Institution, Salisbury House, Finsbury Circus, London, E.C. 2.

Instrument society of America. Journal. Monthly. $5.00 p.a. Pub. by the Society, 1319 Allegheny Ave., Pittsburg, Pa.

Instrumentation. Quarterly. Pub. by Minneapolis-Honeywell Regulator Co., Philadelphia 44.

Magazine of concrete research. 3/6 per no. Pub. by Cement and concrete assoc., 52 Grosvenor Gardens, London, S.W. 1.

Operations research society of America. Journal. Irreg. $6.00 p.a. Pub. by the Society, 6410 Connecticut Ave., Chevy Chase, Maryland.

Post office electrical engineer's journal. Quarterly. 2/6 per no. Pub. by G.P.O., Alder House, Aldersgate, London, E.C. 1.

Scope. Monthly. 30/- p.a. Pub. by Creative Journals, 9 Grosvenor St., London, W. 1.

Stork review. Irreg. Pub. by Koninklijke Machinefabriek Gebr. Stork, Hangelo, Holland.

Technical journal of the Brush group. Quarterly. Pub. by the Brush group, Duke's Court, St. James's, London, S.W. 1.

Yale scientific. Monthly. $2.00 p.a. 244-A Yale Station, New Haven, Conn.

STANDARDS REVIEWED

American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.T.M. Standards on adhesives (with related information), $1.75 (U.S.).

In this specification all the ASTM methods of test relating to adhesives are brought together. In addition to adhesives in general there are standards for rubber cements, brake shoe adhesives and vulcanized rubber and electrical insulation. Definitions of terms and methods of test are included under each section. The specifications cover such properties as storage life, strength, tensile, working life and resistance to chemical reagents.

ASTM standards on copper and copper alloys, pa., $5.00.

This compilation includes in their latest form 123 ASTM standards, covering 108 specifications; 10 test methods; 2 classifications: one of coppers, the other of cast copper-base alloys; 2 recommended practices: one for tension test specimens for copper-base alloys for sand castings, and one for designating significant places in specified limiting values; and one hardness conversion table for cartridge brass.

New material comprises specifications and test methods for: round chromium-copper wire for electronic devices; seamless copper tube for refrigeration field service; copper and copper-alloy die forgings (hot-pressed); soft or annealed coated copper conductors for use in hook-up wire for electronic equipment; copper-zinc-manganese alloy (manganese brass) sheet and strip; nickel-tin bronze castings; determination of cross-sectional area of stranded conductors; and stiffness of bare soft square and rectangular copper wire for magnet wire fabrication.

Standards cover: specifications for electrical conductors; plate, sheet, rolled bar, and strip; rod, bar, and shapes; nonferrous metals; wire; pipe and tube, ingot; sand and die castings; filler metal; and methods of test for copper and copper-alloys.

British standards, British standards institution, 2 Park Street, London, W. 1. British standards are available from the Canadian standards association, National research building, Ottawa, Canada.

B.S. 1054: 1954— Engineers' comparators for external measurement. 2/6

Comparators are now made with magnification factors of 10,000 and over. The standard has, accordingly, been revised and, while it relates primarily to comparators of the vertical type, it may be adopted for horizontal types. In addition to stating requirements for features such as work-table, measuring anvil, pointer, scale, etc., standards of performance are laid down and tolerances on scale readings are specified in inches and millimetres for comparators of various degrees of sensitivity within the range covered.

B.S. 2501:1954 — Manufacture and testing of refrigerating cabinets (reach-in type). 3/–.

B.S. 2509: 1954 — Layout of periodicals: a guide for editors and publishers. 3/–.

The standard deals with data for identification of periodicals; the presentation of the contents, and matters relating to individual issues; the periodical as a bound volume; special problems such as changes of size and title, amalgamation and division. The last section makes recommendations for supplements, series, reports and symposia which are similar to periodicals. In general it covers scientific, technical and other periodicals used for reference over a long period.

Canadian standards, Canadian standards association, National research building, Ottawa, Canada.

C.S.A. B78.1-1954—Mechanical engineering drawing standards. $1.75.

This publication makes available for the first time in Canada a comprehensive standard on drawing office practice. The standard covers the field of mechanical engineering drawings under the following sections:

1. Drawing sizes, format, title blocks, revision blocks, etc.
2. Lines, lettering, scale, notes and abbreviations.
3. Views, projections, sections and cross-hatching.
4. Drawing conventions.
5. Dimensioning.
6. Tolerancing.
7. Machining and roughness symbols.

Over 150 drawings illustrate the points covered by the text. Of particular interest in the section on tolerancing is that part dealing with geometrical tolerances for straightness, flatness, parallelism, squareness, angularity, concentricity and the specification of symmetry and position.

C.S.A. C22.2 No. 71: 1954 — Construction and test of portable electric tools. $1.00.

Potentials up to and including 250 volts between conductors are specified, with application to hand tools, transportable and bench tools, and electro-magnetic tools. Specification details such as construction and input, marking, and tests are included.

C.S.A. C22.2 No. 99: 1954 — Construction and test of domestic electric ironing machines. $1.00.

This specification concerns both portable and stationary domestic ironing machines, either with or without automatic temperature control for potentials of 250 volts or less. It does not apply to commercial or industrial types of laundry ironing machines.

C.S.A. 080 series—Specifications for wood preservation. $15.50 series.

The 35 specifications in this series are intended as a manual of good practice for operations pertaining to chemically-preserved wood. The first group of standards deals with analysis methods of creosote, of water-borne preservatives and fire-retardant formulations, and of oil-borne preservatives among others. The second group deals with procedures in treating various timber products, e.g. preservative treatment of piles, poles, posts, and crossties by pressure methods. Conversion factors and correction tables are covered in one group and types of preservatives in another. The miscellaneous group of standards includes instructions for the inspection of preservative treatment of wood, for the care of pressure-treated wood after treatment, and a glossary of terms used in wood preservation.

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Reinforced Concrete Bridge at St. Clothilde, neor Drummondville, P.Q. (Contractor: CORMIER LTD., Victoriaville, P.Q.)

Concrete Bridge at St. Roch l'Achigan, P.Q. (Contractor: René Chompoux, l'Epiphonie, P.Q.)

Concrete Bridge neor Rivière du Loup, P.Q.
(Contractor: J. A. RATTE & FILS, Les Etroits, P.Q.)

Owner of Bridges: Quebec Government, Department of Public Works
Minister of Public Works: Hon. Roméo Lorroin
Deputy Minister: Ivan E. Vollée
Chief Engineer: O. Desjardins.

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BUSINESS & INDUSTRIAL BRIEFS

A Digest of Information

received by

The Editor

Appointments and Transfers

Lincoln Electric Company.—At a recent meeting of the Board of Directors, R. G. Alison was elected vice-president in-charge-of sales of the Lincoln Electric Company of Canada Limited, Leaside, Ontario.

Mr. Alison has been with Lincoln Electric Company since 1937 when he graduated from the University of Toronto, Faculty of Applied Science.

●

Fraser Companies.—V. H. Emory, manager of manufacturing — pulp and paperboard, Fraser Companies, Limited here, recently announced several staff appointments. C. T. Clark has been appointed manager of the company's Edmunston mills succeeding Mr. Emory. G. C. Beatteay has been named manager of the Atholville mill of the company's subsidiary, Restigouche Company, Limited. He succeeds Mr. Clark in this position. E. O. Houghton succeeds Mr. Beatteay as sulphite mill superintendent at Edmundston and L. G. Sears assumes Mr. Houghton's former position as superintendent of the Atholville mill. H. G. Larlee has been appointed groundwood and woodhandling superintendent at Edmundston succeeding Mr. Sears.

●

Don Mills Developments.—T. H. Bartley, former general manager of the Toronto Industrial Commission, has been appointed Industrial Consultant to Don Mills Developments Limited.

A graduate in civil engineering from the University of Toronto, Mr. Bartley was employed by the federal government in the field of industrial research prior to joining the Toronto Industrial Commission to pursue similar work in 1931. He was made general manager of the Commission in 1937 and held that post until his retirement earlier this year.

●

J. R. Philips and A. Lauder.—Following the appointment of T. Lindsay as Executive Vice-President, the Board of Directors of Phillips Electrical Company (1953) Limited announce the following changes in organization: J. R. Philips, a member of the Board and vice-president (operations), has been appointed to the new position of vice-president (finance). A. Lauder, presently works manager, is appointed vice-president (production and engineering). E. J. Thomas will succeed Mr. Lauder as works manager.

●

Public Works.—Works Minister Winters announced recently that following completion of temporary assignments, three senior members of the staff of the Harbours and Rivers Engineering Branch of the Department of Public Works are returning to their previous positions.

J. M. Vogin has returned to his office as Ottawa District Engineer following his temporary assignment to a position under Harbours and Rivers Engineering Branch Chief Engineer, A. A. Anderson.

C. W. Morgan, who has been substituting for Mr. Vogin in Ottawa goes back to his regular position as district engineer for the Department of Public Works at Toronto.

C. A. Stocking who has been acting district engineer at Toronto during Mr.

J. R. Philips

A. Lauder

E. J. Thomas

RAIL TRAFFIC HELD UP ONLY 12 HOURS!

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Assoc. Company Plants at: AMHERST, N.S., QUEBEC, SAULT STE-MARIE, EDMONTON

Morgan's special tour of duty in Ottawa, returns to his former position in the Harbours and Rivers Engineering Branch at Toronto.

●

Canadian Westinghouse. — Increased participation in the rapidly-expanding electronic tube industry by the Canadian Westinghouse Company has brought about a structural reorganization of the firm's lamp-tube division, which formerly operated as a single unit.

Two separate divisions have now been established under general manager L. A. McCalpin. H. E. Rice, formerly manager of the company's television-radio division at Brantford, Ontario, has returned to Hamilton to manage the newly-created tube division. He is succeeded by Ricardo Muniz who formerly held the post of operations manager at the extensive television facilities at Brantford.

New Equipment and Developments

A. V. Roe Canada Limited Becomes Three Company Group.—Another major move in the steady advance of A. V. Roe Canada Limited was announced on December 2. Two new companies are formed and a third is acquired, to make up a three-company operating group, with A. V. Roe Canada Limited as the parent company.

Crawford Gordon, Jr., president and general manager, announced the group is to be made up of these three companies:

Avro Aircraft Limited — which is formed out of the Aircraft Division, currently employing about 10,000. Orenda Engines Limited — formed out of the Gas Turbine Division, currently employing about 6,000. Canadian Steel Improvement Limited, producer of precision forgings in a wide range of materials, employing about 400, which is bought outright by A. V. Roe Canada Limited. A plant expansion program is underway for this company which will include a light alloy foundry.

Operating heads of the three companies are: Avro Aircraft Limited — Fred T. Smye; Orenda Engines Limited — Walter R. McLachlan; Canadian Steel Improvement Limited — Cyril J. Luby.

●

Canadian Sirocco.—The Canadian Sirocco Company, Limited, Windsor, Ontario announce the opening of their Vancouver Office located in the Shelly Building, 119 West Pender Street, Vancouver 3, B.C., and the appointment of A. L. Pike as Vancouver branch manager.

Mr. Pike graduated from the Liverpool Technical College in England as an Electrical Engineer and after service during the war years with the Royal Navy came to Canada in 1946 as sales engineer for A. R. Williams Machinery Western Limited.

●

Warnock and Hersey Merger.—In a joint statement by Byron T. Kerr, president of Charles Warnock and Company, Limited, (established 1926), and E. Peter Hersey, president of The Hersey Laboratories Limited, (formerly the Milton Hersey Company Limited established 1888), announcement is made of the merger of these two old-established companies under the new name of The Warnock Hersey Company Ltd.

As a result of this merger, the new company will become one of the largest inspection, appraisal, and testing companies in Canada, serving the construction, manufacturing, railroad, pulp and paper, petroleum, public utilities and other fields.

Concurrently with this change, the new company announces the opening of a modern head office and laboratory building in Montreal, and a new branch office and laboratory in Edmonton, Alta. The staffs of both companies will continue to operate the company. These staffs have been augmented by a large number of engineers, chemists and other technicians at the head office and nine branch offices and laboratories throughout Canada.

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Royal York Hotel,
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May 23-24-25, 1956
Montreal, Que.

June 12-13-14, 1957
Banff, Alberta

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L. AUSTIN WRIGHT, M.E.I.C.
Editor

H. G. THOMPSON, M.E.I.C.
MARGARET GRIFFIN
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Field Secretary
236 Avenue Road, Toronto

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17,400 copies of this issue printed

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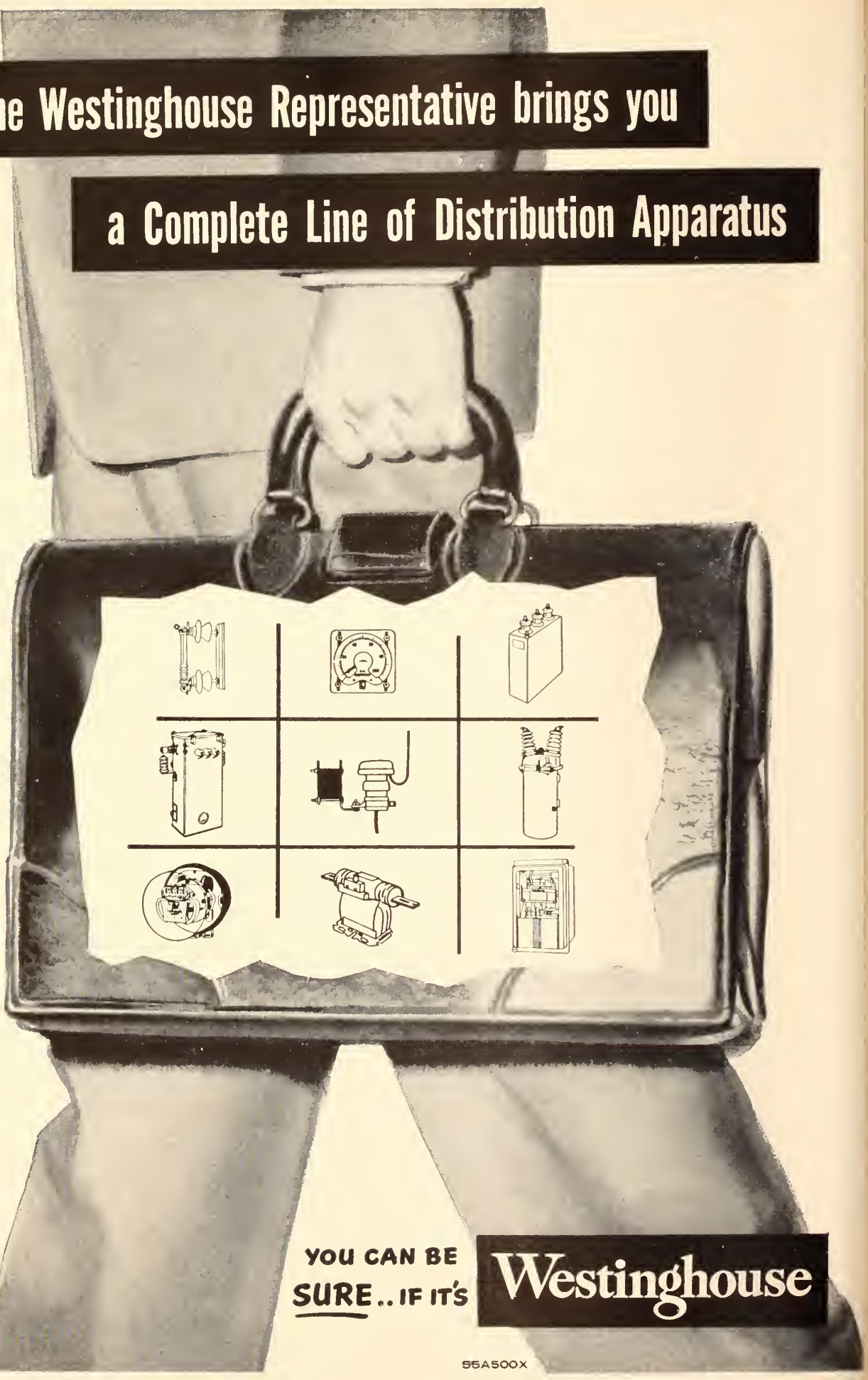

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56A500X

Mass Production

of the

Calculating Machine

by

Henry A. Spencer, M.E.I.C.

Industrial Engineer.
Research Council of Alberta.

Mass production of a precision product such as a calculating machine is a complex operation, due to the critical nature of materials and dimensional tolerances. The author has clearly related the importance of the manufacturing and business methods applicable to the successful production of such a machine.

This paper is of a type infrequently published in the *Journal*. Its contents will be a welcome addition, particularly to industrial engineers.

One of the most ingenious applications of engineering skill is the mass production of a calculating machine. (Fig. 1.) Within covers the size of a typewriter, mathematical problems are solved by mechanical actions. One merely selects numbers and the operation to be performed, and the machine does the rest. Even a square root problem requires the depression of only one button.

When the machine is operated with the covers removed it is apparent that many parts act at high speed to accomplish the calculation. Their movements are described in the accompanying illustration.

Close examination of each part reveals that it has been made by mass-production tools. There have been adjustments but no expensive fitting by hand. Since there are a large number of cooperating parts, inaccuracy in any one of these may be multiplied by leverage in another part of the machine. Close tolerances on dimensions are therefore necessary. These things are achieved by good control of tooling and assembly, and, first of all, by the careful planning of experienced designers.

Origin of Ideas for Design

Calculators usually are designed by a group of research engineers who have developed the ability of mechanical and structural visualization. Mention a possible new machine function to these men and they immediately picture the timing, layout and relation of parts —whether there will be an interference or a difficult manufacturing problem. They begin to invent and suggest ways of achieving the function. So much is invented that a staff of patent lawyers is maintained to protect new ideas.

The ideas for an entirely new calculator or for a new feature may come from many directions. The sales and service staffs are the eyes and ears of any organization. Their reports from the field often decide the course of action to be taken. Within the organization, the manufacturing department may ask for

Fig. 1. A typical modern calculator.

a modification or redesign for simpler construction and assembly. In the research department an engineer may invent something completely new which the sales department will find is valuable to the potential customer.

Although the machines as originally designed are workable, they may not be economically producible nor foolproof. For instance they may be noisy, or awkward to operate, or may have hidden defects which an operator encounters in special applications. To overcome these faults, the machine must go through a period of development. The length and difficulty of this period depends largely on the engineer's ability to adapt ideas to manufacturing practice.

Design Background in Manufacturing Methods

The engineer who works as a designer is familiar with his shop. From his knowledge of the machines which will produce parts quickly and cheaply, he learns how to develop new parts which can be made easily in these machines.

Several types of machines used in modern calculator manufacturing turn out quantity with precision. The Automatic Screw Machines, commonly called "Automatics", usually make round parts, and do many cutting, drilling and milling operations simultaneously, rather than in sequence. Until they are finish machined, the parts may be held on the rod from which they are turned. With the use of "needle bar" (pre-ground stock) accuracy may be had economically by the elimination of separate part grinding.

For flat parts, the punch press works like a cookie cutter. Sometimes the parts are formed or have other operations performed in different stages of the same die. A strip of metal is forced into one side of the press. As the die goes up, a movable stop positions the strip, and the die closes to punch out part of the pattern. The stop pushes aside to allow the strip to be moved into a new position, where it lines up with more punches.

On the next stroke of the die, a complete part may be punched out of the strip over the first holes, and at the same time the first holes put into the strip for the next part. The die described would be called a two-stage progressive die or "follow" die. Parts falling into the bin will have small burrs on the edges, since they are cut by shearing. The burrs are removed by belt slicking or tumbling in suitable compounds.

Moulding with plastics or die casting machines eliminate costly practices. Dies for both machines can be made so accurate that parts are more interchangeable than if individually machined. Sometimes a network of parts is produced on runners in star or grid shapes. Parts are removed at a thin section by manual fracture of this "neck". For certain plastic applications, double injection of different colours is performed. Keytops and dials are made in this way.

These machines work best in certain specialized operations. The type of design governs the kind of machine used, and the machine governs shape and size of part designed. In every case the designer who is on friendly terms with tool and die makers will have the opportunity to learn. For instance, on their advice he may find it best to round corners on die made parts to make the die last longer. For sectional dies, however, parts of the die are ground separately and then fitted together. In this case it may be wiser to design a sharp corner. A great deal depends on regional tool practice in the particular shop for which the design is being made.

Design from Layout to Production

The engineer has an idea which he puts on paper in the form of an enlarged "layout" or scale drawing of the mechanism. Accuracy here is maintained by the use of high quality paper and instruments, including a magnifying glass. Experimental parts made from detailed drawings of this "layout" are tried in actual machines by "mechanicritics", who test them for ease of assembly and performance. Sometimes three or four prototype machines, each consisting of thousands of parts, are built solely for study.

Often new parts must be fitted into an existing machine. The square root machine is a typical example of an exceptional achievement. This kind of design demands complete knowledge of all parts and their sequence of operation. A designer probably will not be a mechanic, but is in close contact with mechanics and learns operation patterns and sequences from them. Occasionally the new part will cause an interference with another part of the machine. The mechanic may be able to readjust the machine for clearance, or the design may require modification.

When parts have been made and tried successfully in the machine they are observed further by a test engineer. A breakdown test is arranged. If the parts require it, they may be subjected to artificial shipping shocks or cold or heat treatments, to determine their reliability. Carbon brushes are tested with several new brush holder designs to see which type has the greatest life. In this case on and off switches are timed to duplicate the action which is most like that found in service. To determine life span, automatic controls are set up to run the machine continuously until some part breaks down.

After this testing has determined the worth of the newly designed parts, more of the same design are made up to try in the assembly line. Since the new parts will affect the production quotas of all who assemble them, line workers are constructively critical. A group of trained inspectors and assembly line foremen check the process of putting in new parts, and report any assembly problems.

The machines thus specially built are tagged for observation. When the research project has been launched by the requests of distributors in the field, these men receive the first experimental machines with newly designed hand-made parts. Records are kept of performance, and the designer is informed of their success. When the design has proved its worth, the research manager sends his authorization to the factory manager and the plant gets ready for production of the engineer's design.

Factory Management

The factory manager is responsible for factory administration, production and tooling. He is adviser to top management on the state of manufacturing, and decides at what time the factory can best go into production of a new group of parts. When new machines are needed, or expansion or cutbacks required, it is his good judgment which helps keep the company on an even keel.

A progressive factory manager may be responsible for the introduction of modern methods, and by skilful manipulation of the resources at his disposal, may pull the factory through a difficult period. Often he can put the sales force ahead of competition by organizing a speedy tooling-up program for a new feature or machine model.

Production Engineering

Production engineering administrates the factory manager's orders. Information from every branch of the factory is gathered, and central records are kept of every part made.

For a complex machine like a calculator, the records are necessarily complex. They are constantly changing with improvements in parts and assembly methods.

The production engineering staff prepares final drawings, standardized as to tolerances and technique. Prints from these are issued to the tool design department, which works out changes in existing tools or designs new ones. Production engineers then check over the drawings and issue tool orders to the tool and die shop. At this time, knowing how the part will be made, they prepare flow sheets.

Flow sheets, standardized as to form are advanced to the methods department. These men check the flow sheets against the proposed tools, and decide the time and type of labour which will be required to make the parts. This information is added to the flow sheets to give the accounting department cost data. Methods engineers may also suggest improved tooling or routing to save time.

Flow sheets are returned at this point to the production engineers who have copies made for each department. Notice is given in this way that the new part is coming, so that preparations may be made. If a special machine tool is required this can be ordered. Provision may be made in advance so that regular production is not disrupted.

Production Control

The production control department, working from sales estimates, decides when parts are needed and arranges for their manufacture. The factory is organized so that each piece of equipment has a few jobs ahead. Enough parts are made at one time to pay for the "setup" time required to put the automatic machines into operation. Excess parts are held in storage, and form a buffer so that enough parts are made to prevent assembly line shortages. The storeroom inventory is an indicator to Production Control of irregularities in production or assembly.

When the production control office receives notice from the production engineering office that changes will affect certain parts, they issue a "stop" order to the manufacturing of those parts. When the flow sheets arrive from production engineering, production control organizes the work to include the new parts and assists in scheduling tool manufacture. After notice has been received from the tool and die shop that tools to make the parts have been inspected, the production control office issues initial orders for the new parts and estimates a trial date and an installation date.

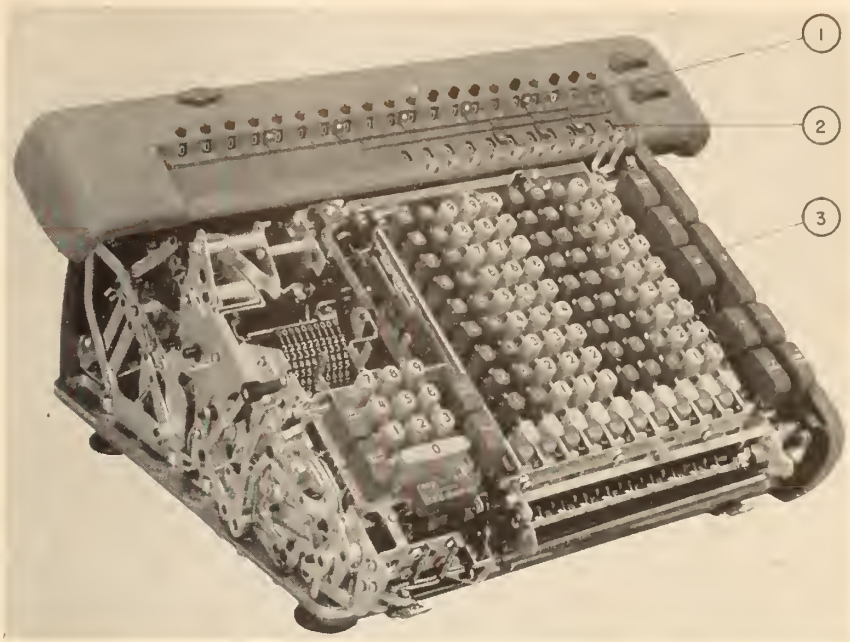

Fig. 2. Covers removed showing part of the mechanism: 1. accumulator dials; 2. counter dials; 3. plus bar.

Materials, stock parts and service orders are controlled from this office. Records here are an indication of the state of manufacturing. Where a large number of parts and machines are handled, a tabulating machine section may be the best method of maintaining adequate control.

Tool Design

The Tool Design department consists of a staff of inventive and highly skilled tool designers who work out inexpensive methods of making parts. Since accuracy is important, the usual form of die made is a "compound" type die. Its accuracy, retained throughout its life, is easily maintained by simple grinding.

Adequate liaison is an essential part of tool design. Tool designers spend much of their time in the tool and die shop. Diemakers are not restricted to careful drawings of dies except for important dimensions. If given a certain amount of freedom in this respect, their experience will enable them to build better dies. Previous experience as a diemaker is invaluable to the tool designer.

Special Parts

Occasionally an emergency arises. For instance, a group of new parts may be required before a tooling program can be set up, or a customer may need many parts of a special nature. Cases of this type are handled by a Special Parts department. These few men have advanced skill and are able to turn out precision parts with speed. They use certain high-speed tools of an adaptable nature such as bench die presses, nibblers and filing machines, but their biggest asset is experience. Perhaps they formed part of the original shop with which the company started business. These men do their own tool designing, production scheduling and fabrication.

Manufacturing Shop

Three main types of mass-production tools have been described above: the punch press, automatic screw machine and plastic moulding machine. They are the backbone of the Manufacturing Shop. Auxiliaries to this shop do secondary operations, such as drilling, tapping, reaming, etc. Small mills, drill presses and specially built automatic machines handle this type of machining.

In another secondary shop, parts may be put together in sub-assemblies before being sent to the line. For example, die riveting machines may apply hubs to swinging levers, and riveting or spot welding machines may assemble other components. Wherever possible, parts are completed so that the assembler does not have to slow down to drill or tap a hole, or perform other hand-finishing operations.

In addition to machining and subassembly other secondary operations include degreasing, grinding, heat treatment, plating and painting. Also, inspection of parts is necessary when a production tool is

being set up and before parts are stored. About 10 per cent of the manufacturing personnel are engaged in statistical quality control.

Assembly Line

The assembly line manager, experienced in every section of the line, is selected for his administrative ability. His production system is set up in consultation with experts of the methods department and his own foremen. Sections of cooperating parts are built up as far as possible in major subassemblies before being put into the machine. As the calculator assumes shape in passing through the line, checks are made on adjustments and running ability by line inspectors, whose responsibility is a faultless machine.

The completed calculators are put through a final inspection by a group of trained operators. Every component of the machine is checked for reliability by standard tests which each machine must pass. These tests are designed to show up the slightest error of adjustment or fit. For example, they will be able to replace a spring pulled out of shape by handling, or straighten a tight shaft.

When the calculators have been thoroughly inspected they are packed in shipping containers and sent to distributors for sale. The containers are made to resist shock, having a large piece of plywood for a base, to which the calculator is connected. Rubber shock mounts are used. In addition to these precautions the machines are well padded, and seldom arrive damaged.

Sales and Service

To sell calculators, the salesman must be able to explain machine functions to specialized people, who may ask very technical questions. A salesman who knows the machine's capabilities and limitations will be able to adapt the calculator to a customer's needs.

The organization of sales is a complex problem. In most cases exclusive company outlets in larger communities are chosen because they can offer best service. Since most calculators have approximately similar functions and characteristics, a good sales and service organization is important in overcoming competition.

Service men in the field inspect machines as they are delivered, and report to the factory on parts which are giving trouble. From the data gathered at the factory, recommendations for design changes may be made to the Research department. The field serviceman may even invent mechanism to satisfy a customer's request for a particular function. This also is reported to the Research department for consideration, so a close liaison is kept between Sales, Service and Research.

Management

In a company of this type, it is essential that harmony between all divisions is maintained by management. The sales and service forces, spread over the whole world, need central direction. Within the framework of the company, irregularities and inequalities result in trouble which must be smoothed out. It is possible for the President not only to manage the company's finances wisely, but also to gain the

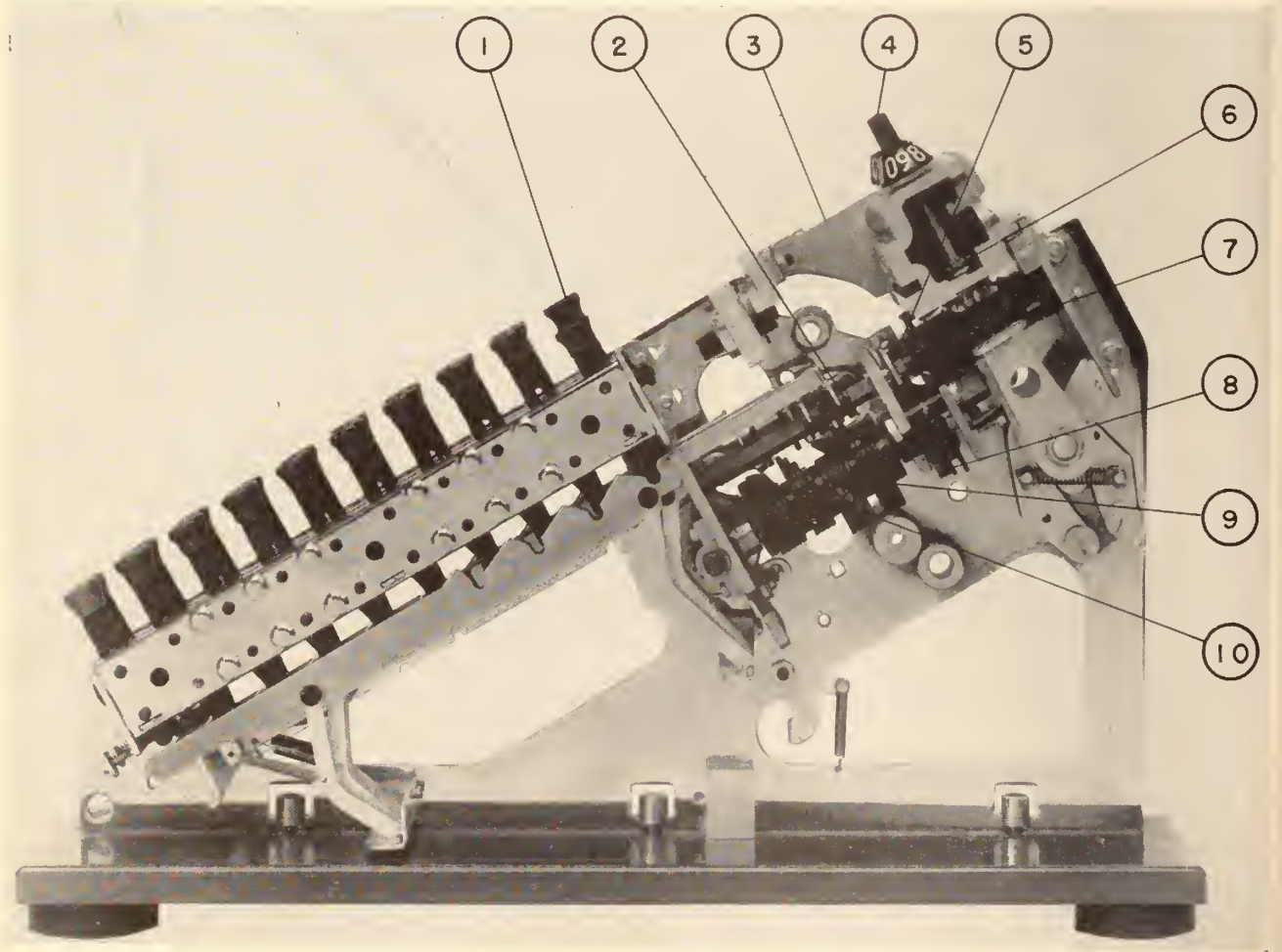

Fig. 3. The heart of the machine. 1. numeral key; 2. selection gear; 3. carriage frame; 4. accumulator dials; 5. geneva disc; 6. dial detent; 7. transfer gear; 8. geneva; 9. zero spacers, 10. actuator.

loyalty of his employees and stimulate interest in production through personal contact.

Summary

The complexity of a calculating machine requires a specially advanced kind of manufacturing. The design engineer, familiar with shop methods, originates and develops mechanism which is put into production by the combined skill of production, tool and methods engineers. Through every phase of the company's operations, in the planning, organizing and direction of manufacturing, engineers extend a guiding influence. The modern calculating machine is a tribute to their abilities.

Action of Calculator

Two main types of keys or "buttons" are common to all calculating machines. The "numeral" keys are arranged in a central square in columns of figures. The "operating" keys are grouped or arranged around the periphery of this main numeral keyboard and are depressed to perform functions like addition, subtraction, multiplication or division. (Fig. 2). There is also a shiftable carriage containing two rows of dials which line up with columns of the numeral keyboard. The short row counts the number of operations which the machine performs. The long row records or "accumulates" answers in the form of products or sums.

When two numbers are to be added, for example, keys are depressed in the main numeral keyboard for the first number, and a "plus bar" or adding key is depressed, which starts the machine cycle and transfers the number from the keyboard to the "accumulator" dials in the carriage. This process is repeated for the second number, and the total sum appears in the accumulator dials at the end of the second cycle.

Each column of numbers in the main keyboard controls the position of a "selection" gear inside the machine. When a numeral key is pushed down, the gear is moved to a selected position, depending on the numeral. This "selected position" determines the number of teeth through which the selection gear will be rotated. Rotational movement occurs when the motor is started by an operating key. The selection gear is the interponent between the motor and the dials, and its position in the system of gearing governs the degree of its rotation, and so governs the number of digits through which the motor turns the dials.

For each cycle the motor section is started by the operating keys through linkages. In constant mesh with a powered shaft, the "actuators" (Fig. 3) turn with the motor section. Actuators mesh with the selection gears and consist of a sandwiched group of segmental gears with from 1 to 9 teeth. (Spacers are provided for the "zero" so that the selection gear may be passed by without rotation.)

When the actuators have engaged and turned the selection gears, inertia tends to make the gears keep spinning. Two factors prevent this. First, a system of "detents" positions and centralizes shafts and dials. Without detents, either half-numbers would appear in the dial apertures or gears would jam on engagement. The second factor is the clock or watch mechanism called a "Geneva" which positively blocks further movement after the selection gear has been turned.

If an operator depresses a "1" in the second column from the right and a "7" in the right column then depresses the "plus bar", almost before he can remove his finger the 17 appears in the dials of the carriage. The action, briefly is as follows:

1. Keys 1 and 7 move selection gears in columns 2 and 1 to positions over the actuator teeth.

2. Depression of the "plus bar" simultaneously moves linkage to interlock or block out keys, pushes gears into mesh with the carriage, starts the motor and opens the clutch.

3. The motor drives the actuators, which rotate the selection gears, the first gear through 7 teeth, the second through 1 tooth. Genevas then stop the rotation.

4. The square shafts, on which the selection gears rotate, transmit power by means of gears mentioned in (2) to the carriage dials.

5. The carriage dials rotate according to the numbers of teeth that each has been moved and show "17".

6. Release of the "plus bar" closes the clutch and stops the motor, and when springs have restored interlocks all keys are made operable again.

7. The counter dial shows "1" since one complete cycle has been made.

When an operator wishes to multiply he may hold down the plus bar and watch the counter dials. This tells him that the machine has added 17 a certain number of times. The counter dial reading multiplied by the number in the keyboard gives an answer in the accumulator dials.

If in the "home" position the plus bar is held for 4 cycles, the answer is $4 \times 17 = 68$ which shows in the upper accumulator dials. The carriage is shiftable, so that if it is shifted one position to the right, and the "plus bar" is held down for 5 cycles, the figure 5 appears to the left of the figure 4. Additions have also been shifted in the manner of longhand multiplication.

17		
54		
68	4 cycles	1 cycle to shift
85	5 cycles	
918		

The answer is 918, since 85 has been added in the next left column. Thus by using the shift key it is possible to get the answer in 10 cycles instead of 54. Automatic multiplication is achieved when these operations are performed mechanically, and a "multiply key" is depressed to start the sequence of operations.

When 7 is added to 7, a further operation occurs. The "tens-carry" mechanism carries 1 from 14 to the second column. As described above, when 7 is added to 0 in a single dial the dial turns through seven places. First it rotates from zero to 7 as the first seven is added. Then it moves 7-8-9-0-1-2-3 to 4. When the dial passes the 9-to-0 point, it has passed ten so it cams a "transfer gear" into place in the next left column. After the right dial has reached the 4 position, a single tooth on the next left actuator moves the positioned "transfer gear" (which operates similarly to the selection gear) rotating the dial to 1 or adding one in that column.

For automatic operations, clutches, cams and latches cause the machine to perform sequential functions. For example, in dividend tabulation, the carriage is shifted back to "home position", automatically cleared to zero, then shifted to a tabular position selected by the operator. On the next continuous cycle, the number in the keyboard is added, with the counter blocked out, and the keyboard is cleared. This puts the number into the carriage for division.

With addition, subtraction, shifting and the above type of automatic operation, the machine can perform automatic division and even square root by the design of relatively simple parts. √

CARBON BLACK

by

George H. Cash

Vice-President and General Manager,
Cabot Carbon of Canada Ltd., Sarnia, Ontario.

A paper presented before the Sarnia Branch of the Engineering Institute of Canada, November 1954.

Outlining the history of early carbon black production, the author shows how, due to the wider demand for natural gas for heating, the original channel process plants have been replaced by the oil furnace production process, using various petroleum refinery residues as raw material. Such a plant is the Cabot Carbon Plant at Sarnia, Ontario, described in this paper, which came into operation in March 1953.

Carbon Black is an important article of commerce of which the public knows little. It plays an essential part in the every day living of all people of the civilized world, for without it the rubber tired vehicles and aircraft of the present age of speed would be unable to move. It is a strategic war material, the shipment of which is still banned to Communist China.

Carbon Black is the term applied to that group of finely divided industrial carbons, used chiefly as reinforcing agents in rubber tires and as colouring pigments in inks and paints. Chemically, they are nearly pure elemental carbon with varying amounts of chemisorbed hydrogen and oxygen. Physically, they are composed of essentially spherical particles of colloidal dimensions. The particles range in size from 2/5,000,000 to 3/1,000,000 inch in diameter. The variations in properties displayed by different types and grades of carbon black are due in large part to the differences in average particle size. Each grade of carbon black may be identified by its own average particle size.

Early Channel Process Plants

The first carbon black factory was constructed at New Cumberland, West Virginia, in 1872 by Haworth and Lamb, who had patented their process. Many plants were built under their patent between 1872 and 1892, principally in Pennsylvania and West Virginia. Their process was an impingement process, utilizing natural gas as the raw material, and either soap stones or cast iron plates as the surfaces against which the flames impinged and on which the carbon black collected.

In 1892, L. J. McNutt designed and patented the channel process, which by 1900 had gained little headway, but by which during the next forty years almost all carbon black was made. In the modern channel process, natural gas is burned from thousands of tiny ceramic jets in an atmosphere deficient in oxygen for complete combustion. The luminous flames play against a relatively cold metal surface. Only the outside surface of each gas stream burns to create the heat necessary for thermally cracking the gas in the center of the stream. Carbon thus formed from the cracking process is deposited on the channels against which the flames play.

The channels from which this process takes its name are standard structural steel channels. They are rigidly fastened together into tables, ten to twelve channels wide, with spaces between to allow free passage to the building vents of gases and uncollected carbon particles. The tables are approximately 120 feet long and mounted on cast iron flanged car wheels. Tables are enclosed in hot buildings, which are sheet iron covered buildings of very light steel framework. They are arranged in tandem.

The tables move slowly back and forth over the flames acquiring a coat of carbon black, which in turn is removed as the tables pass over scrapers mounted directly over hoppers set at fixed intervals. Pairs of tables are solidly held together by steel pipes, to which toothed racks are securely bolted. The racks ride on and are moved by pinions on a main drive shaft running the length of the unit. The tables are moved back and forth a distance of 8 feet each way, by means of a reversing electric motor. This travel in each direction requires 8 minutes for completion.

A carbon black unit usually consists of from 40 to 72 hot buildings, each 12 to 14 feet wide by 140 feet long, and spaced 4 to 5 feet apart. One-half of the buildings of a unit are on one side of the driveshaft alleyway, and one-half on the other. The black scraped off the channels is moved by screw conveyor from the hoppers through the main gathering screw conveyor to the processing building.

It is by the channel process that the intensely black colour pigments are made. They are usually packaged in the fluffy state because of better dispersion properties in that state. Most carbon black factories do include equipment, however, for forming the product into tiny pellets. In the pelleted form the

product is much cleaner to handle and is sufficiently firm and stable to permit shipping and handling in bulk. Thus there is no packaging expense and, since pelletized carbon black is much more dense than fluffy black, savings can be effected in freight costs, and particularly ocean freight costs, by shipping the pelletized product.

Prior to 1912 carbon black and lamp black had been used in the compounding of rubber, but it was used primarily to colour the rubber and was used in relatively small quantities. In 1912 the reinforcing properties of carbon black in rubber were finally realized, and the first important advance in the manufacture of tires was made in that year. The first cord tire utilizing carbon-black-reinforced rubber was produced during 1912. These tires were tested alongside the white rubber tires of that period, and were found markedly superior in wearing qualities and much more resilient. The black tires gripped the road much better than did the white tires, and gave the driver a greater sense of security.

Channel Type Disappears as Price of Gas Goes Up

It was not long until all tire manufacturers had to meet the competition offered by the new black cord tire, and the demand for carbon black therefore increased tremendously. By 1917 the demand for carbon black became greater than the supply. Furthermore the supply of cheap natural gas was rapidly disappearing in the Eastern States. The industry was therefore forced to move to the Southwest. A number of companies were drawn to Monroe, Louisiana, where a huge gas field had been discovered and, being in limited demand, the gas was very cheap. None of the great pipe line systems had been projected at that time.

While some carbon black plants still exist in the Monroe area, others were subsequently moved to central Texas. But the great migration of the industry came in 1927, when it moved to the Texas Panhandle where fabulous stores of casing-head natural gas were found. Gas could be purchased there for ¼ cents per thousand cubic feet but, until it could be used in the manufacture of carbon black, hundreds of millions of cubic feet were vented to the atmosphere each day for months on end.

Such wasteful practices will never again be permitted on the North American Continent. Neither is it likely that channel type carbon black plants will be constructed again in North America. Natural gas has become too valuable for domestic household uses to permit its use as a channel black raw material in the future.

The Fall of 1929 saw the end of the large construction program for channel type plants, and no further expansion took place until 1937 when the depression moderated and times appeared to be getting better. Several channel plants were built in that year. The next, and probably final, construction program of channel type plants was carried out during the latter months of World War II, when the United States Government urgently required more channel black for the war effort.

Construction of quite a number of plants was begun in 1944, but most of them were in various stages of completion when the war ended in 1945. Now, nine years later, many companies have found it advisable to shut down and junk a number of their channel black plants, and it is likely this policy will continue for two reasons:—

1. Better carbon blacks can be made from other raw materials, and,
2. Natural gas is becoming much too dear for producing carbon black at a price which will be competitive with other types of carbon black.

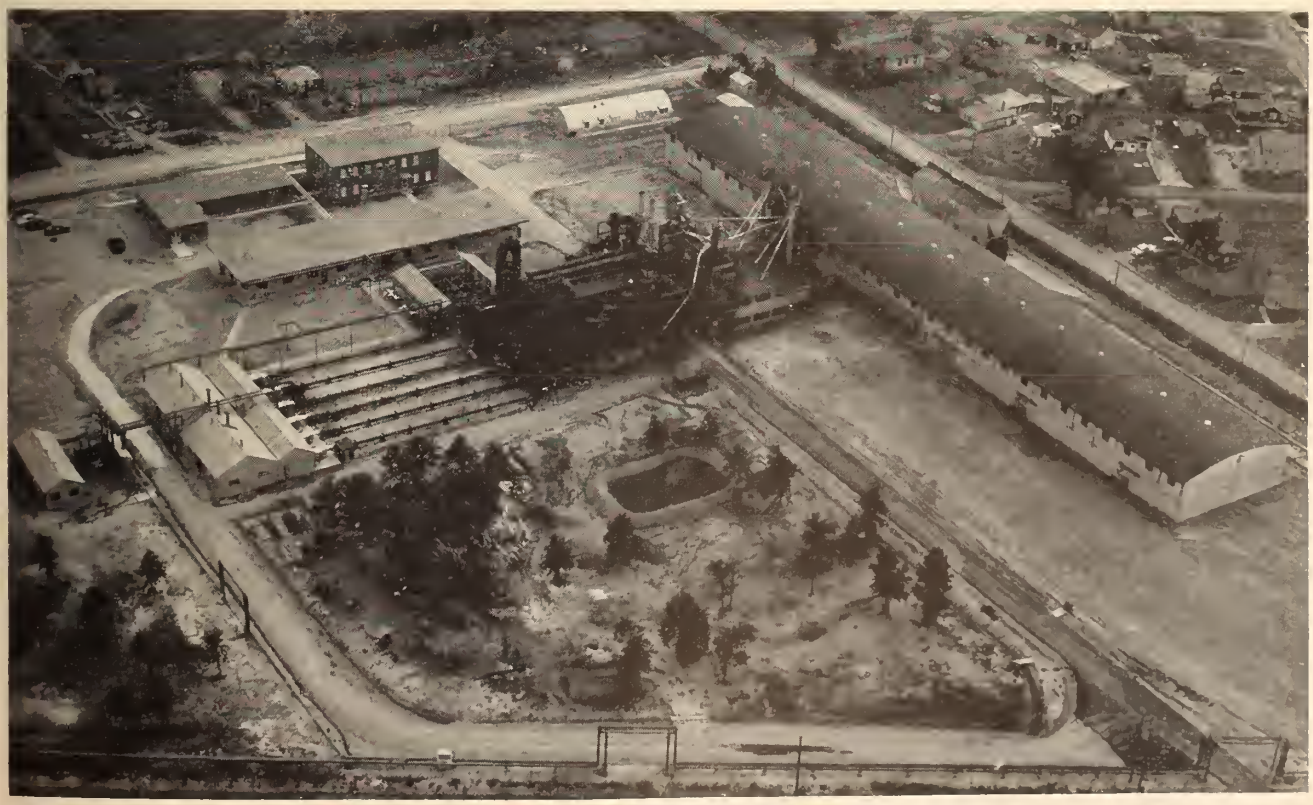

Fig. 1. Oil furnace of carbon black factory, Sarnia, Ontario.

Furnace Combustion Process

In 1928 the most significant step since 1892 was made in carbon black manufacture. It was the development of the Furnace Combustion Process. The first plant utilizing this process was constructed near Pampa, in the Texas Panhandle. For this process, plants are much more compact than the channel plants. One furnace which occupies an area of 240 square feet will produce as much black as 30 channel type hot buildings, which required an area of 75,600 square feet.

The furnaces are about 15 feet wide by 16 feet long by 5 feet high, and are lined with high heat duty fire brick backed by insulating brick to protect the metal shell. Each furnace incorporates five or six special removable burners inserted into the face of the furnace and held in place by special eyebolts. They are designed for quick removal and replacement. From two to five furnaces form a unit, the product from which all passes into one common collection system.

The carbon black made by this process, although utilizing natural gas as the raw material, is much coarser than the channel blacks and the yield is much higher, but the selling price is much lower. Therefore, higher gas prices are also having an effect upon the manufacture of gas furnace blacks.

All carbon black is produced in a reducing atmosphere. Only sufficient air is mixed with the raw material to completely burn the correct amount of fuel, to maintain the required temperature for cracking the unburned portion. Generally, the greater the percentage of fuel completely consumed, the higher the quality of the black resulting and the lower the yield. It is much easier to maintain the proper combustion conditions in the furnace type plant than in the channel type. Everything entering the furnaces is accurately measured and controlled, whereas in the channel process only the total fuel to each unit of 40 buildings or more is measured.

Typical Gas Furnace Plant

In the Gas Furnace Combustion Process the cracked raw material results in finely divided carbon particles and gas consisting primarily of carbon monoxide, carbon dioxide, nitrogen and hydrogen. The temperature of the gases leaving the furnaces is about 2,000°F. They pass through long refractory-lined steel cooling tubes, which terminate at a refractory lined precooler.

In the precooler are a number of high pressure atomizing water sprays, which serve to cool the gases to about 900°F. The gases then pass into an unlined cooling section immediately above the precooler, which is also equipped with atomizing sprays. The temperature is further lowered to 450 °F. Strangely enough, little of the carbon black is dropped from the gas stream in the cooling process, because the atomized water, consisting of very tiny particles, is instantaneously evaporated and the black is not made wet.

The primary collecting equipment, which immediately follows the cooling section, consists of an electrostatic precipitator and cyclone collectors. This serves to agglomerate the particles into relatively large bunches or clusters. Some of the product drops out of the gas stream into the conical bottoms of the precipitator housing, although most of it is carried by the gas stream into the first cyclone collector. The primary collecting equipment is about 95 per cent efficient.

Since the gas stream is not cleaned perfectly by the primary col-

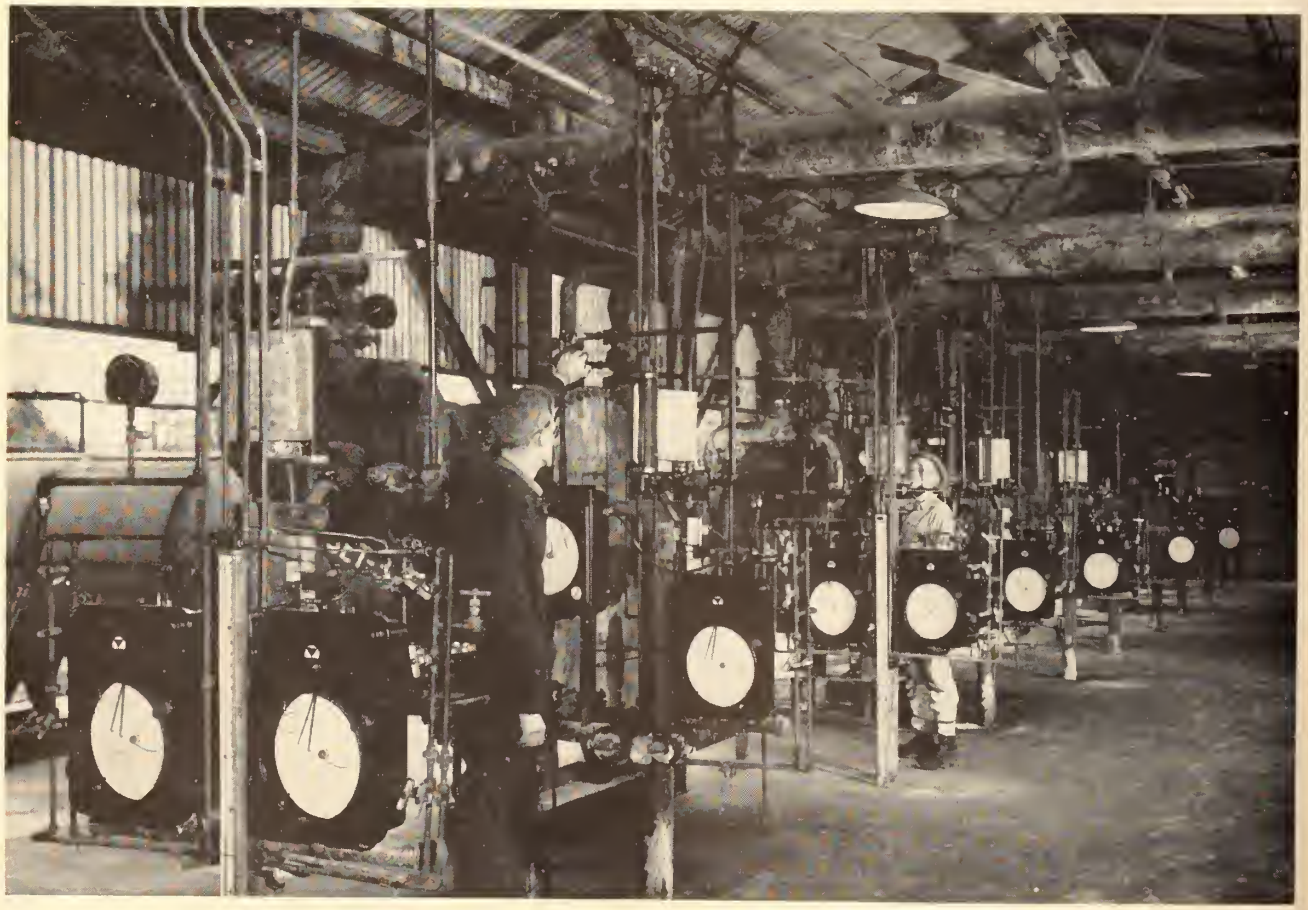

Fig. 2. Carbon black reactors and control equipment.

Fig. 3. Bag filter control panel, hoppers and pneumatic conveying systems.

lection equipment, it is necessary to install secondary equipment to complete the clean-up. This equipment has taken several forms; water scrubbers alone, water scrubbers followed by wet precipitators, and bag filters. Bag filters have been found to be the most satisfactory equipment to date.

The product is trapped out of the collector hoppers into the conveying system by means of star valves or rotary air locks. It is then conveyed, usually by means of pneumatic conveyors, to the processing equipment where it first passes through hammer mills, in which all gritty particles are finely pulverized. Some of the product may then flow to the fluffy black packers, but the most of it is directed through the pelletizing equipment, thence to the automatic packers or to the bulk storage and loading bin. The processing equipment used for furnace type blacks is essentially the same for all types of blacks, regardless of the method of manufacture.

Gas furnace blacks were of minor importance until the synthetic rubber-production program was launched in 1943 to supplant natural rubber supplies lost to the Japanese. It was found that gas furnace blacks were essential to synthetic rubber compounds, and almost overnight the demand for such blacks was infinitely greater than the supply. More gas furnace plants were urgently needed.

Plant construction with highest Government priorities and backing got underway immediately and, by the end of 1943, the production capacity for gas furnace blacks was almost six times as great as that of 1938. During the remaining years of the War, production of this type of black increased to 12 times the 1938 production. The carbon black industry co-operated completely in the all-important effort to keep tires rolling for the War machine.

Better Blacks from Oil Furnace Combustion

Almost immediately after the end of the War in 1945 new types of carbon black, of excellent rubber reinforcing quality, appeared on the market and at once received wide favour from the rubber tire industry. In many ways they were found to be superior to either channel or gas furnace blacks. They were carbon blacks manufactured from liquid hydrocarbons rather than natural gas, and became known as Oil Furnace Blacks. These blacks are made by the Oil Furnace Combustion Process which differs from the Gas Furnace Combustion Process only in the design of the furnaces or reactors.

The oil type furnaces are cylindrical in shape rather than rectangular, and are heavily lined with several layers of insulating and very high heat resisting refractory. Operating temperatures of oil furnaces are higher than those of gas furnaces, consequently the wear and tear on the refractory is greater.

The two processes previously discussed have depended entirely upon large supplies of very cheap natural gas for raw material. These two conditions could be met only within the limits of, or closely adjacent to, extensive gas fields. With the discovery of the process for utilizing various petroleum refinery residues as carbon black raw material, it has become feasible to construct carbon black factories far from the source of raw material.

In fact they may be located wherever they can be reached by pipeline, road transport, rail, or tanker, provided transportation rates are not prohibitive.

As a result, two large factories have been built in England. They have been producing carbon black for the British and export market since July, 1950. These plants utilize raw material from the United States as well as from local sources. Another plant has been built in Sarnia, Ontario (Fig. 1), to produce carbon black for the Canadian market and for export. This plant went into operation in March of 1953. Raw material from both the United States and Canada is being used in the Sarnia operation.

Oil furnace plants may be operated at higher producing rates than those of gas furnace plants. For instance, a plant sized to produce 30,000 pounds daily of semi-reinforcing gas black, will produce nearly 90,000 pounds of highly reinforcing black made from oil. The control and measurement of the streams of air, gas and liquid entering the furnaces are very closely maintained. (Fig. 2) It is from the various instrument settings that we know the grade of carbon black we are making. The cooling of the gases released in the process is done either by water evaporation or atmospheric cooling. In any event, the gases enter the collection equipment at about 450°F.

Cabot Carbon Plant at Sarnia

In the latest design which has been used for oil furnace plants — and the Sarnia plant falls within this group — the electrostatic precipitators have been eliminated as agglomerators, because they are unnecessary. It has been found that two additional cyclone collectors in series will accomplish about the same result as a precipitator. At the Sarnia plant four cyclone collectors in series are utilized for the primary collection phase.

Following the cyclone collectors, there is an aftercooler, in which there are additional atomizing sprays. In this section the gases are cooled to 270°F. before passing to the bag filter, the secondary collector. This temperature is closely maintained by a controlling instrument, Fig. 3, for the orlon filter bags which will operate for a year or more at 270°F., will last very few hours at temperatures above 300°F. Orlon is not affected by the dilute sulphuric acid atmosphere present in the bag filters.

The filter bags efficiently complete the clean-up of the gas stream. This is essential in view of the situation of the plant within a residential area. The conveying and processing equipment items are identical with those used for channel and gas furnace blacks.

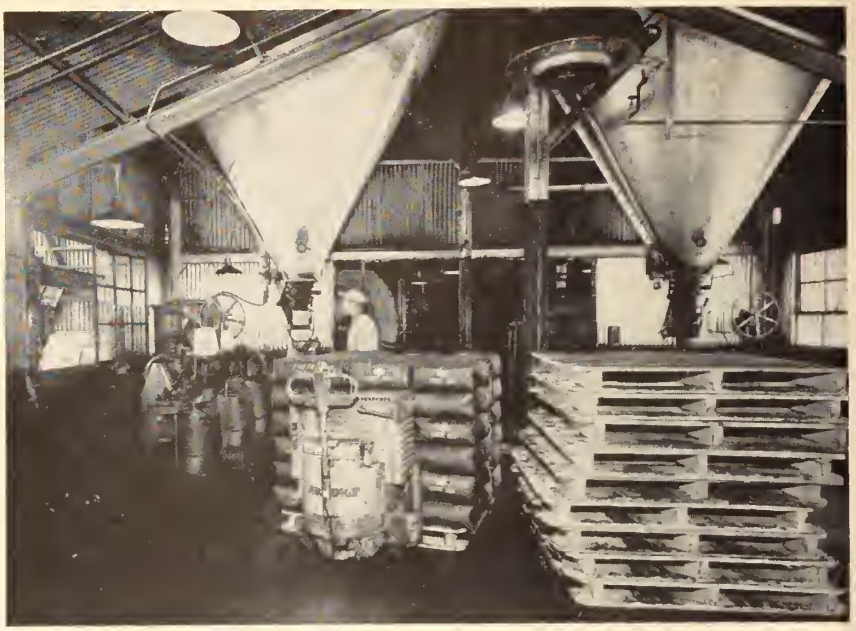

Fig. 4. Bag packing equipment.

Furnace Thermal Process

In 1922 another type of carbon black process was developed. This process is known as the Furnace Thermal Process. The blacks produced by the thermal process are relatively coarse. Compounded in rubber they contribute little to the natural tensile strength of rubber. They are high yield, therefore cheap blacks, produced from natural gas. They may be mixed with rubber in almost any proportions without appreciably altering the properties of the rubber. Hence they are used in extending rubber. These carbon blacks are much cheaper than raw rubber, therefore the mixture of the two becomes cheaper as the percentage of carbon black in the mixture is increased.

The thermal process is a batch process operating on a cycle. The furnaces or reactors are refractory lined with checker brick work. The furnace is first under a heat load, for a certain period, utilizing waste hydrogen gas resulting from the process. Then the heating fuel is turned off and the make fuel immediately turned on.

The carbon black and gas thus formed by cracking are forced out of the reactor through coolers and on through the bag filter, the only piece of collecting equipment required for this type of black. The reactor is then purged in preparation for another heating cycle. All operations are automatically controlled by a mechanical brain which operates the hydraulic valves.

Various Products and Their Uses

There are some forty-six grades of carbon black being manufactured today. Each has its specific use. The finest and blackest of channel blacks are used principally for expensive lacquers and enamels. Many other grades of channel blacks of varying degrees of blackness are used for printing inks of various types, and for paints. In the colour black field, however, new oil furnace blacks are now making inroads. In all probability, in future years blacks made from liquid hydrocarbons will replace all, even the finest, of the channel blacks.

The black produced at Sarnia is of two qualities, both of which are used primarily with rubber. The premium grade, High Abrasion Furnace Black, is, as its name implies, an abrasion resistant reinforcing pigment for rubber. It is used primarily in tire tread stock. The other grade, Fast Extrusion Furnace Black, is particularly useful in Butyl rubber, for it permits very smooth extrusions of the Butyl rubber inner tubes, insuring leak-proof tubes. It is also used to a certain extent in the side walls of tires, and in rubber covering for electrical cables.

It is not likely that many additional grades of carbon black will be manufactured at Sarnia, although the advent of the tubeless tire may dictate some changes not previously apparent. √

Management Techniques—

How Can They be Used to Better Advantage?

This sixth annual panel discussion on management problems and techniques was held at the Institute's meeting in Quebec on May 14, 1954. These discussions have been attracting increasing attention and interest and this one was no exception. Whether or not you are primarily an administrator, we believe you will find something of value in the remarks of the members of the panel and in the discussion which followed.

Introduction

The Chairman: Six years ago, at an annual meeting of the E.I.C. in Quebec, the Engineering Institute of Canada and the Canadian Management Council experimented jointly with a management session at the end of the annual meeting. This was an innovation for the Engineering Institute of Canada. It was so successful and so well-attended that the next year another management subject was selected and discussed. From that time a management session at the end of the technical sessions has been a regular part of the E.I.C. annual meetings.

As engineers we deal with technical and scientific matters, but every engineering job must be managed and consequently many engineers find themselves at some time in their careers operating in the management field rather than in the technical. It is still not generally recognized by many engineers that when that happens, they are operating in a field where special skills are required. They must learn and use these new skills if they wish to be successful in their new fields. This means that in addition to actual practical experience in the field, some time should be devoted to studying the theoretical aspects of management.

Unfortunately, there is still a widespread prejudice against this special study and it is important that an engineer in the management field make certain that he is not influenced by this prejudice. It should be obvious to an engineer that, granted that practical experience is the most vital factor, theoretical study plus practical experience is better than practical experience alone.

The title of our panel today carries by implication the thought that we management engineers are not making the best use of management techniques. What are these techniques which we are going to discuss? There is not time to go over them all; suppose I mention a few to orientate our thinking.

Long Range Planning

Such a study would include not only the question of planning for long range sales, but planning for other matters which would help both customers and employees. Most companies think they have long range plans, but when it comes to a showdown how many really well-worked-out, long range plans are there which attempt to forecast developments for say five, ten or fifteen years ahead?

Organizational Planning

Again, many companies have organization charts, but how many of these charts are really used to advantage and actually represent more than a list of people who are in control of certain operations at the time of printing?

Employee Participation

There is much literature to support the fact that employee participation can give a tremendous lift to a company in many respects. Here is a known technique and yet how many companies actually study this question of participation and make real attempts to improve it year by year?

These are merely examples of techniques. Others will be mentioned by members of the panel. It is, of course, not desirable that every manager use all the techniques. What he must do is examine them and make selections from them; having selected some for use, he must support his selection *con-*

Chairman: C. A. Peachey, M.E.I.C., *General Manager, Communications Equipment Division, Northern Electric Company.*

Panel Members:

Lillian M. Gilbreth, Hon.M.E.I.C., *Management Consultant, Montclair, N.J.*

A. M. Mackenzie, M.E.I.C., *Assistant Vice-President, Labour Relations, The Bell Telephone Company of Canada.*

E. A. Perry, *Manager, Hollinger Consolidated Gold Mines*

J. B. White, *Director of Personnel, Aluminum Company of Canada*

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sistently and follow through to make sure that his plans are *implemented*. This is where many fail. They attempt to apply as a packaged job a technique such as job evaluation, forgetting that such a technique must be interrelated with other developments in a company. One could not, for example, apply job evaluation in a plant which was technically under-developed and where morale was low. That would merely increase the problems in the plant.

Implementation and follow-through are required in both the static and the dynamic techniques of management. An organization may use static techniques such as I have mentioned, but they become effective only if the manager has dynamic skills, such as the ability to create harmony, to arrange for flexibility, to give inspiration and to develop a mature organization. Such developments take time, in fact, may take several years before the real advantages are apparent. The main thing is that there must be continued improvement. In that connection I would like to quote a sentence I read a few months ago. Unfortunately I do not recall the author's name. The statement was: "In order for a system of business management to continue to perform as well as it has been doing it must keep on doing better". This is the basic philosophy behind our system of free enterprise. It is accepted as basic by almost everyone in almost every organization. No employee nor employer seems to visualize any other condition except constant improvement for the employees, continuing improved working conditions and better performance all round, year by year.

This is what we are committed to, and not to the status quo. If we are to succeed, we must apply known management techniques and utilize new ones as they are developed.

The members of this panel will each speak for a few minutes and give examples from various fields of our subject. They will attempt to make clear how broadly these techniques apply.

Development of Techniques

Mr. Mackenzie: A management technique may be defined as "a systematically developed method of general application in solving specific sets of management problems wherever they may occur".

There are many management techniques undergoing successful development that offer challenging promise of usefulness. Our chairman has indicated the broad field for these techniques and I will touch on just two specific cases.

Job Evaluation

Job evaluation appears to be a good example of management techniques in the industrial relations field. It is a method of establishing, in a systematic manner, the relative values of jobs in a job family. I should stress that it evaluates jobs and not employees.

A few years ago we used a system of classification in our clerical family of jobs. Growth and the complexity of our departmental functions raised serious problems which could not be met by this method. We therefore studied and installed a job evaluation plan.

Our experience with clerical job evaluation as a management technique would appear to have both plus and minus values, and I hasten to say more plus than minus in our opinion.

On the plus side we think we have accomplished the following:

Secured complete, accurate and impersonal descriptions of the duties normally associated with each clerical job.

Determined by an acceptable process the relative value of all clerical jobs in different departments.

Provided a useful means for comparing company wage structure with wages in outside industry.

Demonstrated to employees at large and to our clerical union that management desires to be as fair and as accurate as possible in appraising clerical jobs.

On the minus side, we might list the following:

Job evaluation, particularly the maintenance of the plan, is expensive.

There appears to be danger of assigning inferior people to job evaluation on the assumption that it is just a routine procedure.

Unco-operative management people who may resent the discipline of job evaluation can circumvent the objectives by rigging jobs to get unwarranted evaluations.

Attitude and Trend Surveys

In the field of personnel administration many decisions are based on assumptions, assumptions as to how people feel about certain things in their work situations or what they believe in respect to the things they are told or not told about the business and about themselves. Therefore any device that can help personnel people to replace assumptions with facts is useful. The attitude survey technique is such a device.

Many firms have already made use of this technique to secure useful information about how to run their businesses better. The statisticians have largely removed guesswork from the sampling process, have developed scoring and a means of interpreting results, and have devised equipment for the tabulation of results. All of these developments are of particular significance when large groups of people are involved, but the principles they have developed have application to business of any size.

The trend survey is directed primarily at measuring the accomplishment being made within a business to improve performance in respect to the objectives associated with the survey. Surveys are made at different intervals to see whether progress is good or poor. This type of survey requires maintaining the original objective and using the same questions. By providing a comparison of results through the answers given, it is possible to assess the effectiveness of the action taken.

In common with other projects an attitude survey must have an objective, i.e., what is it we want it to accomplish ? Before any work is done the objective should be established and the top management of the business should be in complete agreement with the objective. This is an important step in any plan involving the use of surveys.

Objectives are broken down into areas of attitudes as a preliminary step in the development of questions. A scale or block of questions is developed for each area of attitude and a scoring arrangement developed which is used to measure levels of attitudes.

Results may be reviewed in group discussions of all levels of management and group appraisals made of the results for each department. These appraisals may then be used as a basis for departmental programs of corrective action.

It should be stressed that it is necessary to be prepared to take action in connection with unsatis-

The panel members: J. B. White, Dr. Lillian M. Gilbreth, C. A. Peachey, A. M. Mackenzie, E. A. Perry.

factory attitude results, or the risk is run of making attitudes still more unfavourable. People feel that in giving frank answers to the questions asked they have indicated areas in which action should be taken.

While good attitudes are undoubtedly worthy objectives in themselves, time spent on this work must have a pay-off for the business and these are some of the returns wanted:

A group which understands and supports in a positive way the objectives of the business, both inside and outside it.

A group which works with enthusiasm itself and endeavours to inspire subordinates to work enthusiastically, too, towards meeting the established goals of the business.

A group which appreciates the significance of teamwork and endeavours to work in harmony with other members of the management team to reach the objectives of the business.

A group which welcomes the challenge of new and wider horizons to the business.

All of these may be summed up by saying that the group helps the business get a better job done.

The Chairman: I will now ask Mr. Perry to give us some facts based on his experience in mining areas.

Management in Mining

Mr. Perry: In our discussion this morning regarding the aspects of the subjects we are to deal with, the application of management techniques to the mining industry was referred to me. At this point, I must say I do not speak for the mining industry as a whole; I can only give you my own views on the subject with illustrations from my own experience.

For the benefit of those who have not worked in a mine, perhaps a word or two on our work administration problems would be in order. Miners usually work in pairs and each pair has its own work place. The foreman in charge of the work sees the men only at the beginning and end of the shift and for about fifteen minutes during the shift. You can see that any supervising must be accomplished through remote control.

Economic pressure forced us to try to improve existing management practices. As a result, a group of us in the Porcupine district got together to see what we could do by way of investigating ways and means to improve our positions.

We found that there were many books on the subjects of administration and management. By making enquiries we could get any amount of help from people interested in the furthering of our group study. We called on the Montreal Institute of Administration and were greatly helped and well supported by it. So much for the background as to how we got into the study of management practices and techniques. The logical question at this time is, "What did we find?" We made two major discoveries.

Management is an Engineering Job

The first was that management is just another engineering process and that the approach to the solution of management problems is the same as the approach to the solution of any other engineering problems. You have to get the facts. You have to know what you *are* doing. From the study of these facts, you can decide what you *should be* doing.

I am convinced that work analysis is the basis of the invention of the various management techniques which must be used to secure effective work. Some of the management techniques which result from the analysis of work are related to methods study and organization, to planning, to standards, to budgetary control and to job evaluation. These have considerable effect on labour relations, on negotiations and on communications within the company.

The second discovery was that management is not a static affair. There is no such thing as a status quo to work. Management is a developing process and must be continually re-evaluated as various situations confront its operation. Furthermore, it is not a one-man job. It can work effectively only as a philosophy for all the supervisors of any enterprise. Management must be voluntarily supported and personally advanced by each person who has supervisory responsibilities. As you can see, it is an educational process which takes a long time to develop.

Does it Pay

The remaining question, that all engineers will ask is, "Does management study pay off?" I am convinced that it does. However, the

benefit does not result from getting people to work harder, but by making provision for them to work together more effectively. The filling in of gaps, that is, doing the work that should be done but is not, and the elimination of overlaps—the duplication of work—are two of the areas where great savings can be made. This was our experience and our cost sheets reflect the improvement.

To sum up, there are three points I want to make about the application of scientific management techniques:

The first is that they are profitable to use. The second is that the selection and application of the various techniques depends upon the analysis that is made of the work to be done. And, third, scientific management is an educational process that requires time and a lot of hard work.

The Chairman: I think we can see that a lot of work has been done in the Timmins area and that the management of our mines, if this be an example, is certainly in good hands.

The next speaker on the panel is Mr. White. He is director of personnel of the Aluminum Company of Canada. Now, they are large producers and an entirely different kind of organization from those presented by the earlier speakers. He will tell us of his company's efforts to select, indoctrinate and develop engineering graduates. It provides another example which I hope will drive home to you the importance of using these various kinds of management techniques.

Training and Development

Mr. White: Your chairman has asked me to talk briefly about training and development techniques. It seems to me the best way to proceed is to relay to you some of our own experiences in that field. I do not wish to imply that our practice represents absolutely the best, but it is a practice with which I am familiar and I know something of its weaknesses as well as of its advantages.

Our industry is to a large extent a technical one. That means we employ a large number of engineers and other technically trained people. I am told we have something in the order of 400 to 500 engineers on our staff. Annually, we require two to four dozen university graduates, most of whom are engineers. That means we have a training problem to deal with whether we recognize it formally or not.

It has been said that training is a necessity that cannot be avoided. I think it is true even when the employer does the training on a highly informal basis. Whether we like it or not, whether it is apparent or not, we do have a training problem. No organization is alone in that field; it is a situation that faces everyone.

In our business we have always had a training program for new employees, university graduates and young engineers, and I would say that the program has never been static. Our present program incorporates much that is new and in process of experimentation and development. Over the years we have used various ready-made programs with rules on how to act on every occasion. They sound wonderful, but on trial they do not produce expected results. We find it better to plan and develop our own programs.

The part of the program to which I refer today pertains to the first year, particularly to the first few months. By emphasizing the first few months of training, I don't wish to imply that training is complete at that time. It is, rather, that we are able to organize our training more formally during this period. In general our program consists of two parts.

The first part is a matter of orientation or initiation: introducing the new engineer to our organization, to our different operations and to our people, to a set of conditions with which he has had little contact. We do this by giving him a series of assignments. That program itself involves co-operation from our whole staff and line organization. To obtain success in this phase it means that our works managers, superintendents and others interest themselves in this portion of the program. The results vary, not only with individuals, but with operating conditions. Sometimes it is easy to place a temporary employee in a useful job for a few weeks or a few months, and at other times it is not so easy.

Naturally, we cannot expose every person to every operation, but our objective is to expose him to more than one line of activity. We conscientiously try to give him some assignments that relate to his original basic training, and others that are in a quite different type of activity, before he is given any regular assignment.

We hope in this way to do a number of things. We have a chance to observe the new employee, not by any one person or any one group of people, but by a cross section of different people in our organization. The new employee, at the same time, has a chance to observe and, in some cases, participate in varied lines of activity. He may be a chemical engineer assigned to a temporary job having more to do with mechanics than it has to do with chemistry, or a mechanical engineer assigned to cost study and so it goes with other branches of technical training. He may find that his interest lies not in strict engineering, but rather in sales, in production, or in some other technical branch of our operations. This is not an uncommon experience.

The second part of the program, to which I want to refer in more detail, has to do with what we might call the "classroom" part. For several years now we have, insofar as conditions would permit, gathered our new employees in groups of two to three dozen, in some one location and for a period of three to four weeks for a series of conferences. Call them classrooms, if you will.

Our program in these sessions has varied from year to year as a result of accumulated experience. Mr. Mackenzie mentioned attitude surveys. Following each one of these annual training sessions, we have made attitude surveys. We ask each group to let us have their opinions about these training programs. As he says, we got some surprises at the answers. Some features have been severely criticised, others have been highly praised. These evaluations from the trainees themselves have been most useful in modifying and developing new programs.

These classroom sessions deal practically not at all with such things as engineering or materials or machines. We assume that the university graduates have the technical background and do not need more of it, and so we don't try to give technical instruction in our classroom work. We feel that in their field assignments trainees will get experience with our own specific technical problems.

Our classroom training has to do almost entirely with human relations and with organization. Training is largely through conference methods, through group discussions.

"Case studies" is the term that best describes our classroom work.

We want to help these engineers and others who are in the training course to learn more about the human factors in business organizations. The program consists of developing discussions and debates among the members of the groups. Under the guidance of discussion leaders, we help them to acquire a better understanding of the motivations which affect productivity and morale in a business organization.

We hope they will learn to recognize impending human problems before they occur, to develop the ability to analyse and see the underlying forces in any human situation. We also want them to develop the ability to deal face to face with people; for example, how to listen with understanding, to another's point of view. For this purpose, some of the group members engage in role-playing practices. In role-playing, they take the part of people in a certain case and act these parts out. The rest of the group observe their performance and give them helpful criticism.

The object of this program, these conferences, case studies and role-playing sessions, is to help our newer employees to learn something in the classroom about business organization. After all, business administration is largely human relations. We want them to understand the behaviour of human beings as well as they understand the behaviour of machinery. We would prefer to have them practice in the classroom with one another, rather than in the field where serious mistakes would be costly.

We think that they will spend the rest of their lives in a search for this understanding and we try to give them some preliminary insight into their problems, so they will develop the habit of acquiring for themselves a realization of the problems ahead.

The Chairman: Thank you, Mr. White, for a splendid exposition of the application of another technique of management.

Now, I have last, but not least, the pleasure and privilege of introducing my friend and our first lady of management, Dr. Gilbreth. Dr. Gilbreth is such a long standing friend of the Engineering Institute of Canada that she really needs no introduction by me.

She has just completed a world-girdling tour and has visited with management groups in many countries, many of them not so well developed as our own. Nevertheless, she has found the same need for the application of management techniques in these countries and indeed it is by the application of these techniques that these countries can reach their desired objectives and raise their living standards. Dr. Gilbreth's trip ended in February at the International Management Congress at Sao Paulo, Brazil, at which she was presented with management's top international honour, the CIOS medal. This is awarded annually by the International Committee of Scientific Management to the person whom they feel has accomplished most in the international management field during the year.

Management Techniques Abroad

Dr. Gilbreth: It was a great privilege for me to spend six months in six countries; not the same length of time in each one, but with an opportunity to see what was happening in the management field there. Three of these countries were seen very hurriedly. It is only necessary to speak of them because of their great willingness to act as resources to ones which need all the help they can possibly get.

The first one I visited was Australia, a wonderful country. It was a great thrill to be there, a guest of Walter Scott's consulting organization on management; to sit in with that organization, as I did in four of the large cities in Australia, and to find how wonderfully organized their management programs are in each of the Provinces, and what a fine federation there is.

I think the thing that impressed me most was the great courage shown in trying out all the techniques of management and evaluating them, in an effort to see how they meet national needs, industrial needs, and one's own needs in one's own organization.

I was much impressed also with the great willingness to do volunteer work and to help any country in the area which might need help. If we had more of that attitude throughout the world, we would solve our problems very much more rapidly.

To show their courage they have invited the world to come to the Twelfth International Management Congress, which they would like to see there in 1960. Three years from now, we go to Paris, but six years from now, we hope we go to Australia, with all financial arrangements already made and with the kind of flexible program which is going to enable us to bring problems and then to try to work out our solutions together.

The second country of this type that I visited was England, as a guest there of Anne Shaw, who is also a consultant, principally in the motion study field. One can feel very proud, I think, of the wonderful maintenance which is done in England.

The third country was Brazil. I did not have what some of my colleagues had, an opportunity to see a great deal of the applications in the management field, but what little I did see led me to feel that sometimes there is a tendency in a new and young country to try everything at once, and an ambition to get, in no time, not only abreast of the others who have had longer experience, but to lead the profession. I think that what we need to value highly is the expressed and demonstrated willingness to lead us all and to help any of the countries in the neighbourhood.

The other three countries I visited were the Philippines, Formosa and India, and they all have some things to offer that I think are worth reviewing in a program like this.

The Filipinos have adopted to a high degree the methods which we deem of value in the management field. You may have noted that the title of this session today is a question, and one found there, the "questioning method". The Filipinos themselves question. With the co-operation of the groups of the United Nations, people come there from other countries. A large number of groups go to the United States from the Philippines, and come from the United States to the Philippines, which leads to the possibility of extending the questions very far and making them very worthwhile. I feel sure that this questioning of our methods is one of the vital things in the whole management field. When we question a particular belief, we have our first chance to make improvements.

One of our men, Dan Brown, connected with training and public service, took the government supervisors in, 30 or 40 at a time for training. Each one of these members submitted each night a question that he thought might help in the type of work being done and a selection from these was made at the next meeting.

It was interesting to see, perhaps because of the special nature of the group, that there were not nearly so many questions on the technical

side as on the human relationship side.

It occurred to me as I was evaluating the 1,000 questions that were collected, that very many of these human relations questions would have been avoided had there been more done on the technical side to begin with. While I realize that management is dependent for its technique upon the human relations side, I also realize that we do not always recognize that the human relations side is dependent upon the technical side also.

As I left, Mr. Brown was working his conferences up the line and getting nearer and nearer to the top group in the Philippines. One very intelligent thing which was done was to invite the heads of the government divisions to conduct at least one session each in the course for the supervisors. Seeing the questions ahead of time, they could answer some of them and stimulate discussion from the floor. To me, it was an amazing thing to see that people living in that part of the world had such a high opinion of the speaker that it was possible for people down the line to ask such pertinent questions up the line. There was a give and take which seemed to me valuable indeed.

In Formosa, the problem is different because of the lack of resources there. We found resources in the engineering profession; there is a Chinese Institute of Engineering. While without doubt at the present time, none of its members are actively engaged in the management field, we did find them willing to sponsor a new project. If you can get the top group in a country or in an industrial town, really interested and willing not only to act as a resource, but to realize that they themselves must know what the problems are and be able to explain them to people of less privilege, you can go a very long way.

We also found there, as I found in the other countries, great resources in the people from all of the other countries who have had more opportunities. They have come to live and work in these countries; for example, some consultants from other countries have settled there for some time and some are there only on a temporary basis and some of them have great industrial knowledge.

I found in all three countries one of the branches of industry which had gone far was the construction, repair, maintenance and flying of aircraft. In every case, I realized that one reason it had gone so far was because the industry all over the world has so many similar, as well as different, problems and because there has been such an eagerness to help and to share. It was very interesting to find that the servicing being given to planes in these countries, was not only given to national commercial planes, but that the national air force was also serviced by the commercial company, and that the air force of other nations, like ours and yours, were given the same attention and maintenance. This really was a most impressive sight, as I talked with air officers of the country and of the various other countries who used the service, and then actually went through the shops, talking to people who were on the technical side and to people on the human relations side as well.

Because I have stressed these great resources in Formosa, I hope you will not feel the Taiwanese and Chinese have a great deal to work with. There is practically nothing in Formosa in books or in laboratories or anything with which you could set up an engineering course of any sort, much less a management course. The language difficulties alone, are great—the Chinese needing to be translated into English and the English needing to be translated into Chinese. I would ask and hope that every engineer in every country will send books and magazines that he can spare to Professor Paul Eaton, who will see that they go immediately to the students or to the Chinese Institute of Engineers, which will see that the whole country profits.

The situation in India is one that could not be described in a few moments. It was interesting to see not only the United Nations standing by and other countries wishing to help, but the generosity with which Great Britain continues to be a resource if wanted. Two professors from British institutes have spent a year there helping set up courses, and I was surprised to see the amount of work and the amount of appreciation of what was being done. I think many people will feel that my short stay and the fact that I did not confine it to people in the management field, or to those who would help in the management field, gave me a narrow view. But one can only report what one sees with one's own eyes. I was much impressed with the fine team work going on.

For example, in the nursing field: a team—a midwife from Great Britain, a nurse from Canada, a dietitian from the United States, with three counterpart people—a team of six trying to tackle situations in a hospital. You never in your life saw so many and such complicated problems. Another example, a plant making sewing machines, and trying not only to furnish work to the worker, to give him enough to live on, but trying also to help the many relatives coming out of Pakistan, those who live on the fringe of the industry, and are given "home work," setting up a little machine right in the living room. You and I are brought up by the Consumers' League to disapprove of home industry, but when this is the sort of thing that people have to do or probably starve, the viewpoint is different!

Questioning in India is very important, too. Some of the Indians questioned me about our family life and felt that we were too critical of their family life. They said that when they saw our movies and read our books, and when I say ours, I mean ours in the United States, not yours in Canada—they did not think very much of our family life, of our family relations. I tried to explain that we meant no criticism of their family relations, but that people all over the country, especially the students, felt they could not get anywhere because of family-run industries. What is the answer to the question? It seems to be education. There are problems in education in every country where I went.

This includes not only education of the head but education of the hands. We should, as we go over the techniques, make it plain that the education of the hands is most important and that in what we do accomplish the technical and the human side go together. I think also that we cannot say that either the human side or the so-called technical side is lacking in technique.

But it takes more than techniques; it takes warm friendly people talking it out in a non-critical way, trying to help. To summarize, we might ask first; do you have an educated head? Second, do you have educated hands, hands which actually do things themselves, as well as just demonstrate what can be done? Third, do you have educated hearts?

The Chairman: Thank you, Dr. Gilbreth, for an inspiring description of these countries you have seen and of their management problems.

We have not too much time, but if there are any questions, I will be glad to have them.

Discussion

Question: Nowadays, when management is composed more and more of engineers, of technicians and of experts, can this trend be correlated to some extent to wider acceptance and use of management techniques or scientific management?

Mr. White: I imagine you assume that the engineer, with a somewhat narrow field of technical training may not be quite competent to handle the wider social techniques which are gradually developing.

Questioner: Not quite that. I think perhaps they bring with them a scientific way of looking at management, a scientific approach.

Mr. White: It is a debatable question whether an engineer's training as a technical man fits him for these social studies. I have often heard it said that studies in the human side of things would fit a man more for social problems, but by the same token, we have all seen people who studied the philosophical, the sociological, etc., side, who would make just as bad mistakes in that field as a man who had been steeped in his early years in technical matters. It depends on the individual.

Question: Do your attitude surveys indicate that the feeling is that training by surrounding the man with proper equipment and with facilities for improvement, succeeds better than subjecting him to a more social type of training, the schoolroom type of training?

Mr. Peachey: In other words we are asked, "Do the surveys indicate that people feel that they should be trained by being surrounded with mechanical facilities, instead of just training in the classroom course?" Perhaps Mr. Mackenzie would answer that.

Mr. Mackenzie: This question is one of great importance. As I have said, we have trend surveys under way. We have made three of them. The first one gave us many surprises in areas where we least expected them. The second one showed some improvement in places, and I think the third one has rather cemented our ideas about what we have to do.

I would say that the trend has shown that there has been a little too much emphasis, perhaps, being put on these particular seminars and courses and special studies.

I will give an example of the human relations course. We went pretty strongly into that. We covered it thoroughly down to the second level and even first level, and I don't believe we got the full value out of such courses. The thinking now is that perhaps there should be more opportunity for men who are beginning to show promise to move around a little more and to be exposed to good management. If we can get our top levels of management thoroughly convinced, I believe we can help these men in that environment of good management. Analysis of our surveys indicates that this technique would be to our advantage.

Mr. Peachey: While you are on your feet, Mr. Mackenzie, here is another question along the same line. I will read it. "Would you give an example of a typical trend or spot survey?"

Mr. Mackenzie: Yes, we do take specific spot surveys as well as trend surveys. I will give an example.

Each year we have been running high level management group operational meetings at which various subjects are discussed and the questions answered by the president and vice-presidents. Two years ago we found through the instrument of our normal trend survey that the lower levels of management felt keenly that they were being left out of the meetings and discussions. We then had a series of meetings at our division and district levels, covering the same subjects that were handled by the top level management team. We then undertook a single or "spot" survey to assess the value and plan for future projects.

A single attitude survey does not give you trends. It just gives you a spot answer to a specific problem. I do not think the value is quite the same in the spot.

Mr. Peachey: There are two questions here which are really the same question. I will read the first one: "What is the best way to interest top management in management techniques?", and another person asks, perhaps more brutally but more to the point, "What happens if the top man of a company is just not interested in scientific management, I mean one of the old school?"

Dr. Gilbreth: In the first place, where we have been able to have top management to participate, the results have been good, that is, if we can get the top level people to help in putting in the training in the industrial program. We urge top management to come to open the first meeting or, if not, to send a letter of recommendation.

After all, the difficulty may be that top management does not realize the importance of what they happen to think and do.

Second, in many countries, there are special courses for top management. If you can have an off-the-record meeting in some quiet place, if you can inveigle those who have taken over the responsibility of finding what it is about, to come, and to get others to come, it goes a long way.

In the third place, I think we should check very carefully, not only by attitude and opinion surveys but by interviews, to see whether the people who are in favour will really participate and will correlate the old with the new. If they are really however "old school" and cannot change, one just has to stiffen one's back and wait until the situation changes. We should respect those who have wide experience, and we should look at the past to see what we can learn from it, but I think our eyes should be on the future, trying to see that appropriate young men and young women, willing to take leadership, are being educated for the job.

Mr. Peachey: I believe we have time for this last question. "Does the panel believe that management techniques ever replace mature judgment or wisdom?" Perhaps, Mr. White, would you like to take that question?

Mr. White: Well, now, "mature judgment or wisdom!" I have no authority to speak for the panel, but I hazard the guess that its answer would be a unanimous "No". Techniques do not replace, are not intended to replace and there is no claim that they will replace mature judgment and wisdom. In management, the techniques on the other hand, will assist judgment. It is not one replacing the other, but augmenting it—a tool to use or many tools to use—and one of the tools is to develop better, or perhaps better developments of, mature wisdom.

Mr. Peachey: Thank you, Mr. White. It is now five o'clock and I promised faithfully to wind this up at five. I will not try to sum up any conclusions to our discussion and I can only hope that you will carry away with you the thought that management in an engineering program is an important part of engineering work and that management in engineering is required and is essential and therefore that the management of those projects must be of the highest order.

Economics of the Nova Scotia Coal Mining Industry

by

Lionel A. Forsyth

President,
Dominion Steel and Coal Corporation Limited.

A paper presented before the Montreal Branch of the Engineering Institute of Canada, March 25, 1954.

It is a pleasant duty to express my appreciation of the invitation to present to you some reflections, and opinions flowing from them, upon matters of absorbing interest to me and of tremendous concern, not only to myself, but to several thousand people whose present livelihood and future security depend upon the Nova Scotia coal mining industry.

Coal from the Cape Breton fields has been in use from the earliest date in Canada's recorded history. Indians, explorers, troops and settlers used this fuel. I am inclined to believe that in Canadian, perhaps in North American, industry, the coal mines of Nova Scotia open the first chapter of their history.

Neither the time available, nor the limitations of my subject, permit me to dwell upon the historical background of Nova Scotia coal. Suffice it to say that, from the earliest times, production from the Nova Scotia fields has developed in gradually increasing importance to that Province and its people.

Coal the Foundation for Maritime Steel

The existence of the coal fields of Cape Breton and of the Nova Scotia mainland was the foundation of the steel industry, which has, for over half a century, been established in Sydney and at Trenton. The combination of Nova Scotia coal and iron ore, first from that Province and today from Newfoundland, has created an industrial organization employing some 30,000 people in operations which extend from the Atlantic coast to the Detroit River.

The integration of the Nova Scotia coal mining industry with basic steel operations is less than half its story—a story which ought to be, or shall I say, *must* be, set fully before the Canadian public, because it is a story in which they have a vital interest.

I should feel much more comfortable if my topic tonight permitted a more general approach than I feel compelled to adopt, but a discussion of the "Economics of the Nova Scotia Coal Mining Industry" must, of necessity, stick close to the facts. Although I am aware of my lack of qualifications to afford the subject the detailed and penetrating treatment that it deserves, I shall do my best to sketch the picture for you in its broader aspects.

Half Our Power from Coal

In my opinion, the approach which will provide you with the best perspective of the role played by coal in our economy, is to examine the relative importance of the various sources of energy and the changes in the relationship which have taken place over a period of years. Although coal has decreased in relative importance in the past quarter century, it is still, by long odds, the most important single source of energy in our economy.

Today coal is the source of about half of our total power requirements. Hydro power provides about 30 per cent; oil and natural gas provide most of the balance. The decline in the relative importance of coal has been gradual but steady, decreasing by about 2/3 of 1 per cent per year for the past 30 years. From this, you can calculate that coal supplied 70 per cent of our energy requirements only 30 years ago. In recent years, the pace of the decline has accelerated slightly, as oil in the East and natural gas in Western Canada have made sharp inroads on the coal market.

Obviously, this is only part of the picture. In a stable market, a decline of 2/3 of 1 per cent would also represent an absolute reduction, but, in actual fact, our requirements have grown, and have grown extremely rapidly in the past quarter century. We now, for example, use more than twice as much power as we did in the late "Twenties". Thus, although the percentage of power requirements supplied by coal has diminished, the absolute quantity of coal consumed has increased. Canada now, for example, burns about 1/3 more coal than in the immediate pre-war years.

Nova Scotia Supplies 14 Per Cent Market

These comments might suggest a fairly promising outlook for the Canadian coal mining industry, but the sad fact of the matter is that the figures quoted cover *all* coal consumed in Canada—not only coal produced by Canadian collieries, but imports from the United States and Britain as well.

In the twenty years prior to World War II, Canadian producers sold in the domestic market ton for ton with imported coal. Today there

is about a ton and a half of imported coal for each ton of Canadian coal burned. We are, in fact, losing our relative position in our own market. In spite of this, Canadian coal consumed in Canada is about the same in quantity as it was twenty years ago. In terms of annual consumption, it amounts to 16 or 17 million short tons per annum, of which quantity Nova Scotia mines supply about 5½ million tons.

The next logical step is to examine the consumption of Nova Scotia coal against total Canadian coal burned in the domestic market. It would be pleasant to be able to say something dramatic about this comparison, but, in actual fact, the trend of consumption of Maritime coal has paralleled the Canadian figures. Perhaps it is not fair to expect a difference to appear, because Nova Scotia coal represents 40 per cent of the total Canadian production. The interesting story about Nova Scotia coal is to be found in the changing composition of the market area into which this coal can economically penetrate.

Ontario Market Disappearing

Quebec and Ontario consume more coal than all the rest of Canada combined. Prior to the war, these two Provinces used about 60 per cent of the total coal burned in Canada. More recently, this percentage has increased until now two-thirds of Canadian demand stems from these Provinces. Ontario is, by a wide margin, the larger of the two markets; in fact, it is about three times the size of the Quebec market.

Apart from its size, the outstanding feature of the central market is the increasing extent to which it is supplied by foreign sources, particularly the United States. In the immediate pre-war years, Maritime collieries supplied about 20 per cent of the central market. During the war, this percentage dropped to less than 3 per cent, as Nova Scotia coal was directed, for strategic purposes, to the bunkers of the Navy and the Merchant Marine. Most of the gain in control of the market was made by United States coal, as British coal was not available for export.

In spite of strenuous efforts to regain its pre-war share of the central market, Nova Scotia coal now represents only 8 per cent of consumption in this area. Even more important is the fact that, so far as central markets are concerned, nearly all of the Maritime coal is sold in the Province of Quebec. The tonnage which enters the Ontario market is extremely small.

Nova Scotia is fast losing her share of the Canadian coal market. Rail dieselization is proceeding so rapidly that the coal fired turbine may be too late to save the railway coal market. If the industry is to survive so its value may be preserved for a national emergeney, inereased subventions, and greater productivity to lower production costs, are "musts". The author diseusses whether operators and governments should eontinue their efforts to save the industry, or aeeept coal's inability to compete with oil and natural gas.

Diesels Cutting Big Rail Market

Speaking generally, not all the coal produced in the Maritimes is entirely suitable for use in hand-fired, natural draft, heating equipment. Although there is some medium volatile coal produced in Nova Scotia, most of the production is high volatile, which in the process of combustion, produces a considerable volume of volatile gases. Unless particular care is taken, these gases will not burn completely and a good deal of smoke and soot will result.

But the disadvantages of a high volatile coal for domestic purposes can be, and have been, overcome by the use of underfeed stokers; and much Nova Scotia coal is now specially treated and sized for domestic stoker use.

The big sales outlets for Nova Scotia coal are the railway and industrial markets. You are no doubt aware that the railways are (or have been) extremely important consumers of coal, but perhaps you did not know that, even in the years 1945 to 1950, the railways used an average of more than 12 million tons of coal per annum, which is about 30 per cent of the total Canadian consumption during that period and almost 40 per cent of the market for bituminous coal.

As the dieselization program of Canada's two major railroads has gained momentum, the use of coal by railroads has declined, until now a quarter of this market has disappeared and there is every indication this trend will continue at an increasing pace. Recent pronouncements tell us that the program of dieselization will be virtually completed within 5 years, and that no coal will be required after that time in the Maritime areas.

Coal Fired Turbine Too Late

You may have heard or read of a new development, which we in the coal industry regard as being significant. I refer, of course, to research on the coal-fired turbine. What you may not know is that this program has developed to such an extent that plans are now being made to construct the first complete locomotive. Up to now, all work has been concentrated upon the engine itself and there is good reason to believe that this unit will be able to operate more economically than the diesel.

What we, in the industry, are concerned about is that complete conversion of railway motive power to diesel engines at an early date will slow down acceptance and utilization of the coal-fired turbine. New diesel equipment, worth millions of dollars, will not, I hazard a guess, be scrapped to take advantage of the newly developed processes.

It is, of course, easy to be critical of a policy which has an unfavourable impact upon an industry with which one is directly concerned. We in private industry, unfortunately, cannot and do not permit ourselves to overlook the consequences of this change in policy.

The real threat to the Maritime economy lies, not in conversion to the diesel, but in the pace at which the change is made. Certainly, new employment opportunities cannot be developed fast enough to absorb the unemployed miners, if conversion to diesel engines is completed within five years. Of course, it would be over-optimistic to hope that other Maritime industry could thrive in the atmosphere of economic instability which will thus be created.

Bigger Subventions Needed

The individual market remains as the major outlet for coal produced in the Maritimes and, for this market, there is increasing competition. Although more coal is used by industry in these days of high volume business, the area which can be effectively served by Nova Scotia coal continues to diminish and the penetration by United States coal increases.

I think you would be interested to know about subventions paid by the Government to assist the movement of Maritime coal into the Quebec market. The present regulations stem from a policy decision made by the Federal Government

in 1923, although transportation subventions were not developed until the early "Thirties", when generally depressed conditions resulted in sharp curtailment of coal production. Under the conditions which prevailed at that time, waterborne Nova Scotia coal could be laid down in St. Lawrence ports to compete with imported coal.

Subvention payments made to the railroads up to a maximum of $2.00 per ton enabled Nova Scotia coal to move into the big Ontario market. From 1933 to 1939, an average of 1.7 million tons per annum moved into Ontario and Quebec markets under subvention, of which more than half went to Ontario. Now, although the maximum subvention payable has increased to $4.00 per ton, Nova Scotia coal cannot compete in Ontario with low-priced coal from the United States and, in fact, competition west of Quebec City is severe. If the market had not grown, the Maritimes would be able to ship less than half of prewar tonnage to the central markets.

The answer to the problem facing the industry is twofold. Obviously, subvention payments do not, under the conditions which prevail, accomplish the purpose for which they were intended. If the original policy decision was sound, subvention payments must be adjusted and revised from time to time. Only the assistance granted during the "Thirties" enabled this industry to perform its outstandingly important strategic function during the war. Nothing has occurred since then to suggest that we would not once again require every available ounce of coal during periods of national emergency.

Production Costs Must Go Down

Secondly, the cost of producing coal must be reduced. To this end, aided by timely loans made available by the Government of Canada, we have expended in the past 3 years 5½ million dollars on mechanization of the coal mines. Of major significance has been the development and installation of the "Dosco Continuous Miner". This remarkable piece of equipment is capable of chewing from the longwall face a ton and a half of coal in 13 seconds and no explosives are required. The design, development and construction of this machine by Dosco engineers and craftsmen I regard as a noteworthy achievement, and the greatest advance in coal mining practice in the history of the industry the world over.

The key to the whole program is to reduce costs by increasing productivity. To this end, it has been necessary to permanently retire some of the uneconomic units of the industry which do not lend themselves to new mining methods. One major change is the shift from room and pillar to longwall mining, which results in much higher recovery of the available coal.

The mechanization program has generated some interesting problems; for example, the driving of a new tunnel in our No. 20 colliery, by which we hope to bring together from some 3½ miles out under the Atlantic the output of three mines, which will then be lifted to the surface at low cost by a continuous conveyor.* The coal is then to be washed and prepared for use in one large efficient and economic treating plant. Thus far, the proposal is logical, but here's the catch —completion of this and other similar projects will raise our output to about 7½ million tons, against a present available market for about two-thirds of that tonnage.

Fight or Surrender?

The problems we face, in which both Provincial and Federal Governments are deeply concerned, are — how much of the lost market can we hope to regain if we proceed to completion of the mechanization project? Will the expenditure of the capital involved justify itself on economic grounds?

Does the experience of the past justify a joint effort by the operators and government to carry the project to conclusion upon grounds of the ultimate national advantage to be derived from the preservation of this industry as an invaluable asset in time of emergency?

Is it better to forget its possibilities, accept as inevitable its ultimate inability to compete with gas, oil and foreign coal, or to assess its real potential value as a national asset and allow it to be developed to such stature as will enable it, when need arises, to supply such deficiencies and shortages in other fuels as have arisen in emergencies not so far behind us?

These questions are, in a sense, rhetorical; at least, to the extent that I cannot provide the answers. They are questions which must be answered, and answered without too much delay. I shall mention only briefly the fact that the future of individuals, families and communities depends upon the answers. It is only fair to state that subventions, and assistance by way of monies advanced for mechanization of our mines, have contributed in large measure toward meeting the necessities of the industry.

I, personally, find it distasteful to appear to increase the dependence of the industry upon government support. I would gladly forego the necessity for so doing. The problems of the industry are now before the proper agencies of government and they will, I know, be carefully and conscientiously considered. My personal conviction is that, if ways and means can be found to bring about the improvements contemplated in mining, transportation and preparation of our coal, this industry, so vital to my native province, and to Canada, can and will play a great and important part in the glorious future of our country.

Coal Industry Accepts Its Responsibilities

But the mere provision of funds for capital outlays, the adjustment and revision of subventions, these acts of government alone cannot rehabilitate this industry, or restore its health. Government aid, no matter what form it takes, like physicians' prescriptions, cannot effectively cure this patient unless the patient is prepared to co-operate to the utmost of its ability to do so.

The management of the industry has a duty to provide wise and competent direction of it, to insist upon efficient and economical production and the utmost effort in marketing the product to best advantage. For the management, I can speak and I can say that it will meet its responsibility.

Those employed in the industry have a duty too, a duty to the industry, a duty to the communities in which they live—communities which are, in many instances, dependent solely upon this industry for their continued welfare. There are those who can speak for the employees, but, in the final analysis, actions speak louder than words and the performance of the future will be their answer.

(*Continued on page 119*)

*Since this paper was delivered there has been a change in the mechanization program. The construction of the new tunnel to consolidate the hoisting of the output of three collieries has been suspended, due principally to the shrinkage of markets. Both the Government and the Company have felt that until the disposal of the output of these collieries, as it would be increased by this project, is assured, the large capital expenditure involved in it cannot be justified.

Scientific Manpower

by

Dr. E. W. R. Steacie

President

National Research Council, Ottawa

As a Canadian chemist, and as one associated with an organization whose objective is the promotion of research, it is a great pleasure to be here today to see this expansion of research facilities. It is much to be desired that Canadian firms should become really active in research and development, and it is appropriate that one of Canada's greatest industrial organizations should become a leader in this movement. There is no doubt that the new facilities will amply justify themselves.

Your president suggested that I should discuss tonight the question of scientific manpower in Canada, in the light of our rapid industrial development. Before doing this I would like to discuss for a moment the general Canadian position as far as research is concerned.

Specific Canadian Problems

Since Canada is a relatively small country, certain specific problems arise. The most important feature of size is what the engineer calls the "scale factor". It is a well known fact that the behaviour of a model is not directly applicable to a large object. In the same way, it is essential that the small laboratory should not be merely a small-scale version of the large one. Consider, for example, a large firm with a research staff of 1,000. This staff might be working on, say, 50 problems with an average of 20 people on each. There is often an unfortunate tendency in a small laboratory to copy a big one, and with a staff of 25, put half a man on each problem. It is, I think, essential that a small research organization should be very choosy about its problems, and should tackle only a relatively small number and do them well. Above all, it is important that the laboratory should not concentrate entirely on short-term *ad hoc* problems. Some long-term problems of scientific importance are essential if the laboratory is to develop the full capacity of its people. It is also essential if an organization is to be successful in hiring outstanding men. The personnel of an industrial laboratory must have an opportunity to maintain their scientific self-respect.

A second feature of the Canadian picture is the fact that we are, scientifically speaking, just emerging from the pioneer stage. In the early days Canada was, of course, merely a producer of raw materials. These were the essential things in the national economy, and naturally industrial research first got going on things connected with the primary industries — mining, agriculture, forestry and the like. It is only relatively recently that much research has been done on matters related to secondary industry. In many ways we have gone through the same stages as has the United States, but about one war behind.

On October 22, 1954, Canadian Industries (1954) Ltd., officially opened an extensive addition to its research laboratories in McMasterville, Que. The extension contains twelve individual laboratories, with room for eight more, which is now occupied by a stores department, machine and glass-blowing shops, a first-aid room and a lunch room. With the original building, there is space for something over a hundred workers, making this one of the larger industrial research laboratories in Canada.

The company felt that this addition to its facilities deserved something more than the traditional cutting of a ribbon by the president's wife or by the oldest employee, so it invited Dr. Steacie to address its guests at the dinner which followed the opening. His remarks appear on these pages.

There is a deal of similarity between the American picture in 1920 and the Canadian picture today.

A third factor, and in many ways the dominant factor, in the state of Canadian industrial research is our proximity to the United States, a much larger and much more highly industrialized country, and one along whose northern border we are strung out in a long narrow strip. The inevitable consequence of this is that most Canadian companies are subsidiaries, or at least smaller associates, of United States companies. This is by far the most important factor in assessing the position of Canadian industrial research. I will return to it again in a moment.

Universities are the Basis

The universities are, of course, the basis of the whole research structure. Our universities have done a splendid job and have, in fact, been far ahead of industry in getting research under way in Canada. They are, like most other universities, in some trouble financially with the decline of endowment revenues and the increase in the number of students. Actually, we have always been an exporter of university graduates to the United States. This is not a desirable situation from our standpoint, and it is very encouraging to note that the situation is steadily improving as Canadian industrial research expands.

Expansion in Activities

Until relatively recently Canadian industrial research has been a comparatively small effort. Most Canadian firms are subsidiaries and research is something which is done at head offices. But there have always been some very striking exceptions to this rule, and in recent years more and more companies are beginning to realize the importance of at least a reasonable degree of self-sufficiency in research. This is just one more symptom of the fact that we are growing up. The opening of this laboratory today is a major example of this trend, and is most encouraging to others. Imperial Chemical Industries' efforts are, of course, outstanding; it is particularly gratifying that their Canadian offspring should be following in their footsteps.

Like everything else in Canadian science, government research before the war was relatively small, especially research for secondary industry. As far as primary industry was concerned agriculture was an outstanding exception. During the war there was a very large expansion, and this expanded position has been maintained. Today government research in Canada is on a scale which is large, compared with that of most countries.

It is difficult to obtain reliable figures on research expenditure, especially in industry. Figures are likely to be arrived at with one eye on the question of prestige and the other on the tax collector, and the resulting "divergent squint" rather blurs things. However, all who have thought much about the question will arrive at roughly the same conclusions, even if they cannot be documented.

Roughly, before the war we were spending per capita about half as much as the United States as far as government is concerned. However, our very large expenditure on agriculture distorts the picture and our expenditure by government on research aimed at secondary industry was far less. Today, however, our per capita expenditure on civilian government research appears to be about the same as that of the United States and the United Kingdom, and much larger than that of most countries.

Manpower for Research

The position as far as industrial research is concerned is by no means as satisfactory. Because of our "branch plant" situation, our industrial research effort was very small before the war, probably about one-tenth as much per capita as in the United States. There has been an improvement, and today we are perhaps spending about one-sixth to one-seventh as much per capita. The position is encouraging. Many companies are opening laboratories or expanding facilities. The trend is, therefore, perfectly satisfactory even if the present position is not. It is the continuation of this trend which raises the question of the supply of scientific manpower.

The position as far as the universities is concerned is not too encouraging. Much research is being done in the universities, and the magnitude of the effort and quality of the work are extremely gratifying. However, teaching loads are heavy, staffs are far too small, and facilities and salaries are by no means at a proper level. The difficulties of university finance are the main problem facing the whole structure of Canadian research.

In considering the position of scientific manpower, especially from the point of view of research or development, there are three distinct classes of people:

The engineer or science graduate at the bachelor's degree level.
The Ph.D. or other research-trained man.
Senior personnel, especially the abler men from 30 to 35 years of age, with experience in directing the work of a group.

Bachelor Degree Graduates

It does not seem to me that we should do too much worrying about the first group. In the first place, some shortage is to be expected in a period of expansion. My view, and I doubt if it differs from that of industry, is that I would rather see too few scientists than too few jobs. In any case I think that the indications are that the shortage will not be too severe.

We have always exported some technically trained people to the United States. This export is decreasing, but there is still an appreciable flow. It has been my experience that recent graduates go to the United States not primarily for higher salaries, but rather because of greater technical opportunities. An engineer who wishes to practise design will go away if the only job he can get in Canada is plant operation. I feel certain that the flow of people can be stopped at any time, if equal technical opportunities become available. As industrial research expands, therefore, men will become available from this source.

A second point is that we can try to use people effectively. At the present moment science is regarded as the "sacred cow," and I feel that there has been an unrealistic use of technically trained people in some countries. We can try to avoid the waste of our scientific manpower.

The main factors, however, are that as industrial demand increases over the next six or seven years, university enrolment will increase in any case, and that it doesn't take very long to train a man with a bachelor's degree. We are just entering the period where university freshmen cease to be "depression babies" and become "war babies". The very large increase in birth-rate after the depression means a very great increase in enrolment, provided the universities can find the men and facilities required. I do not personally subscribe to the view that anyone who doesn't take a science or engineering degree is a total loss. In fact, I think it will be disastrous if the present trend away from the humanities is too long continued.

Ph.D. Graduates

The second category of people presents more of a problem. A Ph.D. takes longer to train than the undergraduate and requires much more personal attention from first-rate men on university staffs. This necessitates more facilities and increased staffs in universities. The universities are aware of the situation and are actively planning for the increase in students. The question is, however, "Can they afford what is necessary ?" I will return to this in a moment. Here again, however, the greatly diminished, but still appreciable flow to the United States can be diverted and will be of some help. All in all the situation is difficult. It seems to me that the increased supply will come just about when needed, if the universities can expand facilities and, above all, junior staff.

Senior Group Leaders

This brings us to the third category, the 30 to 35 year group of active independent university investigators. This group is essential to the expansion of the output of research students. It is equally essential as the one possible pool from which to draw research directors for new laboratories and senior group leaders for expanding laboratories. Here, I think, is the trouble.

It should be pointed out that we went through this situation during the war. The supply of new Ph.D.'s was not too short since the university output was considerable. The real shortage was in men about 30 to 33 *with real experience in directing research* and great ability.

In a research organization a few people make all the difference. If five per cent of the staff of a research laboratory are really first-rate, with imagination and initiative, all is well. Lacking this five per cent, very little that is worth while will emerge from the laboratory. If we are going to expand, these are the essential people. This is where the shortage really is now, and where the future acute shortage will be. The problem is to develop people of this type, i.e., to get behind them when they appear and to give them the opportunity to develop themselves. In both Britain and the United States the source of supply of such people is the universities. The question is how to hold more people of this type in the universities, where they will help out in the training of research students and will themselves develop the experience and ability to direct research.

University Financial Support

The real problem is merely the financial problem of the universities. Endowment is no longer possible on a sufficient scale. What is essential is current support for research in universities, without interference with academic freedom. Government aid, in spite of constitutional problems, has been considerable, but the universities need much more.

One very striking thing in Canada has been the relatively small support of research in the universities by industry. It is here that industries can themselves contribute to assuring the supply of the scientific manpower they need. I do not mean to be critical of industry, because I think that the situation is an entirely natural one. Financial support of university research by industry has been small, because the industries in many cases have themselves done little or no research.

Today industrial research is expanding and one hopes that this will mean an expansion in university support. What is needed is freer, more general support, and more support for the outstanding man at the post-doctorate stage. Above all support which is not earmarked for "practical" investigations is needed.

I.C.I. Research Development

The lead in this type of support has long been held by Imperial Chemical Industries in Britain. I know of no company which has contributed more than this one towards the development of research and of research workers, through senior post-doctorate fellowships, grants, and in other ways. Now this assistance is by no means unselfish. I have heard it said that since practically all university graduates in Britain will end by working for Imperial Chemical Industries, the company is merely developing its own staff!

Seriously, however, this is essentially true as far as industry as a whole is concerned. Industry needs the men which only the universities can supply. There are no constitutional problems involved in this type of assistance. It seems to me that this is the only possible solution of the present university predicament. It is not cheap if it is done properly, but it is the only way to assure a strong foundation for Canadian science and an adequate supply of men for the coming demands of industry. If we can thus give the maximum opportunity to the best of our younger men, I think other manpower problems will take care of themselves. √

ECONOMICS OF THE NOVA SCOTIA COAL MINING INDUSTRY

(*Continued from page 116*)

Maritimers Should Use More Coal

There are others, as I see it, who owe a particular duty to this industry and I should fail in my responsibility, if I did not mention them. I refer to those people of the Maritime Provinces, and particularly those of Nova Scotia, who do not take part personally in coal mining operations. The intimate connection between successful operation of the mines and prosperity in Nova Scotia has been so often proven that I do not need to enlarge upon it. I sometimes wonder whether some Nova Scotians realize it.

Surveys which we, of the Dominion Coal Company, have conducted have disclosed the surprising fact that, in many areas and some of them coal mining areas, many Nova Scotians pass up the product of the mines and use other fuels in preference to our coal. Our experience has been that Canadian industrial users in large number will continue to use Nova Scotia coal, as against foreign oil, or foreign coal, even at considerable financial disadvantage to themselves.

In the past fifteen years, however, householders and proprietors of smaller commercial establishments in Nova Scotia have installed oil burning equipment, which has displaced from the local market over 500,000 tons of Nova Scotia coal per year. This is a state of affairs which reflects little credit upon either our organization, or upon our fellow Nova Scotians. The coal they refuse to use must be sold, if sold at all, in Quebec and in Ontario. We must ask the rest of Canada to help us meet the cost of carrying it to consumers outside of the Province where it is produced.

It is an old and a true saying that God helps those who help themselves. We believe that we can provide these heretics, or backsliders, with cheaper, better fuel than they are now using, and we propose to tell them how and why. Then, if their loyalty to the industry of their own Province is not sufficiently strong to compel them to support it and the men who work in it, they cannot object to being held accountable for their share of the consequences. √

A Method of Computing Maximum Snow Loads

by

M. K. Thomas

Meteorological Division,
Department of Transport, Toronto.

Computed maximum snow loads have been derived from extreme snowfall, snow cover and rainfall data in the decade from 1941 to 1950. The derived loads are evaluated against those obtained from building codes now in use in major Canadian cities and found to be comparable in most cases. The value of these derived loads to smaller municipalities is mentioned.

In this study to determine snow loads on roofs, a flat, horizontal, unheated roof has been considered to be the same as the ground surface. While a roof is usually more subject to wind action than the ground, this may result in either a sweeping off of the snow cover or a piling of drifts, depending on the position of local wind obstructions. With sloping roofs and roofs not insulated from building heat, it is generally expected that snow load conditions will seldom become as severe as on a horizontal, unheated surface.

Snow depths are measured daily at most climatological stations in Canada. These data indicate the average depth of snow on a horizontal surface about each observation station. Areas which have been blown bare, or which have been heavily drifted, are avoided as far as possible in observing snow depths. Amounts of freshly fallen snow are also observed at least daily at all climatological stations.

Freshly fallen snow in Canada is arbitrarily given a specific gravity of 0.1 in computing total precipitation data. This relationship is good on the average, but from storm to storm the snow density may vary widely. On the ground snow usually begins to pack and consolidate at once. The weight of further snowfall contributes to this settling, as does wind action and melting. This causes the density of snow on the ground to increase unevenly in different layers as the season progresses. The specific gravity of the snow layers toward the end of the snow season is usually in the range of 0.2 to 0.4.

Method

The first step in this snow load study was to search the 1941-50 records for the maximum reported depth of snow on the ground. These data were plotted on a chart and lines of equal maximum snow depth were drawn at intervals of 10 inches. This chart is shown as Fig. 1. The isolines were kept as smooth as possible and if the maximum depths at two adjacent stations did not agree, the larger figure was adopted.

It must be remembered that most observing stations, from which records have been used in this study, are located at airports or in urban locations. It is believed that snow in the bush and in rolling, forested country accumulates to greater depth than in the open. This is also the case in mountainous country, where the maximum depth of snow on the ground in inaccessible, high valleys and passes is most certainly greater than the valley station data, from which this chart is largely drawn.

To obtain a better understanding of the maximum reported depth of snow on the ground, a survey was made to determine when this maximum usually occurs. From Fig. 2 it can be seen that maximum depths are expected in January and February in most of coastal and southern Canada. In interior Canada, as the latitude increases, the period of usual maximum depth is delayed. North of Hudson Bay this period is usually in May.

Since maximum snow depths always occur immediately following a heavy snowfall, it was felt that the average density figure should be somewhere between that of 0.1 for freshly fallen snow and 0.2 to 0.4 for an old snow pack. A specific gravity of 0.2 was arbitrarily chosen as the average and was used in reducing snow depths to weight units.

In southeastern Canada, most structural failures due to snow loads are reported when a winter or spring rain falls on a heavy snow cover. For several hours the snow cover is able to hold the rain and often no run-off takes place, but the load increases steadily. Frequently this type of storm produces a mixture of heavy wet snow and rain. In the Prairie Provinces and in northern Canada, heavy rainfall is quite unlikely during the period of maximum snow cover and this factor is not so important. On the Pacific Coast, rain is frequent and abundant during the winter months, but with its occurrence, temperatures are usually sufficiently high to melt a snow cover quickly.

To consider the rainfall factor, the records were searched for the maximum amount of rainfall which has fallen in 24 hours during the season when a maximum snow cover might be expected. A period of 24 hours was chosen because (1) it was felt that rain for a longer period would most certainly produce appreciable run-off and (2) it is the only period for which rainfall intensity figures are generally available. Data used were from the period 1941-50, which is similar to the period used for snowfall data. Enveloping lines were drawn on a chart which indicate the probable limiting position of the 24-hour amounts which might fall during this period. This chart is shown as Fig. 3.

To obtain the computed maximum snow load chart as shown in

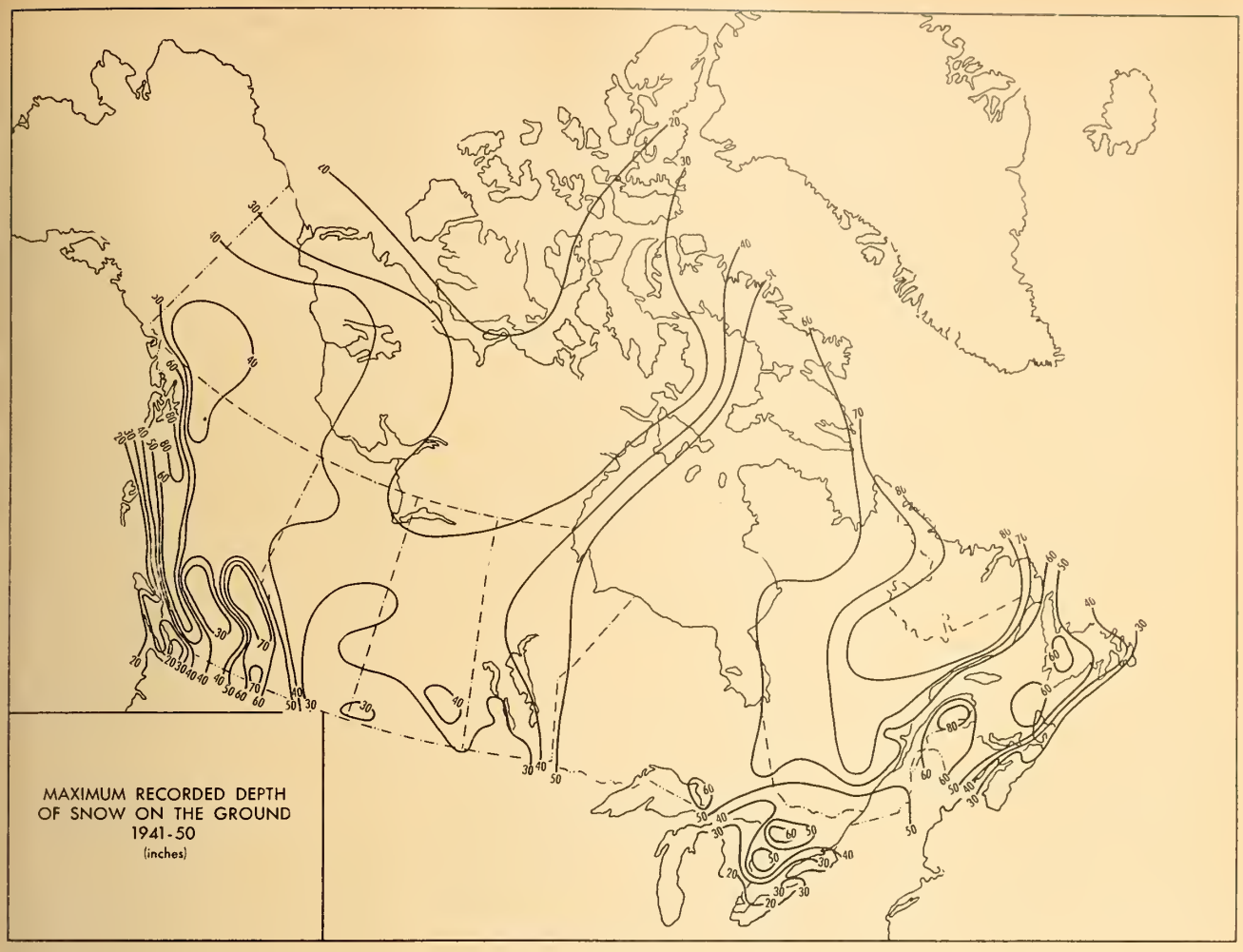

Fig. 1.

Fig. 4, the specific gravity of 0.2 was applied to the maximum reported depth of snow on the ground and to this was added the estimated maximum amount of rainfall which might fall into this snow cover in 24 hours. In order to convert from inches of water to pounds per square foot, all values were multiplied by an approximate factor of 5. In drawing the computed maximum snow load map the pattern between stations was made to resemble, as far as possible, that on the maximum snow depth map, since snow depth is by far the largest factor involved in most of Canada.

This computed maximum snow load, shown as Fig. 4, is the same chart that is used as Chart 8 in Part 2: Climate, of the National Building Code 1953. It also appears as Chart 4-2 in the Snow Section of the Climatological Atlas of Canada.

Evaluation

Besides the National Building Code (1941), there are numerous municipal building codes in force in Canada in which there are provisions for snow loads. Different loads are usually given for flat roofs and for roofs with a slope of more than 20°. Table I lists the thirty-four most populous cities of Canada, with a comparison of snow loads according to their own codes and the National Building Code (1941).

Snow loads (L) in the 1941 National Building Code were derived from the equation $L = S + R$, where S is the sum of the average snowfalls in January, February and March over a number of years and

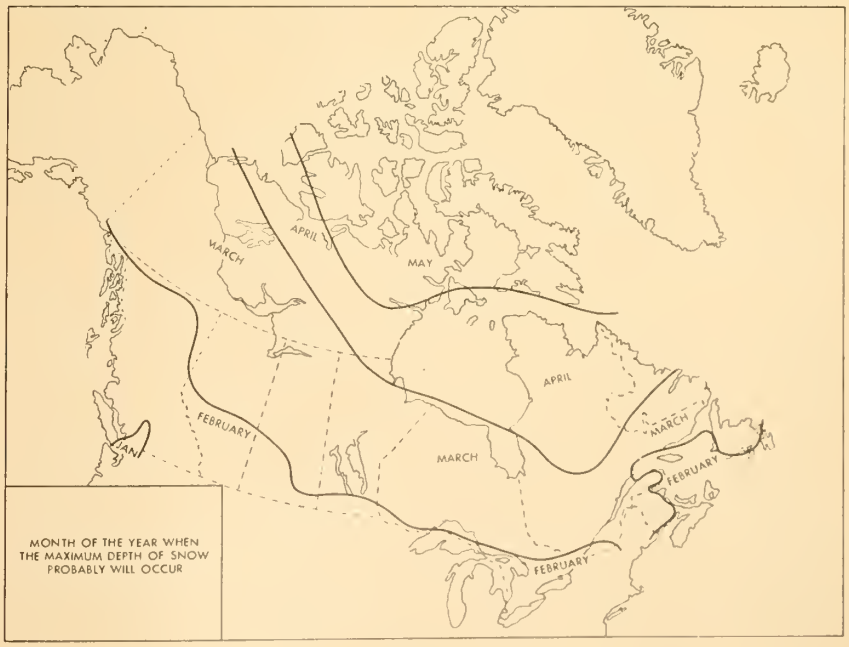

Fig. 2.

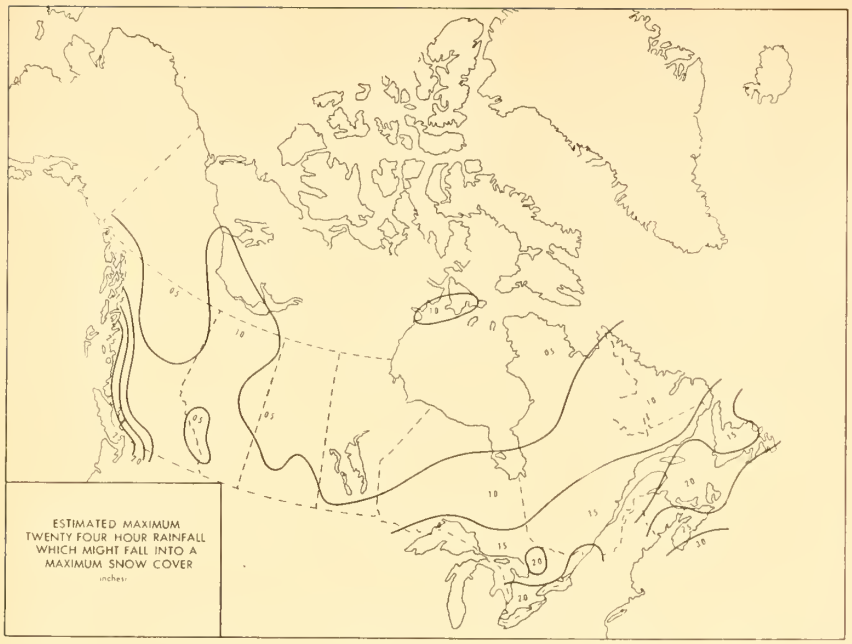

Fig. 3.

R is correspondingly the average rainfall in inches. This equation applies to a flat roof and adjustments may be made for sloped roofs. The equation gives values for Montreal and Toronto which are very similar to snow loads in their municipal building codes and to the snow loads obtained in the present study. However when applied to other parts of Canada the values obtained from the equation are not satisfactory.

In the Pacific Coast region (see Vancouver) and the Maritime Provinces (see Halifax) where there is an abundance of winter rainfall, the 1941 equation gives values which tend to be high. In the Prairie Provinces (see Regina), since snowfall in the October-December period is not considered, the loads as derived by the 1941 equation are too small. Other sources of error in values obtained by the equation are that the equation is based on mean values and assumes that all precipitation falling in the three-month period might remain on a roof. Perhaps this equation was used chiefly because of the reasonable values it gave to the major cities of Ontario and Quebec.

The snow load values that have been developed in this study appear to have the proper magnitudes, when compared to those in most codes in use in 1952. Of the cities listed in Table I, nineteen have definite snow loads listed in their codes. Comparing these to the loads derived here, eleven have values which differ by 5 pounds per square foot or less, newly derived values in five cities are 10 to 15 pounds less than that now in force and three cities show new values which are 10 to 15 pounds greater than those given in their 1952 building codes.

At most of the cities where the newly derived values are 10 pounds less than that now in force, the value in use is the rather standard 40 pounds. These cities—Vancouver Victoria, Regina and Sarnia—do not lie in heavy snowfall regions, but the possibility of heavy falls is present and had this study been based on thirty years' data, greater snow depth data might have been obtained. The same applies to Verdun, where the value in use is 60 pounds and the value derived here is 50 pounds.

At three locations in Ontario, however, the situation is reversed. According to values obtained in this study, the snow loads in the 1952 codes of Ottawa, Kingston and Sault Ste. Marie are undervalued by 10 to 15 pounds per square foot. It is felt that the 1952 code values at these cities may have been influenced by values used at Toronto, where the probability of heavy snow cover is not so great. With this apparent under-designing at Ottawa, Kingston and Sault Ste. Marie, we might expect these areas to report a greater proportion of structural failures due to snow loads than other Canadian cities.

Table 1: A Comparison of Snow Loads According to Diferent Building Codes (Pounds per Square Foot)

City	Prov.	Municipal Bldg. Code in Force 1952	National Bldg. Code 1941	Computed Maximum Snow Load
Montreal	Que.	50	53	50
Toronto	Ont.	40	40	35
Vancouver	B.C.	40	101	30
Winnipeg	Man.	30	15	35
Ottawa	Ont.	40	41	50
Quebec	Que.	—	48	50
Hamilton	Ont.	40	41	35
Edmonton	Alta.	—	12	25
Windsor	Ont.	—	35	30
Calgary	Alta.	30	10	25
Halifax	N.S.	—	76	40
London	Ont.	—	53	40
Victoria	B.C.	40	51	30
Saint John	N.B.	57	57	50
Regina	Sask.	40	8	30
St. John's	Nfld.	—	77	50
Verdun	Que.	60	53	50
Saskatoon	Sask.	—	11	35
Sherbrooke	Que.	—	44	55
Three Rivers	Que.	—	41	60
Kitchener	Ont.	40	36	40
Hull	Que.	—	41	50
Sudbury	Ont.	40	26	40
Oshawa	Ont.	—	40	35
Peterborough	Ont.	—	41	60
St. Catharines	Ont.	40	32	35
Brantford	Ont.	40	36	35
Sarnia	Ont.	40	32	30
Fort William	Ont.	—	14	55
Kingston	Ont.	40	39	55
Sault Ste. Marie	Ont.	40	27	55
Port Arthur	Ont.	—	14	55
Sydney	N.S.	—	73	40
Outremont	Que.	50	53	50

Snow Load Studies in the United States

A research study on snow loads has recently been completed in the United States by the Weather Bureau under the sponsorship of the Housing and Home Finance

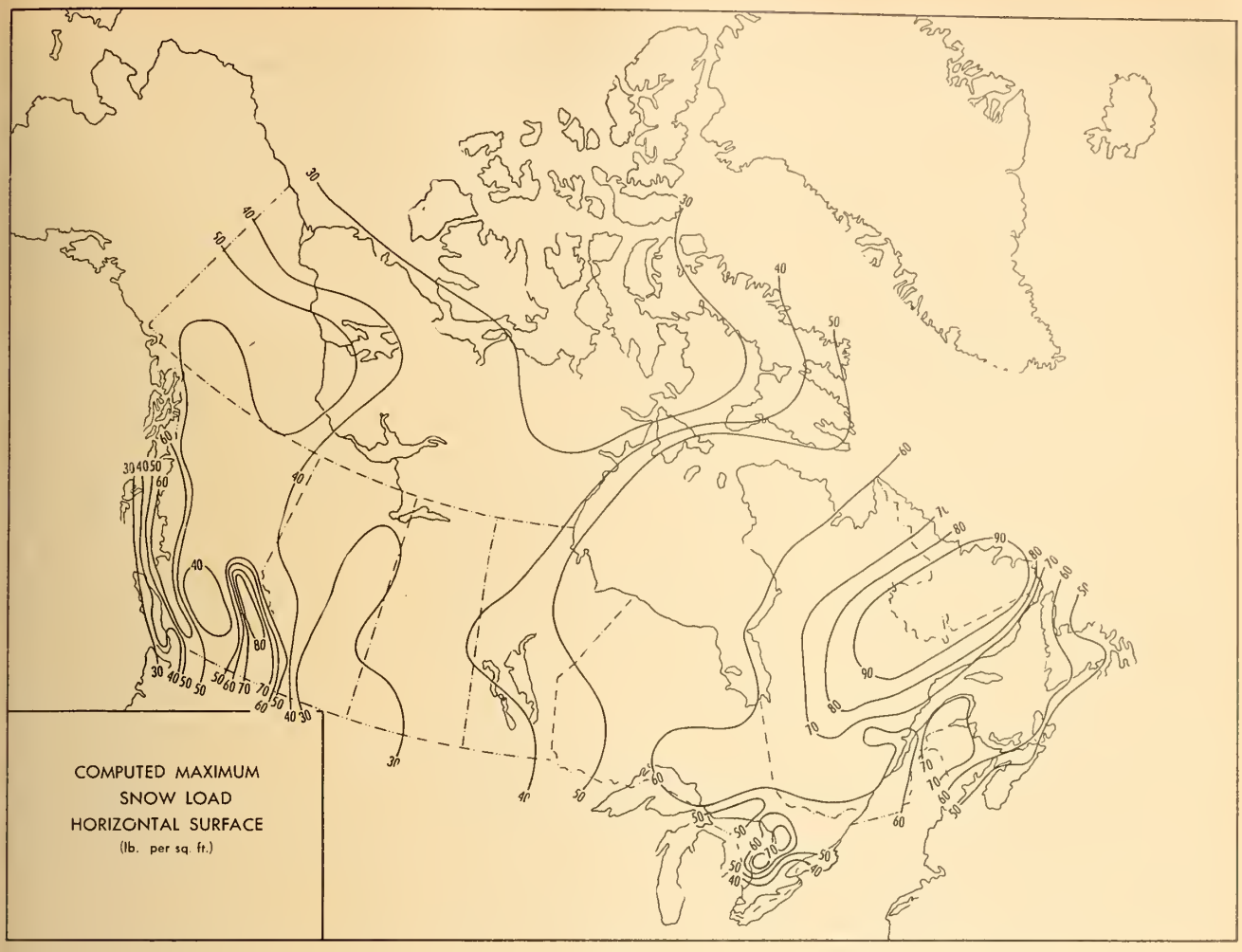

Fig. 4.

Agency. The problem has been attacked a little differently than the method used here, but the results seem to be comparable.

In the publication "Snow Load Studies"[4] several maps are obtained, one of which shows the estimated weight of seasonal snow pack equalled or exceeded one year in ten. This is apparently used as a basis for the recommended minimum snow loads selected for the different United States regions by a structural engineer. The paper then proceeds to show that when these loads are multiplied by the usual safety factor of 2½ the results are comparable to the weight of the estimated maximum accumulation in the ground plus the weight of a maximum probable snowstorm. This is considered the most extreme condition possible.

Conclusion

Snow loads in this paper have been derived from snow and rainfall data in the decade 1941 to 1950. With both elements, emphasis was put on the maximum values in any region. No safety factor has been considered, nor has the influence of any other live loads been included; the loads derived are strictly from climatological data and are rounded off to the closest 5 pounds in Table I. In general, the resulting values are comparable with those in use in the 1952 building codes of some twenty major cities across Canada. Perhaps the greatest value of this paper is to indicate to smaller municipalities the proper snow load values to use in preference to direct adoption of values in use at nearby large cities.

Acknowledgments

This paper records work done by the author in connection with the revision of the National Building Code of Canada. This was carried out as part of the author's duties as climatologist to the Division of Building Research of the National Research Council, to which position he was seconded from the Meteorological Division, Department of Transport. The paper is published with the approval of Andrew Thomson, Controller of the Meteorological Division and of R. F. Legget, M.E.I.C., Director of the Division of Building Research, under whose immediate direction the project was undertaken.

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Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

NEW INTERNATIONAL COLLECTION OF REFERENCE RADIOGRAPHS OF WELDS

Polytechnic Four-Weekly, April/May 1954, pp. 317-318.

As everybody knows a great number of radiographs are taken on important weldments such as boilers, bridges and steel structures. In order to be able to give the radiographs correct interpretation and consequent rating a collection of reference radiographs has been used. The radiographs have been taken from welds with typical defects and the cards on which the reference radiographs are attached contain information with regard to weld defects and radiographic data.

The standard collections which have been available so far have had acceptance only within the country of origin, although the Swedish collection has been used to quite some extent outside of Sweden.

Studied by National Institutes

One of the first tasks of the International Institute of Welding (IIW) was to prepare a collection of reference radiographs of welds which could be accepted in all countries represented in the IIW. In the Technical Committee 5 a great number of suitable radiographs were examined by experts from the IIW-countries and 50 of them were selected and accepted as reference radiographs for various typical weld defect. Thus this collection has an international acceptance.

The execution of the IIW decision was left to the following national institutes for technical X-ray service:

Svejsecentralen, Denmark,
Rontgen Technische Dienst, Holland,
Rontgenkontrollen, Norway and
Tekniska Rontgencentralen, Sweden.

Earlier collections have been published in book form. The new collection employs the card system giving the following advantages:

1. It is easy to enlarge the collection and separate radiograph cards can be replaced by better ones.
2. Due to the fact that the cards are punched after a certain system it is very easy to pick out all radiographs showing a certain weld defect, for instance porosity.

The card system has also made it possible to employ normal transparent film copies, which give exactly the same definition and contrast as the original radiographs. The collection is available in two different forms, viz.

1. With a transparent film copy inserted in a rectangular hole in the card. This type of card is intended for all normal interpretation under office conditions. A viewing box is needed for this type of card.
2. With paper copies pasted on the cards. The paper copies are cheaper and slightly inferior to the film copies with regard to density and contrast but on the other hand they are not as easily damaged as the film copies. The paper copies are intended for use on the site or for educational purposes.

The cards contain information with regard to marks, weld defects, welding position and plate thickness as well as radiographic data. One side of the card has English text; the other French.

COLLOIDAL MOLYBDENUM DISULPHIDE

F. Gordon Kay, *Machinery*, v. 85, n. 2187, October 15, 1954, pp. 811-12.

Although molybdenum has been known for many years in the metallurgical field, it is only comparatively recently that it has been employed in the field of lubrication. Purified molybdenite (MoS_2), more commonly known as molybdenum disulphide, possesses valuable antifriction properties due to its crystal structure. It was first applied as a lubricant in the form of a finely ground powder.

Experiments reveal that molybdenum disulphide has better chemical and thermal stability than certain other lubricants. It does not decompose in an inert atmosphere at temperatures below 500 deg. C., nor is it adversely affected by temperatures as low as −40 deg. C. Moreover, it does not attack metals as do certain special lubricants containing appreciable amounts of free sulphur.

As molybdenum disulphide was more widely employed for lubrication purposes it became evident that its application was limited to surfaces to which it could be supplied conveniently at fairly frequent intervals, or to mechanisms such that the replenishment, from time to time was not necessary.

In order to provide more permanent dry lubrication, a mixture of molybdenum disulphide and corn syrup was originally applied to the surfaces and baked to produce better adhesion of the solid particles. Later this practice gave way to the use of resin-bonded coatings, which not only adhere more firmly to the bearing surfaces but also provide superior lubrication over longer periods of time. Molybdenum disulphide dispersions are now being adopted.

Application to a Difficult Problem

Cutting tools present the lubrication engineer with one of his most difficult problems. Pressures are high and a great deal of generated heat must be dissipated. Molybdenum disulphide is an excellent lubricant under extreme pressure conditions, and when dispersed in a carrier liquid it may be used to pretreat the cutting tool, and as an addition to the lubricant or coolant

used during the actual cutting operation.

If a straight mineral or sulphurized oil is in use the addition of a dispersion of colloidal molybdenum disulphide in oil is recommended. One part of this product is added to each three hundred parts of the oil. For soluble oil/water emulsion, an alternative is available.

Amongst the metal cutting operations for which molybdenum disulphide is being used may be noted broaching, grinding, turning, screw cutting, tapping, and reaming. Reports received from machine shops engaged on various types of repetition operations, provide evidence of the improvements brought about by the addition of molybdenum disulphide to grinding and cutting coolants, whereby loading is reduced and tool life increased at higher cutting speeds.

Other Uses

Molybdenum disulphide is also used as a die lubricant in hot metal working operations, such as deep drawing, press forging and tube drawing.

For the lubrication of the bearings and gears in machine tools, colloidal molybdenum disulphide is said to give excellent results.

Advantage may be taken of the extreme pressure properties in connection with the lubrication of lathe beds; planing machine slideways; gears and bearings of automatics, gear cutters, and other machines.

ONTARIO HYDRO LABS ARE LEADING RESEARCH CENTRE

Electrical News and Engineering, July 1954, pp. 98-101.

From the earliest days of the Ontario Hydro-Electric Power Commission, the growth of its functions in the Province inevitably began to introduce technical problems of construction, operation, maintenance and consumer service. It was soon realized that research and testing facilities would be essential, and in 1912, a laboratory was set up in the basement of one of the transformer stations. In the intervening forty odd years the original three-man department has become a division of the Engineering Branch, with a staff of about three-hundred and occupying more than 70,000 square feet of floor space.

A section designed to serve the needs of the Commission in the fields of physics and mathematics, has been formed. The section keeps informed of any advances made in the pure sciences, with a view to applying basic research findings in the Commission's operations.

Typical Recent Work

Typical recent work includes: use of mine-detectors for detecting flaws in concrete; development of a simple telescope method of locating overheated conductor-joints prior to a bolometer survey; establishment of a precise optical method of checking the long-time alignment of three widely spaced points, with an accuracy of one part in five million; detection of leaks in buried cables which have an inert-gas-filled sheath; and miscellaneous studies using radioactive cobalt for inspection purposes.

Mathematical studies recently undertaken include the prediction of time series for application to load forecasting; the statistical design of experiments; and the interpretation of data obtained. Assistance with research programs is a continuing responsibility; a current problem involves a study of the theory of reduction of photo-elastic measurements.

Meteorology is a field of research which affects various phases of several long-term investigations having a wide interest throughout the commission. A knowledge of meteorological factors is important in, for example, studies of lightning protection for Commission transmission lines and structures. Measurements of ice thrust on concrete dams and studies of "galloping" of transmission-line conductors are other projects in which meteorological factors obviously are important. Weather conditions also have effects in corrosion, paint deterioration, wood rot, decay of plastics, and other problems.

The possibility of long-term precipitation forecasting is of much interest for estimating water reserves; a study is being made to assess the value of the later developments in this field.

In the electrical research field studies of lightning and surge phenomena have advanced significantly; new equipment has been designed and installed and valuable data have been compiled for analysis. A surge generator has been constructed in the laboratory. The present capacity of 600 kv. will ultimately be increased to 1,500 kv. The expansion of the Commission's system has greatly accentuated the need of high voltage and high-power testing of electrical equipment. Multi-channel instruments have been built to record the sequence of relay operations which occur during system disturbances. Improved station operation is visualized by means of an operations recorder now being designed; considerable reductions in the size of the annunciator board and meter panels in control rooms are expected to result. Development of these instruments may ultimately be of value for fully automatic operation of generating and transformer stations; a preliminary survey has indicated the feasibility of such operation.

Effects of Television

The fairly recent inception of television transmission in Southern Ontario necessitated a continuous study of interference problems and their causes.

Data on the current-carrying capacity of ACSR conductors have been determined. Based on these data, simplified nomogram charts for a range of conductor sizes have been prepared for the use of operators. These nomograms will often permit larger emergency power loads to be carried than were allowed under previous operating rules.

Improved methods of control-room lighting of both new and existing stations have been the subject of an extended investigation. In addition to lighting surveys at existing stations, a major investigation is being conducted on a full-scale model of the control room planned for Sir Adam Beck-Niagara G.S. No. 2. Several systems of lighting are being evaluated in continuing tests for glare rating, brightness ratio, and general appearance.

The applicability of fluorescent lamps for street lighting in Ontario is being determined by an extensive study. In particular the problems of reduced light output at the lower outside temperatures and difficulties of starting under cold weather conditions are being considered.

A New Electronic Development

A new electronic development is a compact telemeter which was designed and installed for the unattended monitoring of the water level of a remote northern lake. A clock-operated transmitter sends the information daily to the nearest Hydro station as a series of long and short audio tones representing feet and tenths of a foot respectively. The level is automatically recorded

at the receiving station on a strip of electro-sensitive paper.

Significant advances have been made in perfecting methods of testing the condition of the electrical insulation of generators. Non-destructive tests developed by the Division, and now widely accepted by engineering organizations and industry, have made possible the estimation of the mechanical flexibility of major insulation and the electrical breakdown strength of its weakest spots. Numerous laboratory studies have been made of generator insulation, of various types and in different conditions; co-operative field tests are being conducted with other utilities across Canada.

Problems of single-phase watt-hour metering have received increased study; for example, detection of inaccuracies in power metering constitutes an essential task. Changes in regulations for Government inspection of electricity meters necessitated many changes in the detailed test procedure followed by the division. New specifications for Commission meters have been prepared and new equipment was assembled for precise performance testing at regional meter centres.

INGLEWOOD'S INDUSTRIAL EXCAVATING SPECIALIST

Ray Day, *Excavating Engineer*, June 1954, pp. 30-34.

In Inglewood, Calif., an entirely new concept of excavating is proving its merit. Emmett Malloy, contractor and dirt man of that city, was sharp enough to originate it. Just 15 years ago, Malloy had to allocate his first $75 fee toward repair of his only piece of equipment. Today he has an equipment spread of 30 units covering work his customers want done, and his business is still growing.

Malloy's spectacular rise in the excavating business can be credited largely to his shrewdness in analyzing the market for his services. He seldom thinks of an excavating job in terms of cubic yards or geological formation; it's always in terms of machine hours and "Can we do it?" His equipment is rated much more on the basis of performance than on initial cost. The type of jobs which are Malloy's specialty call for working in cramped quarters, analyzing complex plans and specifications, extraordinary planning which covers the whole field of industrial building, and just plain management. Malloy can't remember the last time when one of his jobs consisted of straight digging.

For Malloy is an industrial excavating specialist. His customers include a Who's Who of the building industry. Instead of huge blocks of cubic yardage, Malloy's jobs more often than not consist of near-impossible chunks of excavation which have to be mucked out safely, or difficult crane jobs calling for the patience of Job and the skill of a trained engineer.

Excavating Has Much to Offer the Contractor

According to Malloy, industrial excavating has much to offer a serious dirt contractor, both from the standpoints of challenge, interest, and personal satisfaction. The various jobs are never easy. They call for unusual co-ordination, the best of operators, and good planning. When the excavating phase of a large building gets under way, everybody from the owner to the general contractor is interested in getting that part out of the way. As a result, an industrial excavating specialist must be more than usually dependable. He must know exactly what he's doing . . . and what his equipment will do.

Malloy operates a sizable fleet of heavy equipment, but he is careful to emphasize that it didn't just grow. His equipment was selected for a purpose to do the special work required, and considerable emphasis has gone into heavy but mobile machinery. Not many big building contractors are willing to buy shovel and dragline equipment when they can get a specialist like Malloy to furnish everything that's needed, and to move the excavation quickly and quietly.

Important Piece of Equipment

One of the most important pieces of equipment on Malloy's roster is a truck and a low bed trailer. The unit is radio equipped with a two-way transmitting set, which in turn is hooked to the Inglewood office and the equipment dispatcher's pickup truck. It is this unit which moves the various pieces of equipment around to the jobs. With its radio equipment, it is so efficient that a drag-shovel often arrives on a job at the same time the superintendent's car arrives. The unit has moved a piece of equipment to as many as three jobs in a day, holding non-effective working time to a minimum for the owner concerned.

Malloy's repeat business is probably the backbone of his work. A sizable percentage of the telephone calls which come in each day represent big contractors whose dirt jobs Malloy has often done calling back to invite a bid on some new project. Several of these contractors are such good business friends that they depend largely on Malloy for bidding costs, so far as his specialty item is concerned.

One of the peculiar things about Malloy's business is that many of his bids are on this sort of invitation basis. For that reason, he is placed in a peculiar position. Unless he keeps his bids as low as possible, he feels that he is helping to jeopardize his general contractor's chances of landing the job. Therefore on many an invitation bid his figures must be even more accurate than on a straight competitive job.

Several important factors bear on the repeat orders. Dependability of performance, speed, and over-all ability count the most. One job which was in trouble so far as the dirt work was concerned produced an SOS on Malloy's telephone. Malloy shot several of his Bucyrus-Erie dragshovels in, and had the job out of danger in about three shifts. Instead of laying off the Malloy equipment at that point, the general contractor took his own equipment and operators off the job and let Malloy go ahead and finish.

Pitfalls to Avoid

Successful industrial excavation can best be done by mentioning the "don't" part of the business, and Malloy has been around enough to qualify as an expert on this subject.

"One of the things you should always be very careful not to do is to tip off prices to anyone," he explained. "Suppose you're invited to bid the dirt work on a big building by four general contractors. Two have their own dirtmoving machinery, and two don't. A bid to the two firms who have their own machines is a sure tipoff on the price their competitors are likely to charge for the work. You're protecting your customer by bidding only with the one company you believe might get the job.

"Another thing which leads to trouble is to attend a prebidding conference with the general super-

intendent who will do the job, and to let the methods he proposes to use get around to his competitors. It leads to ill feeling as much as anything in the business.

"Bidding with everybody is another thing a dirtmover should not do. There is altogether too much of that practice in today's market, in my opinion. Usually a common sense analysis of any given project and its general bidders is sufficient to tell a man what to do about his bid."

Malloy's thinking in this connection is straightforward. He simply believes in stacking as much percentage with him as possible. For example, he would be much more likely to bid close on an industrial job for a client who never made it a practice to do his own excavating.

SCALE MODELS

H. J. Bowen, *Chemical Engineering*, v. 61, n. 8, August 1954, pp. 176-182.

Today's designer is caught between the demands for lowering engineering costs; good design for new complex plants; and a shortage of competent engineering talent. He needs a new engineering tool, a technique that will reduce design, capital and maintenance costs, that will speed up construction and operator training for faster start-up—and still result in a well designed plant.

More and more he is turning to the use of engineering scale models to help him achieve these goals.

Essentially, the scale model is a three dimensional planning tool. To understand how it can be used, let's trace the different phases of a scale model, as they develop during the design and building of a chemical plant.

We will be describing a particular type of model, called an "engineering" model. Actually a model may be started at any time during design, or even after design is completed.

A model built after design is completed is termed a "training" model. It is useful for detecting interferences; training operator labor. And it may be useful for construction if it is completed in time for the pipe erection crew.

The training model has limited design value. But the engineering model (a model built ahead of, or parallel with the blueprints) can be of considerable value to the designer. The engineering model not only detects design errors early in the game—but tends to prevent errors creeping into the design in the first place. This engineering model costs about twice as much as the training model, because it is being continually revised.

Different Phases of a Scale Model

First, a preliminary, engineering model is built from flowsheet data. It consists of a fictitious structure and movable equipment. Bay sizes and floor elevations may be quickly changed. Stairs, platforms, ladders, ventilation ducts, manholes, are fastened down with pressure sensitive tape. The model is used to establish optimum equipment arrangement and minimum building. The major equipment can be quickly changed at this stage.

Next a basic model is built quickly (without waiting for steel and equipment details) and moved to the design office. Major layout designs have been made on the preliminary model and used to build the basic.

The third phase involves piping design. The modelmaker (who is also a design engineer) and the piping designer lay out the piping systems in the model—working from flowsheet data. All important pipes, valves and instruments are shown. Pipe is depicted with thin brass wires, each containing several discs to represent outside diameters (including insulation).

Piping drawings are not made until after the model has been reviewed and corrected by operating, maintenance, and construction personnel. Piping drawings are much cheaper, since they are simply copied from the model.

In the fourth phase, the model maker strips out the fine wires, and working from the drawings, installs full size (to scale) piping. This serves as a check on the drawings. Piping is coded; red for steam, green for water, etc. This fourth phase is optional.

In the fifth phase, the model is sent to the construction crew. Here it is used by subcontractors in preparing their bids; by construction people in planning building schedules.

In the sixth phase, it's sent to the manufacturing department and helps in the training of operating, maintenance, and supervisory personnel.

Mistakes to Avoid

Probably a great many models have been built which were not justified. Observance of this list of "don't" will assure justification.

1. Don't permit the model maker to include "gingerbread" or model details which do not have definite application. You cannot always justify showing lights, conduit, handrail, ladder cages, flanges, curbs, etc.

2. Don't force designers to use a model; they must be sold on it. After all, they have design methods which work, and they are reluctant to tamper with design schedules to try something new. This resistance is normal inertia to change, and is met with whenever any untried idea is proposed.

3. Don't permit the "perfectionist" to delay design with insignificant changes. The model gives him an unprecedented opportunity to do this. It is the business of the leading designer to remind everyone that this $10 million plant must earn $15,000 a day.

4. Don't build the model too late. If you hope to get full engineering advantage, the model should be started as soon as approximate equipment sizes are known. A "training" model may be built after design is finished, but its utility is limited to training and perhaps construction planning.

5. Don't start piping studies until the flowsheets are reasonably firm, otherwise such studies may be wasted.

6. Don't perform piping studies on paper (except stress analysis) if a model is available. The latter is infinitely faster because you can see all the physical variables.

7. Don't permit the model to become out of date after it is delivered to the construction forces. There is always a dribble of piping changes going to the field after piping drawings are issued. If construction men find a few pipes in the model that disagree with latest drawings they will lose confidence in the model and will refuse to use it. The simple remedy is to keep the model up to date as long as design changes are coming through.

8. Don't make one group, e.g., design department, bear the entire model cost when other groups (construction, operation and sales) intend to use it. This produces resistance from the injured group.

9. Don't neglect to get written reports on model usage from design, construction and operating people. Such reports provide basis for future action.

Month To Month

JAN. FEB. MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Columbia-Fraser River Scheme

Some time ago the Engineering Institute was informed in confidence of the proposal to develop a great volume of power in the Fraser River by means of tunneling the flood waters of the Columbia River into the Fraser. However, the need for keeping this confidential seems to be over, inasmuch as one of the leading weekly papers a short time ago ran quite a display on its front page, telling a great deal of the proposal.

To quote from the article which appeared in the *Financial Post* of December 25, here are some of the features:

"The scheme lying behind an innocent-looking announcement from Jean Lesage, Minister of Northern Affairs and National Development, is to build a billion dollar hydro development giving western Canada some thirty billion kilowatt hours of cheap power every year.

"To investigate the economic feasibility of the project, the Federal Government proposes to spend $250,000 in the coming year. Equal sums may be necessary for another year or two before Canada can say definitely that the scheme is advantageous, though the first summer's work should give a pretty good indication.

"In brief, this is the project:—

Switch the peak season flow of the Columbia River through a huge tunnel into the basin of the Fraser River.

To store the flood waters which rush down between April and September, and to release them into the Fraser basin between October and April, when the Fraser's flow is at its lowest.

Thus to use in Canada the peak flow of the Columbia water which now goes to waste, and also to develop power sites on the Fraser and its tributaries by doubling the off-season flow without interfering with the fisheries.

"It would be more than double the power to come from the Cornwall section of the St. Lawrence Seaway.

"If the plan proves as sound as preliminary indications suggest, it will –

Put an end to all Canada-U.S. arguments as to how the United States should pay for the advantages it would get from having Columbia flood waters stored in Canada. The benefits will not go to the United States; they'll be reaped in power plants on the Fraser and its southern tributaries, notably Eagle River and the South Thompson.

Permit the development of power-sites on the Fraser and its tributaries without interfering with the salmon run, which is still regarded as inviolable. The increased flow will all be at the off-season, and there will be no increased danger of flooding.

Turn Vancouver and the interior of British Columbia, and possibly Alberta as well, into a power-rich region, with all that means in the way of new industries.

Provide about one million acre-feet per year of water, available from no other source, for irrigation in the Okanagan Valley.

"Until the new studies are completed several conflicting views about the scheme are held in Government circles. But all authorities agree on one point; the Columbia-Fraser diversion, if it proves practicable, would not take away from the United States any benefit which it now enjoys from Columbia River waters. The water-flow serving existing United States plants will be protected."

The information which has come to the Institute from the aforementioned very reliable source indicates there is every likelihood of the scheme proving to be practicable.

Cover Picture

It would be hard to pretend that our cover picture this month is a technical one. However, this issue does contain a paper on snow loading, page 120, and knowing this we could not resist the temptation to present this fine Canadian winter scene. And we do show a roof with a heavy load of snow on it.

Photo by Max Sauer

Who Said There Was No Shortage?

It is a satisfaction to anyone to see the day when some statement of his, which is questioned at the time it is made, is ultimately proven and admitted to be correct. This has happened to the Institute within recent months.

The official opinion of the Institute over the last ten years has been that there is a shortage of engineers in Canada. That opinion has been assailed many times and in many ways. There have been stormy meetings in the Institute auditorium, letters to the press, letters to the Institute, telephone calls and many conversations.

Some of these critics have used pretty strong language, and have even suggested that the Institute was urging the training and the importation of engineers in order to create a surplus that would result in reduced salaries. Looking back it is difficult to realize how bitter some of these people were—and how out of touch they were with actual conditions.

Today on all sides we see articles about the shortage of engineers. It looks as if at last the real conditions are recognized and the seriousness of the situation appreciated. The Institute has been hammering at these conditions for years, and at times seemed to be a lone voice. It is a great satisfaction to find that at long last, the Institute has been proven right. The officers were never in doubt.

Newspapers are carrying display and classified advertisements for substantial numbers of engineers, for the armed services, for the Civil Service and for industry. Similar advertisements have been in *The Engineering Journal* for a long time. Editorials are appearing in many papers, and people are making speeches about it. Many public organizations are studying the situation and supplying frightening stories to the press.

Recently (January 21st) the Montreal *Gazette* said that Air Marshal W. A. Curtis, former chief of the Air Staff and now vice-chairman of the board of Avro-Canada Limited has made "a plea to federal authorities to take action to end a shortage of qualified engineers. He claims that the shortage amounts to a 'real national defence problem'—that the U.S. has been recruiting heavily on this side of the border and that Canadian aviation firms have had to secure U.S. aeronautical engineers on loan. On a straight per capita basis, he warns, Russia is training two and a half times as many engineering students annually as is Canada."

Four days later in an editorial the *Gazette* refers again to Air Marshal Curtis. Under the heading "Expanding Canada's Wings" there is a reference to Canada's aircraft industry, and its importance to the nation. After a brief review of the industries' accomplishment the editorial says:

"One gap remains, a gap which must be bridged: Canada is seriously short of engineers. The complexity of modern aircraft means that the engineering alone, during the years of design development, runs into hundreds of thousands of man hours. One out of every eight employees must have engineering training. Air Marshal Curtis estimates that 300 men with scientific training could be absorbed by the Canadian aircraft industry immediately.

"This is a complaint that has been heard with increasing frequency, in all industrial fields, that Canada's production of engineers is not keeping pace with demand. For Canadian defence, as well as the continued growth of the economy which supports it, some national program seems required.

"It is evident that industry should co-operate in every way in making the required training more available to young Canadians."

The January *Engineering Journal* carries in the employment section, advertisements for about 300 engineers in a great variety of posts. The number of replies is alarmingly small.

There *is* a shortage of engineers, and it has existed for many years. No organization is in a better position than the Institute to know about this. It is the Institute's policy to use its unique opportunities to assist in overcoming this national problem. There can be no doubt but that a shortage of engineers is bad for Canada, and if it is bad for Canada it is bad for every engineer in Canada.

Tops Again

One of the pleasant experiences each year is to receive from Ecole Polytechnique, Montreal, the tabulation showing the new student members of the Institute as well as those who have joined in previous years and are still at the College. As has been noted before in *The Engineering Journal*, Ecole Polytechnique stands highest, percentagewise, of any of the universities in Canada.

This year there are ninety-nine new applications. This makes a total in the college, of 374 student members out of an enrolment of 514 excluding the first year. This is approximately 73 per cent of the enrolment for the whole college.

In the final year, out of a total of 107 students enrolled, 98 are student members of the Institute. This is almost 92 per cent of the total. It must be admitted that these are startling figures.

As one would expect, the high enrolment is due primarily to the interest taken in the Engineering Institute by one or more members of the staff supported by one or more students in the senior year.

If this same percentage could be made to apply to the students of each of the Canadian universities where engineering is taught, it would make a tremendous difference in the enrolment of the Institute. It is a well proven fact that those who join the Institute as students are the ones who stay as members of the organization throughout their entire professional careers. They too are the ones who are most active in carrying out the Institute's policies. It is most encouraging to get such splendid support from Ecole Polytechnique.

Bouquets

For some years it has been the custom in the month of December to send out letters advising certain members of the Institute that on the first of the following month they will have qualified for Life Membership. The immediate reaction is that a great many pleasant letters are received at Headquarters.

Almost all members say that they have received the notice with mixed feelings. While they are delighted to be Life Members, they are shocked to find that they have reached an age where such a privilege is a possibility.

Some of the letters go back into the personal history of the engineer. These are particularly interesting. They tell something of the earlier

days of engineering in Canada, and also offer some experience and advice that should be helpful to those who follow after. It is intended from time to time to run a few of them in *The Engineering Journal*.

It is a source of pleasure and comfort to find that almost without exception these members speak of how they have valued their membership in the Institute and of the help it has been to them. It is gratifying to have these words of commendation from persons who have been members for thirty-five years. Believing that others would enjoy some of the letters, certain portions are being extracted and put together into an article which it is planned will be published shortly in the *Journal*, without of course disclosing the identity of the writers.

It is expected that the membership will find these observations both interesting and useful.

Correspondence

This exchange of letters between A. D. Margison, M.E.I.C., and Col. T. M. Medland helps to clarify the important question of the interrelated rights of engineers and architects, specifically in Ontario. The Margison organization should be supported in its efforts to deal with misinformation about the engineer's right to design buildings, or any other structure within his competence. EDITOR.

Col. T. M. Medland,
Executive Director,
Association of Professional Engineers of Ontario,
Toronto.

In the Province of Quebec the field of the Consulting Professional Engineer has been, as you are aware, partially restricted by the terminology of laws antedating the advent and the subsequent widespread growth of engineering. However, this condition does not apply elsewhere in Canada. It is, therefore, a matter of concern to us that our attention is drawn from time to time to the fact that some officials of private and public bodies, including utilities, have obtained the impression that only an architect or an architectural firm can act direct for a client in the design of buildings, and further, that engineering phases must properly either be routed to engineering consultants through an architect or done by engineering staff in his immediate employ. Recently you drew our attention to a printed pamphlet containing misleading and inaccurate information in the same vein. It is our understanding that the Association proposes to take remedial steps against further public distribution of such pamphlets.

We believe that these circumstances have not contributed to the best functioning of the two professions in the current development of Canada. While this is a long-term matter for the attention of the associations of both professions, it is an immediate matter of concern to us because we are essentially a professional engineering firm incorporating an architectural department. As you know, since the founding of this firm, we have been organized to provide an overall design and supervision service. We have an architectural department in addition to several engineering departments and we co-ordinate in one professional firm all facilities for the planning, design and supervision of construction of industrial and commercial projects. We know that professional engineers are entitled to have architects in their employ and maintain an architectural department just as architects may have professional engineers in their employ and maintain engineering departments. We know that engineering firms are not legally restricted in scope vis-à-vis architectural firms and that it is a matter of choice for the client.

We are writing to you to obtain a letter outlining the true state of affairs so that we may send facsimile copies to clients or prospective clients who may have been given misleading information and may have established policies thereon. It would be of assistance if you would include in your letter specific comment on the two points mentioned at the end of the preceding paragraph. A. D. MARGISON
October 13, 1954

A. D. Margison,
Vice-president and
General Manager,
A. D. Margison and Associates Ltd.,
Toronto.

When the Government in Ontario passed legislation establishing the practice of professional engineering and of architecture as closed professions, it was realized by those who framed the statutes that the two professions in some respects overlapped. Because of this overlapping, care was exercised to ensure that the right of practice of each profession was safeguarded. This is accomplished by a section in The Professional Engineers Act excluding from the provisions of that Act the registered architect, and in The Architects Act by a section excluding from the provisions of that Act the registered professional engineer.

A professional engineer is limited in his professional activities by the Code of Ethics of the profession and by no other means. The pertinent section of the Code is:—

> "A Professional Engineer,—
>
> (b) shall undertake only such work as he is competent to perform by virtue of his training and experience, and shall, where advisable, retain and co-operate with other professional engineers or specialists."

To be specific, a professional engineer may undertake any work which he is competent to perform. Secondly, if, in his opinion, it is advisable to secure the services of an architect or any other specialist, he may do so either by permanent employment on his staff or on a fee basis.

I should point out that this is the situation as it exists in the Province of Ontario and in the other provinces of Canada with the exception of Quebec where the legislation pertaining to the two professions is slightly different. T. M. MEDLAND
October 13, 1954

Ontario Hydro Changes

Just as the *Journal* was going to press, word has been received of the appointment of R. L. Hearn, M.E.I.C. to the chairmanship of the Hydro-Electric Power Commission of Ontario, a position made vacant by the unfortunate death of Robert Saunders. A. W. Manby has been made general manager and Otto Holden, M.E.I.C., has been appointed chief engineer.

These appointments will be well received by the profession. All three men are highly competent for these posts, and will bring honour to the profession in the execution of their duties.

To all these gentlemen the Engineering Institute extends its congratulations and its sincere wishes for success in their new responsibilities.

More about these appointments will appear in the March *Journal*.

Salaries and Professional Status

(Contributed)

In *Civil Engineering* (ASCE) for November, 1954, there appeared the "observations and conclusions" of the salary committee of the Junior Forum of the Los Angeles Section of the American Society of Civil Engineers. To put it briefly, the committee thought that engineers' salaries were too low and compared unfavourably with the incomes of tradesmen. To prove the point, they submitted a graph showing the accumulated incomes of engineers as compared with those of physicians and of some forms of skilled labour. If we take 45 years after graduation from high school as a point of reference, make allowance for negative income during college years and use these Los Angeles figures as closely as they can be read from such a small-scale graph, the results are much like the Table below:

If these figures are correct, they go a long way toward proving the committee's contention, but we feel that their accuracy is open to some doubt. First, there does not seem to have been any account taken of the varying value of the dollar. It isn't the amount of one's paycheck that matters, it is what one can buy with it. In 1908, when this writer was married, his income was $75 per month; he and his wife got along very comfortably on it. It was 1911 before he reached the $150 bracket, still quite comfortable, thank you.

Again, the committee has estimated that construction workers will be laid off only one month in twelve. This may be true in the Los Angeles area, with its climate and its boom, but it is certainly not true in Canada. Our climate alone prevents any thing like full-time employment for all construction workers. While operations can be and have been carried on in our most severe winter weather, the practice is seldom economical and hence not often resorted to except in emergency.

Figures to make a real comparison between our conditions and those in California do not seem to be readily available, so one must rely on one's general knowledge and experience. This writer thinks it would be easy to show that our engineers at any stages of their careers are better paid than artisans at similar stages. If this committee's figures are correct, there is no financial reason why Canadian engineers should emigrate to the United States, or at any rate, to California.

The committee's remarks refer only to civil engineers, of course. We of the Institute, being all kinds of engineers, would be interested in similar figures for other branches of the profession. For example, how do the incomes of mechanical engineers compare with those of moulders, machinists and toolmakers? And where does the electrical engineer stand with respect to the station operator and the lineman?

What remedies did the committee suggest for the conditions it found? Naturally, the first one was that engineers' salaries should be raised, always a safe and popular recommendation. Second, they thought that perhaps the American Society of Civil Engineers should consider revising its organization so that "more latitude would be possible in pursuing the professional and economic concerns of the engineer." What this means is not clear. Does it mean that the Society should become a sort of high-class labour union? The answer is not of much importance, for the changes contemplated would have raised fees by some $15 a year, more than the committee felt members would agree to pay.

Third, the committee said it was "thinking along the line of stronger, more dynamic local sections . . . Possibly a permanent local section office . . . with a staff . . . whose sole job would be to enhance the position of the . . . engineer, would be the solution.

We don't believe this is the answer. It has been tried elsewhere and by at least one other profession, with results very much open to doubt.

Maybe we need to be taught to blow our own horns more frequently and more musically. Here no doubt we can learn a good deal from others. But the fact is, as it always has been, that the tone of any profession is set by the reputations of its members. If engineers wish to enjoy the highest public esteem, they should cease being so concerned about their incomes and become more concerned about the contributions they can make to the public good. They should realize that there are thousands of first-class citizens, some very highly regarded, who are getting along successfully on smaller incomes than they. We do not suggest that engineers should work for nothing, merely that if they wish engineering to be regarded as a real profession they must act like professional people.

	Non-earning university years	Earning years	Total accumulated income	Annual average income
Physicians	9	36	$530,000	$14,700
Civil engineers	4	41	283,000	6,900
Plasterers	0	45	278,000	6,200
Electricians	0	45	235,000	5,200
Carpenters	0	45	210,000	4,650
Common labourers	0	45	163,000	3,600

Ontario Leads the Way

Dr. MacKinnon Phillips, minister of health of Ontario, announced early in October at a meeting of Institute members in Owen Sound, that by July, 1957, every Ontario municipality of 2,500 people or over, must have ready approved plans and specifications for the construction of sanitary sewers and a disposal plant. Of course, if sewers are already built, only plans and specifications for a disposal plant will be required.

This order affects 164 municipalities, of which 81 have no disposal plants and 28 of these have no sewers. There are also 15 other towns under 2,500 population with sewers, but without plants; no doubt these, too, will have to comply with the order. In addition, there are a number of existing plants which need overhauling or extension.

This program calls for the expenditure of many millions of dollars and the services of many engineers. It is a step in the right direction and it is fitting that Ontario should be the province to take it, for that province is densely populated and many of its towns are so located that they must perforce discharge their sewage into relatively small streams.

Conference on Properties of Steam

The fourth international conference on the properties of steam was held at the University of Pennsylvania on September 1, 2 and 3, 1954. In attendance were representatives of Canada, France, Germany, India, Italy, Japan, United Kingdom and the United States. The representatives from Canada were Dr. E. Whalley of the National Research Council and Prof. H. G. Conn, M.E.I.C. of the Department of Mechanical Engineering, Queen's University.

In general the discussions centered around the developments since the last conference which was held in 1934. Messrs. F. G. Keyes and J. H. Keenan presented a paper* "The Present Status of Steam Properties" on behalf of the American Society of Mechanical Engineers Research Committee on Properties of Steam. Other experimenters discussed in some detail their laboratory techniques and some of the results.

Some extracts from the Keyes-Keenan paper are as follows:—"The result achieved by the third conference of 1934 was the definitive International Skeleton Steam Tables accompanied by estimates of accuracy or 'tolerances' and included the designation of fundamental units, definitions and conversion relationships.

"The additional experimental data reported for water substance since 1934 indicates no trend which in any way reflects against the accuracy of the 1934 tables. There is an exception however in the case of the 1950 Russian data which extends beyond the 1934 superheat volumes in temperature and in pressure. Pressures computed using the equation of state based on the skeleton tables superheat data fail of agreement with the new Russian data being smaller by the order of one per cent.

"The need of additional experimental data extending beyond the range of the 1934 skeleton tables is urgent, not alone for present design needs for turbine design suited to even higher pressures and temperatures. The higher limits proposed are fifteen hundred degrees Fahrenheit and fifteen thousand p.s.i.a. With contemporary material and the experience accumulated earlier together with the 1934 data of proven accuracy as a base on which to build, these very high limits are believed attainable."

*This paper may be obtained through the facilities of the Engineering Institute library.

In addition to discussing the properties of steam as they appear in the steam tables, various experimenters reported the results of their attempts to measure the following:

(a) Pressure volume temperature data.

(b) The Joule-Thomson coefficient.

(c) The specific heat at constant pressure.

(d) The rate of change of enthalpy with respect to pressure at constant temperature.

(e) The thermo diffusivity.

(f) Viscosity.

(g) Thermo conductance.

(h) Thermodynamic temperature scale.

(i) The sound velocity measurements.

An interesting feature of the conference was the complete freedom with which information was interchanged between the representatives of the various member nations. The results to date emphasize the need of devising an international organization to carry out the research program necessary to provide the data concerning the properties of steam at these higher temperatures and pressures. The happy experience in the earlier venture in international co-operation is ample evidence that there will be a really significant advance in our knowledge of the properties of water.

Ontario Association Officers

The annual meeting of the Association of Professional Engineers of the Province of Ontario took place in Toronto on January 29. The new officers and members of their Council are listed in this issue in the News of the Ontario Association.

J. R. Montague, M.E.I.C.

It is a matter of interest and satisfaction to note that so many of those elected are members of the Engineering Institute. This is a further indication of the similarity of interests between the Association and the Engineering Institute.

Another interesting feature is that Colonel L. F. Grant, a past-president of the Engineering Institute and now field secretary, has been elected to the Council. Members of the Institute will see in this not only a recognition of Colonel Grant's rare qualities, but also of the relationship between the Institute and the Association.

To the new president, J. R. Montague, we offer our congratulations. In this office his responsibilities are heavy, and he will have a great opportunity of rendering a service to the profession.

Britain Host to Young Canadian Engineers

1955 will again see the choice of 38 of Canada's young engineering graduates to go to Britain as Athlone Fellows.

Mr. Robin Ross, the Deputy High Commissioner for the United Kingdom, visited Canadian universities during January and February to make the selection. He travelled with an expert, Dr. H. H. Burness of the U.K. Ministry of Education, and visited Halifax, Fredericton, Quebec, Montreal, Kingston, Toronto, Winnipeg, Saskatoon, Edmonton and Vancouver.

The Athlone Fellowships were first awarded in 1951. Men who have held these fellowships have now begun to make themselves known in all aspects of Canadian industry and engineering. They, and the firms and organizations with whom they spent their time in the U.K., have paid striking tributes to the value of these fellowships.

Thirty-eight fellowships are offered each year—28 to engineering students in their final year and 10 to graduates who have spent some time in industry. Fellows go to Britain for a two-year stay, during which they follow post-graduate

programs of advanced practical work or research. They then come back to Canada to resume their careers with improved qualifications, specialized experience, and a knowledge of life and industry in Britain, a knowledge that will be valuable both to Britain and Canada.

The Athlone Fellowships are financed by the United Kingdom Government, and the award covers all travel costs, living expenses, and any academic fees that have to be met.

Information about the fellowships can be obtained from the registrar of the following Universities and Colleges:

Nova Scotia Technical College.
University of New Brunswick.
Laval University, Quebec.
McGill University, Montreal.
Ecole Polytechnique, Montreal.
Queen's University, Kingston.
University of Toronto, Toronto.
University of Manitoba, Winnipeg.
University of Saskatchewan, Saskatoon.
University of Alberta, Edmonton.
University of British Columbia.

Dr. William Abbott, who has come to Canada every year since the inauguration of the fellowships, was not here this year. He has taken on further fellowship responsibilities for the Federation of British Industries, which make it impossible for him to travel outside the United Kingdom.

ASME Annual Meeting, 1954

The American Society of Mechanical Engineers has commenced its seventy-fifth year and at its recent annual meeting in New York elected Dr. David W. R. Morgan, vice-president, Westinghouse Electric Corporation, Pittsburgh, Pa., as president for 1955.

Dr. David W. R. Morgan was born in Martins Ferry, Ohio, and graduated from Ohio Northern University in 1913 with a degree in mechanical engineering. He joined the Westinghouse Company at East Pittsburgh following graduation and has been with that organization ever since. Many of his earlier years were spent in the condenser-engineering department of which he became manager in 1918. Subsequently, he was in charge of various departments and plants concerned with the design engineering and manufacture of diesel engines, pumps, gas and steam turbines. In 1948 Dr. Morgan was elected a vice-president of the company and served as general manager of the South Philadelphia works until 1953 when he was transferred to head office at Pittsburgh.

Dr. Morgan joined the American Society of Mechanical Engineers as an associate member in 1916, became a member in 1936 and was made a fellow in 1949. He was a vice-president and member of the executive committee from 1943 to 1945 and since that time has served as chairman or member of several other important committees of the Society.

New regional vice-presidents who took office at the same time as Dr. Morgan were: William H. Byrne, president, Byrne Associates, Inc., New York; J. B. Jones, professor of mechanical engineering, head of the Department of Mechanical Engineering, Virginia Polytechnic Institute, Virginia; Ben George Elliott, professor of mechanical engineering, chairman of the department of mechanical engineering, University of Wisconsin; Clifford H. Shumaker, professor of mechanical engineering, chairman of the department of industrial engineering, Southern Methodist University.

Other incoming council members were the three newly-elected directors-at-large: George A. Hawkins, dean of engineering, Purdue University; Harold C. R. Carlson, consulting engineer, New York; Louis Polk, president, Sheffield Corporation, Dayton, Ohio.

C.I.S.S. Meets at Montreal

The Canadian Institute on Sewage and Sanitation held its twenty-first annual convention this year at the Windsor Hotel, Montreal, on October 25, 26 and 27. Some 430 delegates were welcomed to the city at a civic reception held in the Mountain Chalet.

The first day's luncheon meeting was addressed by Councillor Lortie of Montreal and by His Worship Mayor Leslie H. Saunders of Toronto. Mr. Lortie described Montreal's 99-man council, 66 of whom are elected and 33 appointed by public bodies, and with an executive committee made up of the mayor and two councillors from each category as an executive body.

Mayor Saunders outlined Toronto's new metropolitan government, explaining how centralization had resulted in better and cheaper water, sewage disposal, education, streets, transportation, housing and overall planning. The Toronto system, he said, was unique on this continent and resembled the London County Council. It had 25 members; a chairman, 12 representatives of the City of Toronto and one each from the 12 suburban municipalities.

Lucien l'Allier M.E.I.C., Montreal, led a forum on street cleaning during the afternoon session, while Douglas Shand of Pointe Claire discussed the national problem of stream pollution during a forum on sludge disposal.

N. S. Bubbis, M.E.I.C., general manager, Greater Winnipeg Sanitary District described experiments on dewatering of sludge by lagooning. While this was an old process, he pointed out, increasing costs of labour, materials and equipment had caused consideration of lagoons as an alternative to mechanical means of dewatering.

The City of Winnipeg's consulting engineers believed that lagooning was the most economical base method of sludge disposal, and had recommended a new installation to replace and modernize existing elutriation and sludge filtration facilities, he stated. These recommendations had been approved by the administration board of the District and in 1955, 18 acres of lagoons will be built. Other speakers included Wm. Vietch, M.E.I.C., London, Ont., and R. L. Kilborn and L. B. Allan, M.E.I.C., of Toronto.

The morning session of the second day opened with a meeting for general business, reports of committees and election of officers. The following were elected for 1954-55; immediate past president, A. E. Chalmers, M.E.I.C.; president, N. S. Bubbis, M.E.I.C., of Winnipeg; vice-president, C. G. R. Armstrong, M.E.I.C.; trustees for term expiring 1955, L. B. Allan, M.E.I.C. and J. H. Irvine; trustees for term expiring 1956, R. V. Anderson, M.E.I.C. and E. E. W. Oke, M.E.I.C.; federation director, Nicol MacNicol, M.E.I.C.; chairman, Canadian Sanitation Equipment Association, J. B. Kinney, M.E.I.C.; and secretary-treasurer, Dr. Albert E. Berry, M.E.I.C.

During this business meeting members were asked to take action on a proposal to set up an administrative office jointly with the Cana-

dian Section of the American Waterworks Association.

This was followed by a symposium on refuse disposal. R. J. Desmarais of Windsor, pointing out shortcomings of the various systems of refuse disposal in use, described a new development known as a "garbage eliminator", with no moving parts, made up of a two-foot-diameter cylinder placed vertically in a 2 ft. deep hole in the ground, on which was mounted a cone locked in place with a ring. Garbage is placed in the cylinder with a small bag of catalitic starter".

Acting like a septic tank, the resulting liquid drains off into the soil below ground level. It will dispose of the average family's garbage for one to three years before moving to a new location. It will eliminate 26 bushels of garbage in two months.

A. J. Deslauriers, M.E.I.C., of Lachine discussed incineration, while G. H. Richards, M.E.I.C., of Toronto spoke on digestion of refuse for land settlement. L. B. Allan, M.E.I.C., conducted a guided discussion on reducing the cost of sewage works.

Following a past-presidents' luncheon, during which a discussion took place on Institute problems and future activities, an inspection trip was conducted by bus to points of interest at Westmount, Lachine and Côte St. Luc. The annual banquet was held in the evening with W. H. Wisely of Champaign, Illinois, secretary of the Federation of Sewage and Industrial Wastes Associations, as guest speaker. Eight delegates were presented with the Institute's 20-year membership certificates. They were Réné Cyr of Montreal, B. F. Lamson of St. Catharines, W. L. McFaul, M.E.I.C. of Hamilton, R. F. Menzies of Ottawa, N. G. McDonald, M.E.I.C., J. F. MacLaren, M.E.I.C., W. B. Redfern, M.E.I.C., and W. Storrie, M.E.I.C., all of Toronto.

The final technical session on the third day was addressed by G. T. G. Scott, M.E.I.C., consulting engineer of Toronto, who presented a paper on "British Practice in the Control of Industrial Wastes". Reviewing the early trade waste legislation from the Rivers Pollution Prevention Act of 1876, and the Public Health Act of 1875, he explained how control was exercised today under the Rivers (Prevention of Pollution) Act of 1951, which in effect placed the whole of any river and its tributaries under the control of a single authority, including water conservation and prevention of pollution.

Other speakers were J. F. MacLaren, M.E.I.C., who spoke on instrumentation of sewage treatment works, J. G. Schaeffer, M.E.I.C., who discussed lagooning as a sewage treatment process; and L. F. Robertson who presented a paper on sewage treatment plant supervision.

Art and The Engineer

One difficulty encountered by engineers is interpreting their work for the layman. Quite often the harsh details of a completed engineering project leave little room for illusion and therefore give the uninitiated the feeling that something not human has been created. But much is being done by individuals and groups to overcome this. Notable for his contribution to the artistic interpretation of industry is John S. Walsh, M.E.I.C., head of the sales development department of the Dominion Bridge Company.

J. S. Walsh, M.E.I.C.

Soon after graduating in engineering from London University in 1929 Mr. Walsh studied for a year at the London Central School of Art. He then returned to engineering, first with the British Thompson-Houston Company in Rugby and then with Browett-Lindley Limited at Letchworth. During the war he was production engineer with the armaments supply department of the Admiralty, serving in England and with the British Admiralty Technical Mission in Ottawa. Mr. Walsh joined the staff of Dominion Engineering in 1946.

On all his travels Mr. Walsh carried a sketchbook. In this he noted street and industrial scenes which he later developed into drawings and paintings and the results have been gratifying. Through diligent application he has been able to hold several one-man exhibitions. The main ones were at the Montreal Museum of Fine Arts, 1945; Montreal Arts Club, 1945; the Oliver Gallery, Montreal, 1946; the Mattatuck Historical Society, Waterbury, Conn., 1947; Hart House, Toronto University, 1952; and most recently at the Kennedy Galleries in Manhattan.

This last showing was noted in *Time* as providing "an artist's eye view of Canada's bone and sinew—her steel mills, oil refineries and grain elevators." It will also help the public towards a more intimate knowledge of engineering and what it means to them.

World Power Conference

The Canadian National Committee of the World Power Conference met again in Ottawa on January 6, with Major General Hugh Young, M.E.I.C., deputy minister, Department of Public Works, in the chair.

The meeting was held to develop further the plans for the sectional meeting of the Conference which is to be held in Canada in 1958. It was agreed that the dates for the meeting would be September 7 to 14, and that the meeting would be held in Montreal.

Other business discussed was the plenary meeting of the Conference in Vienna in 1956 and the sectional meeting in Jugoslavia in 1957.

It was agreed that separate subcommittees be established to handle the various items associated with the preparation and the conduct of the Conference, but it was agreed that for the moment no personnel should be named until further time had been given to the study of the most suitable chairmen.

T. M. Patterson, M.E.I.C., was elected honorary secretary to replace the late Norman Marr, M.E.I.C.

The next meeting of the committee will be at Ottawa on Thursday April 14.

Canada and Accrediting

Recently efforts have been made by the Institute to "rate" Canadian curricula without embarking on the elaborate procedure necessary to accredit them as is done by the Engineers' Council for Professional Development (ECPD) in the United States.

Dr. L. F. Grant, field secretary of the Institute and chairman of ECPD has secured the co-operation of universities, registration bodies and technical institutes in Canada to make up a tabulation for inclusion in the annual report of ECPD. The tabulation is reprinted in *The Engineering Journal* for the information of the members of the Institute.

Canadian Universities

(Note: Publication of this list does not imply accreditation by ECPD or by any Canadian organization).

Eleven Canadian universities or colleges offer courses in engineering subjects leading to the baccalaureate degree.

Accrediting has not been carried out in Canada, but in the table below are given the courses offered by these universities and the letter "x" denotes that the curriculum in question is accepted as fulfilling presently the academic requirements for membership or registration in the engineering bodies shown. These are the Engineering Institute of Canada, the Canadian Institute of Mining and Metallurgy and the Chemical Institute of Canada, these three Institutes corresponding to the Founder Societies in the United States. The curricula also are accepted by the associations of professional engineers of the provinces shown, which associations carry out in Canada the functions performed by the state licensing boards in the United States.

The omission of the letter "x" opposite any curriculum may mean:

a) that the engineering society or association in question does not accept this curriculum as fulfilling the academic requirements for registration; or

b) that the engineering society or association in question is not familiar with this curriculum having had no occasion of making a thorough study of it; or

c) that the engineering society or association in question is not prepared to formally accept the curriculum as fulfilling the academic requirements for membership or registration, although it does accept it on occasions, the case of each applicant being decided on its merits.

	Chemical Institute of Canada	Engineering Institute of Canada	Canadian Institute of Mining & Metallurgy	Associations of Professional Engineers of: Alberta	British Columbia	Manitoba	New Brunswick	Newfoundland	Nova Scotia	Ontario	Saskatchewan	Corporation of Professional Engineers of Quebec
University of Alberta												
Chemical Engineering	x	x	x	x	x	x	x	x	x	x	x	x
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Irrigation Engineering		x		x		x	x	x*		x*	x	
Mining Engineering		x	x	x	x	x	x	x	x	x	x	x
Petroleum Engineering		x	x	x		x	x	x*	x	x*	x	
Engineering Geology		x	x	x	x	x	x	x		x	x	
Engineering Physics		x		x		x	x	x		x	x	
University of British Columbia												
Agricultural Engineering				x			x	x*		x*	x	
Chemical Engineering	x	x	x	x	x	x	x	x	x	x	x	x
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Forest Engineering		x		x	x	x	x	x*		x*	x	
Geological Engineering		x	x	x	x	x	x	x		x	x	
Mechanical Engineering		x		x	x	x	x	x	x	x	x	x
Metallurgical Engineering		x	x	x	x	x	x	x	x	x	x	x
Mining Engineering		x	x	x	x	x	x	x	x	x	x	x
Engineering Physics		x		x		x	x	x		x	x	
Ecole Polytechnique												
Génie chimique—Métallurgique	x	x	x	x	x	x	x	x	x	x	x	x
Génie Travaux publics—batiments		x		x	x	x	x	x	x	x	x	x
Génie Mines Géologie		x	x	x	x	x	x	x	x	x	x	x
Génie Mécanique Electricité		x		x	x	x	x	x	x	x	x	x
L'Université Laval												
Génie Chimique	x	x	x	x	x	x	x	x	x	x	x	x
Génie Civil		x		x	x	x	x	x	x	x	x	x
Génie Electrique		x		x	x	x	x	x	x	x	x	x
Génie Géologique		x	x	x	x	x	x	x	x	x	x	x
Génie Minier		x	x	x	x	x	x	x	x	x	x	x
University of Manitoba												
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Geological Engineering		x	x	x	x	x	x	x		x	x	
Mechanical Engineering		x		x	x	x	x	x	x	x	x	x
Engineering Physics		x		x		x	x	x		x	x	
McGill University												
Chemical Engineering	x	x	x	x	x	x	x	x	x	x	x	x
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Mechanical Engineering		x		x	x	x	x	x	x	x	x	x
Metallurgical Engineering		x	x	x	x	x	x	x	x	x	x	x
Mining Engineering		x	x	x	x	x	x	x	x	x	x	x
Engineering Physics		x		x		x	x	x		x	x	x

	Chemical Institute of Canada	Engineering Institute of Canada	Canadian Institute of Mining & Metallurgy	Associations of Professional Engineers of: Alberta	British Columbia	Manitoba	New Brunswick	Newfoundland	Nova Scotia	Ontario	Saskatchewan	Corporation of Professional Engineers of Quebec
University of New Brunswick												
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Mechanical Engineering		x		x	x	x	x	x	x	x	x	x
Nova Scotia Technical School												
Chemical Engineering	x	x	x	x	x	x	x	x	x	x	x	x
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Mechanical Engineering		x		x	x	x	x	x	x	x	x	x
Metallurgical Engineering		x	x	x	x	x	x	x	x	x	x	x
Mining Engineering		x	x	x	x	x	x	x	x	x	x	x
Queen's University												
Chemical Engineering	x	x	x	x	x	x	x	x	x	x	x	x
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Mechanical Engineering		x		x	x	x	x	x	x	x	x	x
Metallurgical Engineering		x	x	x	x	x	x	x	x	x	x	x
Mining Engineering		x	x	x	x	x	x	x	x	x	x	x
University of Saskatchewan												
Agricultural Engineering		x		x		x	x	x*		x*	x	
Chemical Engineering	x	x	x	x	x	x	x	x	x	x	x	x
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Geological Engineering		x	x	x	x	x	x	x		x	x	
Mechanical Engineering		x		x	x	x	x	x	x	x	x	x
Engineering Physics		x		x		x	x	x		x	x	
Ceramic Engineering (discontinued)			x	x		x	x	x*	x	x*	x	
University of Toronto												
Aeronautical Engineering		x		x		x	x	x	x	x	x	
Chemical Engineering	x	x	x	x	x	x	x	x	x	x	x	x
Civil Engineering		x		x	x	x	x	x	x	x	x	x
Electrical Engineering		x		x	x	x	x	x	x	x	x	x
Mechanical Engineering		x		x	x	x	x	x	x	x	x	x
Metallurgical Engineering		x	x	x	x	x	x	x	x	x	x	x
Mining Engineering		x	x	x	x	x	x	x	x	x	x	x
Mining Geology		x	x	x	x	x	x	x		x	x	
Engineering & Business		x		x		x	x	x		x	x	
Engineering Physics		x	x	x		x	x	x		x	x	
Ceramic Engineering (offered from 1926 to 1951 but now discontinued)			x	x		x	x	x	x	x	x	

*This course is accepted as partial fulfillment only of the academic requirements and the applicant who has completed this course may be required to write examinations.

The President in the West

Above: President D. M. Stephens visited the University of British Columbia during his western tour. In this group there is the president of the E.I.C. student section, Past-president J. N. Finlayson, President Stephens, Dean H. C. Gunning, president of U.B.C. Dr. Norman A. M. MacKenzie, and W. O. Richmond, chairman of the Vancouver Branch.

In the left column, pictures taken at a Branch dinner meeting in Vancouver. In the first picture, Dr. H. C. Gunning, D. M. Stephens, W. O. Richmond and C. Bentall; second picture, W. N. Kelly, G. H. Bancroft and A. Peebles; third picture, R. Angus MacLachlan, W. O. Scott, T. V. Berry, T. E. Price; fourth picture, John K. French, A. B. McEwen, W. M. Stobbart.

At the annual meeting of the Association of Professional Engineers of B.C.: C. Bentall, retiring president; Dr. H. C. Gunning, incoming president and J. A. Merchant, registrar.

Mr. Stephens visited the engineers' school at Chilliwack, B.C. The picture at right shows the president's party. He placed a wreath on the Sapper's Cenotaph during a special ceremony, with Lieut.-Col. H. D. Berry also taking part (second picture).

Below: The president attended the tenth annual dinner meeting of the Winnipeg Branch, Electrical Section. At the head table, P. Shane, Mrs. Stewart Barkwell, R. T. Harland, Mrs. Fetherstonhaugh, Mrs. A. E. Macdonald, Dr. E. P. Fetherstonhaugh, Mrs. Searfe, President Stephens, Professor N. A. Williams and Dean N. F. Scarfe.

Right: Two group pictures of the Branch meeting at Saskatoon.

A more complete picture story of Mr. Stephens' tour of Western branches appeared in the January issue.

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

The Impact of the St. Lawrence Seaway on Industry in Ontario

J. M. Thompson
Vice-President and Comptroller
Canadian Westinghouse Co. Ltd.,
Hamilton, Ont.

The St. Lawrence Seaway is a major economic development which will have an impact on the growth of Canada greater than anything that has happened to it since the building of the transcontinental railways in the last century. All sectors of the economy from Halifax to Vancouver will be affected to some extent by the changing pattern of distribution which will be created by the opening of an additional two thousand miles of our interior to cheap water transportation to and from the seacoast.

Canada exports approximately 25 per cent of its national production to world markets; most of its exports are bulk primary goods such as grains, wood pulp, newsprint and ferrous and nonferrous minerals. It is essential that we should have low cost transportation for the successful marketing of these products. The importance of the Seaway to Canada as a whole cannot be overstressed. However, the benefits of the Seaway will not be unmixed blessings; there are sure to be many areas that will experience at least some temporary dislocation, but these will undoubtedly be greatly outweighed by the cumulative advantages from the complete project which will accrue to all.

The development of the Seaway will provide two distinct advantages. First, the Canadian economy as a whole will benefit from low-cost transportation resulting from ocean-going freight being made accessible to the very hinterland of the country. Second, a further abundance of low-cost electrical power will become available to industry in Ontario.

While all Canadians are interested in the Seaway, it has particularly captured the imagination of the people of Ontario. They show unbounded confidence that its completion will give further impetus to the great industrial expansion which has taken place since the end of the war, particularly in the "Golden Horseshoe," extending from Oshawa to the Welland Canal. Every town on the Great Lakes has plans for improving its harbour facilities and dreams of becoming a busy port, welcoming ocean steamers with their cargoes from the four corners of the earth. Towering above all these claims are those coming from the general direction of Toronto and Hamilton, for each of these old rivals has great confidence that most of this trade will eventually terminate in its port and that new industries will spring up in its backyard to continue the boom to which it has become accustomed.

During the period of construction of the Seaway, Ontario industry is bound to be benefited from such a major undertaking with its large capital expenditure. However, I think it would be well to be somewhat critical in assessing the value which the Seaway might, on its completion, afford to industry in Ontario. Ontario is primarily a manufacturing province. Its principal industries are newsprint and wood pulp, the mining of ferrous and nonferrous metals, the manufacture of iron and steel and the production of a broad range of industrial products, including automobiles, farm implements, electrical products and textiles.

Approximately 85 per cent of the exports of the newsprint industry go to the United States; generally speaking, this trade flows north to south and should not be affected by the opening of the Seaway. It is possible that through lower transportation costs overseas markets might become available to the industry, although it must be recognized that the interior markets of the United States served by the industry would also be opened to overseas competition. I would guess that the industry will do well if it holds its present position.

It is difficult to believe that a differential in freight will result in any significant expansion in the mining of ferrous and nonferrous minerals. Such a differential will not of itself be sufficient to stimulate increased production from present levels, nor to accelerate exploration and development of new properties.

The manufacturers of iron and steel products will, undoubtedly, be the major beneficiaries from the Seaway. This is because the rich ore bodies of the United States, from which they have been able to obtain their requirements in the past, are now largely depleted. The Seaway will enable them to replace this source of essential iron ore from the deposits in Labrador without any increase in present costs. Were it not for this development, it is possible that in the next five years they would have to increase their steel prices by approximately $2.00 per ton, because of the necessity of having to use lower grade iron ore. The point we must keep in mind is that the Seaway will simply perpetuate an advantage which the iron and steel industry already enjoys and will not of itself create an expansion of the steel industry by reason of the availability of this low-cost ore. It should also be remembered, insofar as Ontario producers are concerned, their markets will be more readily available to producers in the Maritimes.

Among the many predictions of conditions to be brought about by the completion of the St. Lawrence Seaway, too many have come from the pens of starry-eyed optimists or of prophets of doom. We doubt if there are any engineers in either group; they have sense enough to know that nothing is either wholly good or wholly bad. As a fair presentation of the pros and cons we recommend this paper, read before the annual conference of the Ontario Chamber of Commerce at Ottawa on January 7 last. Its sensible discussion applies in the main to all the provinces as much as to Ontario alone.

Lower transportation costs to or from the seacoast will not have any appreciable effect on Ontario industry, except in possibly a comparatively small number of industries that are dependent upon the use of bulk raw materials from abroad, or whose finished products, by their very nature, entail high transportation costs and are marketed either in eastern Canada or abroad. A wide range of Ontario industries is now suffering from the severe foreign competition and is experiencing great difficulty in meeting it. If transportation be an important element of cost to any of these industries, then they are going to be faced with a further lowering of their protection by the removal of a natural trade barrier. This can only add to their present competitive difficulties.

It is the accepted economic thesis of our Government that the growth and prosperity of Canada are dependent upon finding markets abroad for our agricultural products and natural resources. These products come from all parts of our country; the advent of new low-cost transportation into the very centre of Canada should be a great stimulus to the movement of such bulk products, because the cost of transportation is an important element in their marketing.

If we are to find markets for our primary products, we must be prepared to import finished goods in return, for we realize that trade must be two-way and that Canada with its abundance of material resources must, if it is going to trade, accept manufactured goods in return. Canada has taken a leading part among the nations of the world in promoting multilateral trade and in advocating the elimination of restrictive trade practices. It is the only signatory to the General Agreement on Tariffs and Trade (GATT) that has scrupulously lived up to the principles of this agreement. Since signing in 1947, Canada has made substantial tariff reductions, has greatly modified its dumping provisions and has eliminated all other discriminatory practices. It can be truthfully said that Canada is today the most accessible market in the world to foreign producers. This comment may seem irrelevant to the discussion of the Seaway, but it is important in any discussions concerning the industrial expansion of Ontario.

It is frequently stated that opening the Seaway will enable Canadian manufacturers to compete more effectively abroad. Even if lower transportation costs substantially reduced export costs of manufactured goods, the two large trading areas of the world, the United States and the sterling areas, would still be virtually closed to Canadian manufacturers. As matters stand at present, it is almost impossible to ship manufactured goods in substantial volume into the United States, due to restrictive customs and other regulations. The markets of the sterling areas are closed to Canadian producers of manufactured goods because of currency restrictions and other trade barriers. The only remaining markets open to Canadian manufacturers are those of Latin America, and, to a much lesser extent, of parts of the Far East and of Africa.

It is for these reasons that I find it difficult to support the commonly accepted viewpoint—that industrial activity will be greatly accelerated by the completion of the Seaway—unless there is a dramatic change in international trade conditions by the time it is opened.

The greatest single factor which will benefit Ontario industry is the generation of an additional 1.1 million horsepower of electricity. This electricity will be fed to the power grid serving southern Ontario. It will be available at one-half the cost to the Ontario Hydro of that being produced at the new Sir Adam Beck station at Niagara Falls and at one-third the cost of steam-generated electricity.

It is estimated that there will be an annual saving of $30 million from obtaining power from this source rather than from the alternative, but more expensive, steam plants. To give some idea of the additional amount of cheap electricity which this represents, consider these figures. In 1953 Ontario consumed 22.7 billion kilowatt hours. The installed capacity of the Seaway development will provide enough power to support an additional consumption of over six billion kilowatt hours annually, or 26 per cent of the 1953 consumption. Mr. Robert Saunders, Chairman of the Hydro-Electric Power Commission of Ontario, to dramatize the enormous amount of energy which this development represents, stated that "the energy is equal to what 28 million men could produce if they worked eight hours a day for 300 days a year, or the annual energy output of nearly twice the population of Canada."

Ontario's industry, which consumes approximately two-thirds of the electricity produced in the province, has long shared in the advantage of low-cost power. If normal growth continues, comparable to that experienced in the last decade, steam plants would have to be installed with subsequent increased rates to cover the higher costs. However, this new source of power from the Seaway will enable the Hydro to continue for some time to provide the advantages of low-cost energy, which Ontario industry has enjoyed for so many years.

To summarize my views, I believe that while the Seaway will be of great importance to Canada as a whole, its most important contribution to Ontario will be in making available a further substantial quantity of cheap electrical energy. I do not believe that the opening of our ports on the Great Lakes to ocean-going traffic will of itself greatly stimulate industrial activity. On the contrary, I visualize that the opening of these ports to ocean traffic will increase the severe competition already being felt by many manufacturing industries.

C.G.R.A. Meets at Toronto

The Canadian Good Roads Association held its annual convention at the Royal York Hotel, Toronto, November 8-10, 1954. A record eight hundred and twenty-five delegates were in attendance, and were welcomed by Hon. Gordon E. Taylor, minister of highways, Alberta, and president of C.G.R.A., who noted that it was the first time in many years that all 10 provincial governments were represented. Hon. William Griesinger, minister of public works and acting minister of highways, Ontario, expressed a welcome on behalf of the province, while His Worship Mayor Leslie Saunders of Toronto and Fred G. Gardiner, Q.C., chairman of The Municipality of Metropolitan Toronto, tendered welcomes on behalf of the city.

Highways of tomorrow will generate better living for all peoples of the world, Robert O. Swain, executive director of the International Road Federation, stated at the opening ceremonies. "Highways will also bring closer co-operation and understanding among neighbors of the Western Hemisphere and easier

means of communication among all nations of the world", he said.

President's Address

The Hon. Gordon E. Taylor declared that "roads are a self-liquidating asset, the life-line of everyday business, commerce and pleasure and the advance guard of new development and expansion . . ."

Every effort should be made, he said, to find out more about the economic, social and cultural facts of roads, and "having the indispensable facts revealed by research and economics at our disposal, we should build and reconstruct roads according to sound precepts in accordance with the laws of physics and science and engineering."

"It is now apparent that C.G.R.A. is ready to undertake new tasks. We have reached a point where we should consider the direction of the Association's development. No organization like C.G.R.A. can exist solely because it holds an annual convention or because it has sporadic meetings. If it is to grow in health and value to its members it must render a genuine service to all its members and to the nation."

"Last year the Association began to lay the groundwork of a library, or information service. As this develops it will become a valuable source of information on all aspects of roads and streets . . . Of one thing I am sure: there is no dearth of subject matter for our future activities. There is a great deal further to go before we reach our potential value as a national organization to our members and to our nation", he said.

Road Research in Britain

The value of scientific study of the many problems involved in the creation and operation of modern highway and street systems was stressed by Dr. W. H. Glanville, C.B., C.B.E., director of road research for the United Kingdom.

In Britain, with 50 million population and over 5 million motor vehicles, more than a million and a quarter workers are directly engaged in road transit operations, with an annual expenditure of £1,500 million, or about 15 per cent of the nation's resources, on road transit and travel, he stated. Comparable figures for Canada would probably be higher in relation to population and number of vehicles. This condition demands that all available funds be well spent and that roads and streets should be planned, built, maintained and used to ensure the greatest possible efficiency.

Road research problems are primarily economic: to provide channels for traffic, determine present and future demands, reduce construction and maintenance costs by improved methods and materials and cut down traffic delays and accidents. In Britain the attack on these problems is centred in the Road Research organization, which costs the nation about £350,000 yearly, with some 450 persons employed.

Expenditures on Roads a Good Investment

Money used to build roads is not spent but invested, Raymond Brunet, president of the Canadian Construction Association, told the Monday luncheon at the convention. Mr. Brunet cited figures to indicate that for every million dollars invested in highways there is an annual return of over $12 million, taking into consideration the ensuing development along the roads and the use to which it is put by those whose products are transported over it. "That is the type of investment we Canadians cannot afford to miss", he said.

Discussing federal financial aid in the United States, Mr. Brunet pointed to the need for a similar pattern of assistance in Canada. "Experience with the Trans-Canada Highway demonstrates conclusively that federal-provincial joint action is also possible in this country, and that proper safeguards exist both for provincial rights and for the expenditure of local funds."

Roads Round-Up

The Monday afternoon session was devoted to "Roads Round-Up", an annual feature of C.G.R.A. conventions. Officials of the ten provinces and of the federal government presented reports on the progress and problems of road building and maintenance during the current year.

In British Columbia thirty-six miles of the Trans-Canada Highway were completed during the past 12 months; an additional 34 miles are under construction and partly completed. In total, 200 miles of the required 685 miles of the Trans-Canada in B.C. are now completed.

Alberta voted a record $41 million in 1954 for highways, bridges and ferries. However, the program was seriously delayed through adverse weather conditions. Alberta now has 5,296 miles of highways; of these, 1,881 miles are paved. By the end of 1956 there will be three main asphalt surfaced highways across the province.

Saskatchewan's funds available for highways exceeded $21 million. Program proposals last spring were for 543 miles of subgrade and 159 miles of surfacing. Because of wet weather, only about 60 per cent of the program was completed. The Trans-Canada Highway between Regina and the Manitoba boundary is open to traffic. Completion by the fall of 1956, across the province, is physically feasible.

In Manitoba abnormally high rainfall caused serious delays in grading, surfacing and bridge programs. Repairs of flood damage consumed a considerable amount of time and the use of construction equipment. Traffic volume continued to increase, with a marked growth in inter-provincial and international traffic.

In Ontario incomplete estimates show that $57 million have been spent on road construction and maintenance for 1954-55. An additional $23 million were scheduled on operation and for special projects such as winter maintenance. Municipalities probably spent another $60 million, of which $31 million were provincial subsidies. There are now in Ontario almost 81,000 miles of highways, roads and streets financed by various public authorities. During 1954 the department paved or resurfaced approximately 427 miles of main highway and prepared 161 miles of new grade. In addition, some 1,250 miles of gravel road were oiled. Work continued on Ontario's 1,404 miles of the Trans-Canada Highway. Although it will be some time yet before the work is completed, long sections connecting some of the larger urban centres are now being paved.

In Quebec considerable progress was made in all fields of activity. The 1954 operations were, approximately, as follows:

	Miles
Permanent pavements (asphalt or concrete)	420
Resurfacing of old pavements	90
Construction or reconstruction	985
Gravelling	1,300
Various improvements	125

Last winter over 28,000 miles of roads were kept open for motor traffic. Although Quebec has no agreement concerning the Trans-Canada Highway, the province is going ahead with its sections of the highway. If the present rate of progress is maintained, Quebec sections of this highway will before long be completed.

New Brunswick allocated a total of over $18 million for highway

work. The total mileage in the province is now 13,132 miles. Further research was conducted with an "ice-free" mixture which, it is claimed, will eliminate ice formation. Results of experiments on two test sections will not be available for some time. During the year 214 miles of grading contracts and projects were authorized. Despite wet weather, more than 380 miles of prime and surface treatment and seal coating were completed.

Outstanding feature in Nova Scotia for 1954 was commencement of work on the Trans-Canada Highway. So far, construction of 32 miles has been started. In addition, 61 miles of other roads were reconstructed and 135 miles paved. At year end the Angus L. Macdonald highway bridge across Halifax Harbour costing $11 million will be opened to traffic. At Canso the causeway will be completed by year end. This project involved not only over ten million tons of rock fill in the causeway, but also a canal and locks on the Cape Breton side. The whole project will cost some $19 million, payable one-third by the province and two-thirds by Canada.

In Prince Edward Island a record total of 240 miles of roads were completed. In addition, about 100 miles were cleared in preparation for 1955. Surfacing totalled 117 miles. Work on the Trans-Canada Highway was pushed through 15 miles of heavy construction. Forty-eight bridges were replaced this year.

Newfoundland budgeted a total of $11.5 million, a larger expenditure on roads than ever before. For the Trans-Canada Highway alone, $5 million was authorized this year. Continuous rain during July and August seriously affected progress on all works. The bridge building program proceeded more satisfactorily. It is hoped that by next year a motor road between Corner Brook and Port aux Basques will be completed.

On the Trans-Canada Highway, despite some of the worst weather conditions in recent times, good progress was made. So far, 1700 miles of grading have been approved of which 1,400 miles have been completed; some 1,200 miles of paving have been approved (1,000 miles completed); and 128 structures have been approved (98 completed). The total of contractual commitments is approximately $170 million, of which half is payable by the federal government.

The Trans-Canada Highway agreements will terminate in 1956. More than two-thirds of the construction period has now elapsed, with slightly less than one-third of the mileage actually completed. In these circumstances it is difficult to visualize the completion of the road on schedule.

Planning Highways for Tomorrow

The entire second day of the convention was taken up by a symposium: Factors in Long-Range Planning. Nine speakers delivered papers, highlights of which are as follows:

A. K. Branham, research associate, School of Civil Engineering, Purdue University, said that at present road users spend only a relatively small sum to provide and maintain highway systems. In many cases this contribution to road costs was less than one-tenth of the total cost of operating the motor vehicle.

He noted that the average motor fuel tax per vehicle in Canada in 1951 was about $63, compared with less than $36 in the United States. It was obvious that higher motor fuel taxes could not be obtained without considerable difficulty. Increases in motor vehicles and in motor vehicle use would not, in themselves, solve Canada's difficult highway finance problem.

Much more investigation was needed to allocate costs to users and beneficiaries of highways and "to determine the place of highway transportation in the national transportation system", Professor Branham said. "The real crux of the problem appears to be not only the need for an adequate transportation policy in Canada and the United States but for the development of a technique whereby the various classes of users and other beneficiaries may be assessed their fair value of the benefits derived."

Brigadier Jean P. Carrière, director, Development Engineering Branch, Public Works, Ottawa, told the gathering that "modern highways must be planned and designed to meet present and estimated future needs immediately as regards traffic loads, frequency, volume and speed."

"The planning and design of existing interprovincial routes has rarely been based on traffic demands and, consequently, many are obsolete by modern standards", he stated. "It is not rational to plan and design a highway without traffic information. Traffic data is absolutely necessary to establish the loads for highway design."

"Canada has large sources of road building materials that have not yet been exploited", stated R. F. Legget, director of building research, National Research Council, Ottawa. Soil is the basic substance of road building and there are many possibilities for improving the use of soils and of using glacial till or boulder clay. There are also possibilities for the use of native Canadian clays to be baked or calcined to form a natural hard road building material.

Because of the potential development of Canada's northland, road builders face formidable problems in overcoming muskeg and snow and ice. Mr. Legget noted that the Division of Building Research had just completed the first snow and ice research laboratory in Canada, one of the few such laboratories in the world.

Dean R. M. Hardy of the University of Alberta outlined some outstanding problems of soils engineering. He said that "we may expect the highways of tomorrow to benefit greatly in quality and economy from a wider application of the known principles of compaction to highway construction. Unlike the field of compaction, little research has been conducted into muskeg phenomena....We in Canada perhaps have a greater economic interest in the problems of road construction in muskeg areas than has any other country in the world. We cannot expect our most generous neighbours to solve them for us."

Dean Hardy noted that the stabilization of soils by chemical treatment held out considerable promise. One of the chemicals is spent sulphite liquor which combats frost action. In combination with chromate salts this chemical can be a very strong soil stabilizing medium.

Large cities will continue to grow larger. There will be no trend toward "excessive decentralization" of urban populations, A. D. Margison, vice-president and general manager of A. D. Margison and Associates Limited, forecast. Central business districts will not vanish or suffer reduction . . . Traffic facilities will continue to lag behind requirements because of a lack of funds.

Traffic problems in central areas will grow unless properly controlled measures are taken to provide suitable parking facilities and traffic arteries. Improved types of rapid transit systems will assist in reducing the requirements for the urban use of privately owned passenger vehicles. These will include subways in urban areas and new types of elevated and grade transitways for economy in interurban as well as urban operation.

"Vehicle design can only progress in keeping with road improvements", the meeting was told by Wilfred J. Chenery of International Harvester Company of Canada Limited.

Mr. Chenery said vehicle design would be a relatively simple matter if fuel and roads would keep pace with it, "because vehicle design cannot get out of step too far with other developments; the engineers' advanced ideas must be temporarily shelved in favour of more modest advancements."

He advocated equalization of freight costs, road limits, standardization of equipment, uniform and equal load limits and road regulation in all Canadian provinces. This, he argued, would benefit the automotive manufacturer, the freight hauler and, above all, the consumer, since it would reduce operating costs while facilitating improved vehicle design and providing for increased safety.

The first priority in planning a new road is to forecast traffic, Philippe Ewart, traffic engineer of the Quebec Department of Roads, told the delegates. This involves study of the following elements:

1) Traffic pattern and trends during the preceding years;
2) Predicting population growth;
3) Motor vehicle registration and predicted ratio of persons per car;
4) Amount of diverted traffic;
5) Amount of induced or generated traffic.

Mr. Ewart said that, with the anticipated increase in population and in motor vehicle traffic, there would be four persons for every motor vehicle in Quebec in 1975. At that time traffic congestion in many parts of the province, particularly in the Montreal area, would be critical. Traffic in this area will, therefore, have tripled by 1975.

W. Arch Bryce, director of the Division of Public Safety, University of Toronto, predicted that unless present highway accident trends are not checked "the cost in blood and dollars will be too high." Since it is generally accepted that driver error is responsible for more than 85 per cent of highway accidents, "it would seem reasonable to attempt to reduce accidents by working with the human factor", he said.

More stringent driver licensing regulations and more and better driver training were considered necessary by the speaker. "Highway accidents are unnecessary. They happen one at a time. We can stop most of them if we want to . . . Personal interest and effort are the commodities that are lacking", he concluded.

Fred Burggraf, director of the Highway Research Board, Washington, said that much factual data have yet to be obtained on the costs of building and maintaining highways of different structural capacities, with the costs of transporting commodities in various types and sizes of motor vehicles.

"Until such basic data have been assembled and interpreted the highway freight carriers and the highway builders will not have the needed factual information to enable them to agree on size and weight standards for vehicles and on design standards for highways that will produce the lowest transportation costs to the general public."

The safety and convenience of the public are of paramount importance to Canadians, Hon. Mr. Justice John D. Kearney, chief commissioner, Board of Transport Commissioners for Canada, told C.G.R.A. members at the Wednesday morning session. He said that the magnitude of the transport problem facing Canada could be expected to exceed that of the United States. Whereas U.S. motor vehicle registrations in the eight-year period 1945-53 had increased by 87 per cent, Canada's rate of growth had been 128 per cent.

In the sphere of metropolitan transportation Judge Kearney recommended the adoption of a realistic attitude. He said: " . . . the aim of a 'parking space downtown for every car' seems to me to be in the same class as 'pie in the sky'." The cheapest and most practical way of dealing with the congestion of city streets would be to make it attractive for the drive-to-work suburbanite to leave his car at home. To do so, city-owned utilities such as tram, bus and subway, might combine with the railways to provide a thoroughfare from the commuter's railway station to the door of his employers.

"I venture to predict that in the not too distant future some of our cities will be obliged to ration their streets and fix priorities for vehicular traffic, particularly at rush hours", he concluded.

National Highway Safety Conference

The annual general meeting of the Association approved the calling of a national highway safety conference by the Canadian Good Roads Association in Ottawa from May 24 to 26.

Resolution on Federal Assistance

RESOLVED that the Canadian Good Roads Association recommend that the Government of Canada arrange for further negotiations with the provinces with a view to extensions of existing agreements or the entering into of new agreements.

RESOLVED that this Association urge the Government of Canada to adopt a comprehensive policy of highway assistance in connection with the improvement of roads other than the Trans-Canada Highway.

Trop peu d'ingénieurs parmi les Canadiens français

(*Le Droit*, Ottawa, 28 septembre 1954)

La réalité statistique au chapitre des ingénieurs—Dans ce domaine, l'Université de Toronto donne le premier rang à l'Ontario—Le Québec aux deux-tiers urbains et doté de milliers d'usines, a besoin d'une forte élite technique—Les remèdes à la situation actuelle: locaux plus vastes pour nos écoles polytechniques, nombreuses bourses d'études, orientation vers le génie des élèves doués pour les mathématiques et les sciences.

Par Claude Asselin

En 1951, sur les 35,000 ingénieurs canadiens, 1,800 sont d'origine française et 33,000 d'origine anglo-saxonne et autres. Les Canadiens français représentent 5.1% du génie civil au pays.

De 1941 à 1953, la province compte 4,210 membres enregistrés à la Corporation des Ingénieurs professionnels de Québec. De ceux-là, 2,806 soit 65.5% sortent de Polytechnique, de McGill et de Laval, nos trois écoles de génie. Les ingénieurs de culture française se dénombrent à 1,552, soit 37%, beaucoup moins que la moitié des ingénieurs qui pratiquent dans les limites de la province de Québec, 527 ou 12.5% viennent de l'Ontario. Le reste se répartit entre les autres provinces, les Etats-Unis et l'Europe.

Sur une base indiquant le nombre d'ingénieurs par 10,000 âmes de population, la province de Québec

compte 10 ingénieurs. La Colombie et la Saskatchewan de 20 et de 19.6 par 10,000 de population. Le Manitoba, 15.7 et l'Alberta, 14.0. Les Maritimes se rapprochent du Québec avec 10.4 ingénieurs par 10,000.

Dans notre province, les diplômés de langue anglaise tous formés à McGill représentent 30 ingénieurs par 10,000 habitants. Chez les nôtres, nous avons une représentation de 4.3 ingénieurs par 10,000 âmes de population.

L'Université de Toronto arrive d'emblée en tête de file quant au chiffre de promotions, de 1941 à 1953. Avec Queen's, elle hisse l'Ontario au premier rang au Canada en totalisant 8,072, soit 39.7% des 20,335 diplômés canadiens de la décennie. Québec va de l'arrière avec 3,643 diplômés ou 17.9%. Déduisant le chiffre de McGill, sauf les diplômés de noms français, il reste ceux de Polytechnique et de Laval: 1,147 diplômés de langue française, soit les 5.6% du total.

1. Au Canada, sur une population de 12.5 millions (1951), environ 4.5 millions sont de langue française. En pourcentage, cela équivaut à 30.8% de la population. Or, dans l'ensemble de la population, on trouve un ingénieur de langue anglaise pour 300 âmes contre un ingénieur de langue française par 2,300 habitants. La proportion s'établit de 1 à 7.

2. Au Québec, la population française du pays s'y concentre à 80%; celle de la province, à 83%. Mais, au point de vue génie civil, les Canadiens français ne dépassent pas beaucoup 37% des ingénieurs vivant dans la province.

3. Les institutions anglaises et françaises du Québec forment 66.5% des membres de la Corporation des Ingénieurs professionnels de Québec. Il ressort que 33.5% des ingénieurs viennent de l'extérieur.

4. On constate que la province de Québec arrive bonne dernière dans la représentation par 10,000 habitants. Fait imputable à la faible proportion de 4.3 ingénieurs de langue française.

5. En 1950, les 125 diplômés de Polytechnique et de Laval représentent 3.5% environ des 3,650 diplômés canadiens. Ajoutons 51 diplômés de langue française de McGill, soit 1% de plus.

Notre province occupe une superficie de 600,000 milles carrés, soit au delà de 2.5 fois la surface de la France. C'est nettement la plus vaste des provinces du Canada. Ce n'est pas la plus pauvre. Non pas, au contraire!

Le Québec occupe le premier rang au point de vue des ressources hydrauliques du Canada et tient même une position mondiale enviable. 6,000,000 de horsepower développés représentent 34% de son potentiel utilisable. Le Québec possède les plus vastes forêts du pays. C'est l'industrie principale de la province: 264,170 milles carrés de territoire boisés. Les mines du Québec le situent au second rang après l'Ontario. Nous pouvons faire fond sur nos industries primaires. Il ne suffit qu'à penser à l'Ungava.

Le phénomène d'urbanisation a centré la population dans les grandes agglomérations comme Montréal. La population du Québec est devenue urbaine aux deux tiers, l'inverse d'il y a soixante ans. En 1951, le Québec attrape 24.3% des investissements de capitaux, fait qui le place après l'Ontario avec 38.1%.

La province de Québec n'est pas une province agricole: le sol arable couvre 8.1% de la surface totale dont les deux tiers sont déjà cultivés et s'échelonnent principalement en bordure du Saint-Laurent, dans la formation géologique de la mer de Champlain. Le mythe de l'agriculturisme, malgré les valeurs folkloriques, et les inhérences profondes au rythme de la vie ethnique, malgré encore les 400 millions de dollars d'affaires (1951), risque de devenir un rempart de papier mâché qu'il faudra tôt ou tard abattre à coups de pied. Une fausse conception de la fameuse hiérarchie des valeurs a contribué à faire la portion congrue au progrès des sciences appliquées dans le Québec. Mais, malgré notre pauvreté matérielle initiale, malgré bien des résistances, nous avons franchi de rudes étapes; il faudrait faire l'historique du génie civil au Canada français et l'accompagner de ses projections dans le présent et dans le futur. D'ici le jour où l'ingénieur prendra la place qui lui revient dans les cadres de notre vie nationale à côté de l'homme d'affaires, du médecin, de l'avocat et du prêtre, il est avisé de reporter à plus tard, à beaucoup plus tard l'idée de la mission civilisatrice des Canadiens français. Ce serait à la fois triste et cocasse de voir se dandiner dans notre azur québécois une autre de ces magnifiques bulles d'air. Un peuple qui n'est pas maître de son économie chez lui, n'a pas à se payer de lubies.

Le Quartier Latin.

Elections and Transfers

At the meeting of Council held at the University Club, Montreal, on Friday, January 21, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

H. J. Barton, *Dalhousie*
K. J. Blakeman, *Toronto*
R. P. Charbonnier, *Calgary*
S. Ekvedt, *Montreal*
A. J. Forster, *Vancouver*
M. C. Giroud, *Montreal*
S. E. L. Kenez, *Hamilton*
D. J. McChesney, *Windsor*
R. C. Marriott, *Montreal*
P. H. Meincke, *Toronto*
J. E. Mikkelson, *S. Francisco*
A. S. Mitchell, *Lennoxville*
L. W. L. R. Pillar, *Ottawa*
B. E. Shinn, *Valleyfield*
J. R. von Renteln, *Kingston*
B. K. Woolfenden, *Montreal*
W. A. Wright, *Montreal*

Juniors:

H. T. Abbott, *London*
A. P. Barsalou, *Winnipeg*
C. R. de Lannoy, *Isle Maligne*
L. M. Elijah, *Windsor*
O. E. Gudz, *Montreal*
A. R. Love, *Montreal*
I. N. Monczak, *Montreal*
E. J. Moreau, *Montreal*
R. D. K. Smith, *Peterborough*
G. A. Tough, *Winnipeg*

Transferred from the class of Junior to that of Member:

R. G. Anderson, *Toronto*
J. P. Bastien, *Montreal*
L. Beaudoin, *Montreal*
L. J. Bilodeau, *Montreal*
W. E. Blake, *Ottawa*
B. R. Bradley, *Sherbrooke*
F. A. Brown, *Arvida*
A. E. Burgess, *Montreal*
G. J. Chalmers, *Montreal*
R. K. Cleverdon, *Toronto*
J. B. Cronyn, *London*
J. Croteau, *Montreal*
E. G. Davis, *Kamloops*
M. Decarie, *Montreal*
E. de Haas, *Toronto*
A. M. Deschenes, *Montreal*
L. J. Dugas, *Quebec*
D. A. H. Farmer, *Ottawa*
J. C. Finch, *Montreal*
J. P. Fleming, *Toronto*
C. A. Fry, *Gravenhurst*
L. Giroux, *Quebec*
J. C. Grant, *Montreal*
J. W. Gunn, *Montreal*
J. Hahn, *Montreal*
T. J. Hogg, *Toronto*
J. F. Hunt, *Edmonton*
J. D. Kean, *Peterborough*
B. T. Kerr, *Montreal*
C. G. King, *Sarnia*
R. W. King, *Edmonton*
G. E. Knight, *St. John's*
J. W. Korez, *Cap de la Madeleine*
R. A. Lanciault, *Lesage, Que.*
P. H. Lavallee, *Chicoutimi*
I. Lemco, *Montreal*
B. R. Lewis, *Windsor*
J. A. Linney, *Montreal*
C. H. Lusk, *Belleville*
K. A. W. Macdonald, *Ottawa*
D. R. McLeod, *Courtenay*
C. N. McPherson, *Montreal*
B. I. Maduke, *Montreal*
T. M. Medzwiecki, *Grand Falls*
G. B. Moffat, *Melbourne*
P. Mongeau, *Montreal*

D. R. C. Morris, *Shawinigan Falls*
E. M. Mosher, *Liverpool, N.S.*
J. J. Normand, *Arvida*
J. P. Oakley, *Halifax*
J. O. Opsal, *Montreal*
B. Panet-Raymond, *Thorold*
G. H. Peacock, *Montreal*
H. Peets, *Montreal*
E. M. Peto, *Toronto*
R. A. Quance, *Sarnia*
U. Raabe, *Winnipeg*
J. A. Randle, *Montreal*
D. F. Rankine, *Peterborough*
L. B. Rose, *Toronto*
G. Rothschild, *Montreal*
R. H. Routliffe, *Sarnia*
S. E. Rutledge, *Montreal*
W. W. Ryan, *Toronto*
R. J. Scarabelli, *Montreal*
P. P. Schopflocher, *Arvida*
E. L. Shanas, *Israel*
A. E. Sibbick, *London*
M. Spino, *Montreal*
R. W. Stedman, *Montreal*
Z. L. Szeliski, *Montreal*
A. G. Tanner, *Montreal*
J. E. Twiss, *Copper Cliff*
N. H. Ursel, *Toronto*
J. P. M. Valade, *Montreal*
G. S. Walker, *Montreal*
T. C. York, *Harrisburg, Pa.*

Transferred from the class of Student to that of Junior:

A. O. Nemec, *St. John's*

The following Students were admitted:

University of Manitoba

R. C. Addison
W. J. Ayres
R. A. Beddome
L. Berman
A. Bookbinder
K. K. Borkowsky
R. D. Brown
G. M. Chernoff
R. J. Conner
M. Corkal
F. R. Cowley
D. W. Craik
G. Cumming
H. M. Curry
H. A. Dalkie
H. Dashevsky
D R. Dawson
E. G. Dillistone
D. G. Dueck
C. R. Ferris
L. J. Fouillard
J. W. Gatschuff
D. S. Gibbons
T. W. Godfrey
R. D. Hansell
D. T. Holloway
W. Hryhorijiw
G. Jansen
J. O. Klein
R. W. Kornelsen
H. A. Krentz
V. Legiec
W. P. A. Lockhart
K. L. Macdonald
G. J. Maguet
F. A. Marsh
C. R. McBain
I. C. McGonigal
W. M. Minuk
D. A. Moir
J. E. Moore
G. A. Morris
J. D. Norman
I. P. Norquay
I. H. Olafson
L. L. Paquin
T. C. Piper
A. C. Pitt
J. N. W. Riddle
J. W. Rudan
W. Saltzberg
F. R. Scrase
J. D. Somers
M. J. Stanbridge
B. S. Stewart
K. Swiderski
J. R. Tansony
S. B. Thorsteinson
R. D. Vryenhoek
D. Wiseman
R. H. Yetman
R. R. Youngberg
C. Zeglinski
N. Zuibrycki

Queen's University

K. N. Ackles
H. G. Belyea
P. R. Bennett
R. R. Bowen
J. R. Clarkin
D. A. Croft
R. S. Forbes
D. J. S. Harshaw
T. A. Harshaw
R A. Highgate
J. B. Lutz
G. R. Lane
H. H. Jones
J. G. McBroom
J. R. McKenna
P. K. Powell
C. M. Sewell
J. D. Truax
J. D. Willis

Ecole Polytechnique

P. Archambault
A. Barbeau
R. J. M. Barbeau
R. Barbeau
G. Genier
C. Germain
C. Guernier
R. C. Gyurik
D. Beaudry
J. Belanger
C. Bellavance
J. G. Berthiaume
J. L. A. Biron
A. Boucher
J. A. M. Boucher
P. A. Bourassa
J. Bourgault
R. Bourrelle
A. Brassard
H. Brassard
L. Brisette
R. Brodeur
J. D. Bruneau
N. Bumaylis
J. Bureau
J. Y. Chagnon
J. A. A. Champagne
M. Charbonneau
A. R. Charrette
R. Collette
J. G. C. Couillard
R. Crevier
R. Cyr
A. Daigle
G. Daoust
J. Daoust
G. E. DeGagne
M. Desruisseaux
J. Deziel
J. G. Dionne
M. Dionne
V. Dore
G. Drouin
J. P. Dubeau
A. Dupras
P. Falcon
R. Fortin
N. Fournier
A. Galarneau
M. R. Gagnon
G. Gascon
J. R. A. Hebert
J. C. Hebert
D. G. Hobart
A. Labbe
W. Lacasse
C. Lafond
R. Lavallee
J. LeBel
M. Leduc
P. Lefebvre
R. Legault
L. Lemieux
J. G. Leroux
A. Lessard
B. L. Lortie
B. Malchelosse
J. P. H. Marceau
G. Marcil
J. G. Marcil
P. E. Marquis
G. McMartin
G. Meunier
L. P. Miron
J. M. Murphy
N. Nadai
J. Nobert
R. Pare
M. Planeuf
C. Picard
H. Pilon
A. Poisson
C. Richard
J. F. Riel
G. Rinfret
J. Roussel
R. S. St. Jean
J. Saint Jacques
P. Thivierge
P. E. Tremblay
J. L. F. Vezina
G. H. Vezina
M. Villemaire

Laval University

J. G. G. Begin
J. Blanchet
G. Bordeleau
C. Bourque
R. Des Roches
D. Grenier
L. Laflamme
M. A. Lamontagne
J. L. Landry
C. Leclerc
J. G. Letourneau
R. Naud
J. J. Pare
J. L. Thibault

McGill University

P. Glockner
J. B Halcro
G. Rock
F. A. Tsao

University of New Brunswick

A. H. Abbott
R. L. Berggren
G. C. Bourassa
P. P. Bowes
J. L. Breault
D. M. Caughey
G. J. Coupal
C. J. Couturier
F. C. Landers
D. MacCallum
M. W. MacKenzie
L. W. Smith

University of Toronto

R. A. Cruise
A. R. Drummond
R. F. J. Falconer
R. J. Nurse
J. L. Vardon
F. M. Yamada

Nova Scotia Technical College

R. A. Bennett
J. L. Carson
W. B. Carson
C. R. Nicol
S. E. Steeves

University of Alberta

F. E. Parkinson
J. F. Reichert

North Carolina State College

S. J. Costis

B. Michel, B.A.Sc., Civil, Laval, 1954
J. M. S. Cherry, B.Sc., Eng., Leeds, 1954
G. Hughes, Student, C.P.E.Q.

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Juniors:

J. G. Bruce
G. M. Mazurek
C. J. Primeau

Students:

G. B. Herbert
E. W. Lucht

Junior to Member:

E. H. Brennan
E. F. Holmgren
R. G. Proudfoot
H. C. Shannon
R. R. Smith

NOVA SCOTIA

Junior to Member:

P. H. Lahey

NEW BRUNSWICK

Member:

R. P. Henderson

QUEBEC

Member:

H. Fisk

Thirty-five Years Ago

Comment on the *JOURNAL* of February 1920

The *Journal* for February, 1920, was entirely filled by the reports of various committees and branches for the previous year, the address of the retiring president, personals and other similar material having to do with the Institute's own affairs all submitted at the just ended annual meeting in Montreal. There were no technical papers whatever, not even a note.

The remarks of Col. R. W. Leonard, M.E.I.C., (president, 1919-20) deserve first comment, though in this *Journal* they were sandwiched between a program of the annual meeting and a list of those who attended it and seem hardly to have been given the prominence one would expect.

1919 was in the era of "reconstruction", of ferment and of uncertainty, all results of the war. With his solid Christian background, Col. Leonard found a good deal of what he saw far from being to his taste. "We are behaving in a remarkable manner . . . because we have . . . left untaught (that) which should have been taught and we have taught much which should have been left untaught and there is a . . . lack of national sanity in us."

Col. Leonard was no friend of

socialism nor of the paternalistic state and he gave both a good going over. He thought that labour leaders needed to be told that their policies should contain more common sense and he upheld the thesis that men are by no means created equal, but they should have the same opportunities, to use or to neglect, as they saw fit. With the neglectful ones he had no patience. He concluded: "Co-operation among all classes and all nations there must be if we are to escape the downfall of civilization." Thirty-five years and another war later, we are still far from reaching this goal.

Many of the 1920 committees disappeared long ago, as the necessity for them disappeared — the Committee on Steel Railway Bridges, the Committee on Engineering Standards, the Committee on Uniform Boiler Specifications and the Committee on Electro-Technics, for example.

Licensing and Salaries

The branch reports make interesting reading. Most of them emphasized the part the branches took or were taking in getting licensing legislation passed in their provinces and their efforts to raise the standard of engineering salaries. In reading these branch reports, the writer was surprised to learn that in 1919 he presented a paper before one of them which he has totally forgotten; he still doesn't believe he did.

Correspondence had picked up a little; three letters, one a long one, were published and two of them were signed with noms de plume, a practice not now encouraged. J. A. Reid, M.E.I.C., wrote from the O'Brien Mine at Cobalt urging the Institute to prepare a booklet giving the history of attempts to secure the licensing of engineers and the arguments in favour of it. It was not Mr. Reid's idea that such a booklet should be generally distributed, but that it should be given as a sort of text to Institute members who were overcome with missionary zeal in favour of the cause.

"Two Engineers of Dept. of Interior" registered a complaint against the practice, common in their department they said, of keeping young graduates on the board if they showed skill in drafting, instead of giving them a chance to advance. They claimed that many of those responsible for this state of affairs were members of the Institute and asked, "Can the Institute do nothing in such cases . . . ?" We haven't heard many similar complaints lately, perhaps because today's engineering graduates are less likely to be respectable draftsmen than their ancestors were.

"An Ontario Member" wrote to support licensing legislation which would cover all engineers, regardless of their particular field, i.e., that proposed by the Institute. He was much concerned lest the proposals of a "Joint Committee of Technical Organizations" should be accepted in Ontario. From his letter we gather that these proposals were to license engineers in their specialties only, e.g., a licensed civil engineer would not be permitted to do mechanical engineering work, an impossible arrangement.

In the Quebec Branch news there was published a schedule of salaries actually paid to engineers by the Canadian National Railways, running from the chief engineer at $10,000 a year, through division engineers at $3,900 to chainmen at $900. It was stated that these salaries were about to be raised, on the average by about 10 per cent.

Notes about Members

The personals of thirty-five years ago do not mean much to the present generation, nevertheless there is the occasional mention of a name that ought to be familiar to us today. From this *Journal* we learn that G. Gordon Gale, M.E.I.C., vice-president and general manager of the Hull Electric Railway, had been elected vice-president of the Canadian Electric Railways Association. Mr. Gale is now president of the Gatineau Power Co. Also we learn that Douglas Bremner, A.M.E.I.C., and Miss Beatrice Macdonald were married on December 11, 1919. Mr. Bremner is now a well known Montreal contractor. Lieut. J. W. McCammon was reported as demobilized; he is now commissioner and general manager of the Quebec Hydro-Electric Commission.

Capt. Yves Lamontagne was another who had just come back to Canada from active service. Mr. Lamontagne dropped out of engineering to become a trade commissioner for Canada in Europe; it is to him that we are indebted for the perfectly delightful series of reprints we recently published having to do with engineering in the late 1860's.

There were jobs offered in the *Journal*, 14 of them, mostly without mention of salary. "The demand for trained men exceeds the supply" and "The demand for draftsmen is also very brisk"—where have we heard these before? Only one "graduate engineer, A.M.I.E.C., . . . six years' civil and mechanical experience" wanted to change his job.

There were 45 applications for admission published; the Institute was growing.

The ASME Boiler Code

Interpretations

The Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

The following Case Interpretations were formulated at the Committee meeting June 11, 1954.

Proposed Case No. 1194

Special Ruling

Inquiry: Is it permissible in welded construction conforming to the requirements of Section VIII to use nickel-chromium-molybdenum wrought material forgings which meet the following chemical and physical requirements?

(This material is now under consideration in ASTM).

Chemical Requirements

Chromium, percent	14.50—16.50
Molybdenum, percent	15.00—17.00
Tungsten, percent	3.00— 4.50
Iron, percent	4.00— 7.00
Nickel, percent	Remainder
Carbon, max, percent	0.08
Silicon, max, percent	1.00
Cobalt, max, percent	2.50
Manganese, max, percent	1.00
Vanadium, max, percent	0.35
Phosphorus, max, percent	0.040
Sulphur, max, percent	0.030

Physical Requirements

(see box)

Reply: It is the opinion of the Committee that nickel-chromium-molybdenum wrought plates, pipes, forgings, and bolting having the chemical and physical requirements specified in the inquiry may be used in the construction of arc-welded pressure vessels complying with the rules of Section VIII, provided the following additional requirements are met:

(1) The rules in Subsection C which shall apply are those given in Part UNF.

(2) The maximum allowable stress values for the material shall be those given in Table I.

Table I. Maximum Allowable Stress Values

in pounds per square inch

Metal Temperatures Not Exceeding Degrees F.	Sheet and Plate	Bolting
100	22,000	10,000
200	20,000	10,000
300	20,000	9,200
400	20,000	9,000
500	20,000	8,500
600	20,000	8,500
700	19,000	8,500
800	19,000	8,500
900	18,000	8,500
1000	18,000	8,500

(3) All butt-welded joints shall be examined radiographically for their full length as prescribed in Par. UW-51 when the plate or vessel wall thickness exceeds 3/8 in.

(4) All butt-welded joints and all nozzle-connection welds shall be examined for the detection of cracks by the fluid penetrant method.

(5) Welding shall be done by the arc-welding process using filler metal that complies with the chemical and physical requirements given in the Inquiry.

(6) The welding procedures and welders shall be qualified under the requirements of the 1953 Edition of Section IX, Part B, except that the tensile strength of the reduced-section specimen shall not be less than the minimum tensile specified for the material in the Inquiry.

(7) The requirements in Par. UNF-65 shall apply to low-temperature operation.

Case Annulments

Case Nos.	*Reason for Annulment*
Nonferrous materials	
1127	This permits a change in the specification limits for silicon and manganese in Type A material under SB-96 and SB-98. These limits have now been adopted in the revised specifications in Section II.
1151	This refers to the 1949 Edition of Section VIII and is to be included with the group annulled as of January 1, 1955.
1179	This covers Figs. UNF-28.6, 28.7 and 28.8 for nickel vessels under external pressure. They are now included in the 1954 Addenda.
1183	This covers Figs. UNF-28.9 to 28.12 inclusive for copper vessels under external pressure. They are now included in the 1954 Addenda.
Unfired Pressure Vessels	
989	This covers 3 grades of SA-268 chromium steel pipe which were added to Table UHA-23 in the 1954 Addenda.
1118	This covers 2 grades of SA-350 forgings for low-temperature service which were added to Table UCS-23 in the 1954 Addenda.
1163	This involves testing heat-exchangers which is covered by revisions to Par. UG-99 in the 1954 Addenda.
1164	This provides a design chart for vessels under external pressure which is covered by inclusion of the chart as Fig. UCS-28.2 in the 1954 Addenda.

Physical Requirements			
Thickness, Inch	Tensile Strength, min, psi.	Yield Strength, 0.2% Offset min., psi.	Elongation In 2 Inches, min., Percent
Up to 3/16	115,000	50,000	40
3/16 thru 3/4	100,000	45,000	30
Over 3/4 to 1 1/2	90,000	45,000	20

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.

Power Boilers, 1952

Table P-7. Under Castings, Carbon Steel, SA-216-53T, (Carbon-Steel Castings Suitable for Fusion Welding for High-Temperature Service), the stress values now shown in this Table remain for this specification of revised date.

Heating Boilers, 1952

Par. H-74. Add the following after the word "Locomotives":

. . . or SA-212 high tensile strength carbon silicon steel plates . . .

Par. H-76. Add a new paragraph to read:

When SA-212 plates are used in the construction of boilers, this material shall be used in qualifying the procedure.

Par. H-77. Add the following sentence to the first paragraph to read:

Welders who will weld SA-212 must be qualified with that material.

Par. H-78(b). Add the following sentence to read:

Welders who will weld SA-212 must be qualified with that material.

Unfired Pressure Vessels, 1952

Table UCS-23. Under Castings, Carbon Steel, SA-216-53T, (Carbon-Steel Castings Suitable for Fusion Welding for High-Temperature Service), the stress values now shown in this Table remain for this specification of revised date.

Par. UG-127(e)(3). Revise editorially by deleting the last phrase to read:

(3) The disk is designed to rupture at not more than the maximum allowable working pressure of the vessel.

Par. UG-133(f). Revise editorially to read:

(f) The set pressure tolerances, plus or minus of safety or relief valves, shall not exceed 2 psi. for pressures up to and including 70 psi.; and 3 per cent for pressures above 70 psi.

Par. UW-51. Footnote (1), page 57, substitute the words "source of radiation" for the words "source of gamma rays" wherever they appear.

g), Revise this paragraph to read:

Penetrameters may be placed on the film side of the joint provided the manufacturer can satisfy the inspector that the technique employed in doing the work is known to be adequate. (See footnote).

e) (1), Revise this paragraph to read:

(1) The penetrameters shall be placed on the side nearest the radiation source except when complying with the provisions given in Par. UW-51(g).

(b) In view of improved welding and radiographic techniques, the Committee suggests that the table in this paragraph be revised as follows:

Plate Thickness Inches	Thickness of Reinforcement Inches
Up to 1/2 incl.	1/16
Over 1/2 to 1	3/32
Over 1 to 2	1/8
Over 2	5/32

Section IX, 1953

Table Q-11.1. Add the following specifications where indicated:

SA-369-53T, Grades FP1 and FP2, P-3.
SA-369-53T, Grades FP3b, FP11 and FP12, P-4.
SA-369-53T, Grades FP21, FP22, FP5, FP7 and FP9, P-5.

Nonferrous

SB-273-53T, Grade GR40A, P-22.

News of Other Societies

The fifth divisional conference of the Chemical Engineering Division, the **Chemical Institute of Canada,** (18 Rideau St., Ottawa 2), will be held March 7-9, 1955, in Ottawa.

The Protective Coatings Division will meet for the ninth conference on February 24 at the Royal York Hotel, Toronto, and the program will be repeated on February 25 in Montreal, at the Ritz Carlton Hotel.

The sixth Canadian High Polymer Forum, sponsored by C.I.C. with the National Research Council, will be held on April 14-15, at St. Catharines, Ont. The annual conference and exhibition for C.I.C. will be in Quebec City, May 30, 31, and June 1.

The **Canadian Electrical Association,** (Room 714, Tramways Bldg., Montreal 1), will hold a meeting of all divisions in the Western Zone on March 7-9, 1955, at the Bessborough Hotel, Saskatoon.

The annual convention of C.E.A. is scheduled for June 27-29, at the Hotel Vancouver, Vancouver.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

New Officers

John Russell Montague, director of engineering of the Hydro-Electric Power Commission of Ontario, heads the Council for 1955 upon his election by acclamation as the thirty-fourth president of the Association of Professional Engineers of the Province of Ontario. This is Mr. Montague's sixth year on Council, three as an elected representative of the mechanical, aeronautical and industrial branch, as second vice-president in 1953 and first vice-president in 1954. During these years he has also been a valued member of many committees and has thus been able to gain an intimate knowledge of the numerous activities of the organization.

Mr. Montague was born in Niagara Falls, Ontario, and in 1914 graduated in mechanical engineering from the University of Toronto. In 1926 he obtained the professional degree of C.E. from Toronto. He first joined Ontario Hydro in 1918, and following two years with a Montreal firm of engineers and contractors, returned to Hydro in 1922.

During 1955 the Council of the Association will comprise the following:

President: J. R. Montague, Toronto.
1st Vice-Pres.: M. W. Hotchkin, Kirkland Lake.
2nd Vice-Pres.: J. H. Fox, Toronto.
Past-Pres.: Col. W. L. Sagar, Toronto.

Councillors:

Civil Branch—T. N. Carter, Toronto; (*) Dean D. S. Ellis, Kingston; Col. L. F. Grant, Toronto.

Chemical & Metallurgical Branch—G. W. Ames, Sarnia; P. E. Cavanagh, Toronto; (*) C. T. Carson, Walkerville.

Electrical Branch—H. R. Osborne, Toronto, J. H. Waghorne, Toronto

Mechanical, Aeronautical & Industrial Branch—(*) Dr. G. R. Lord, Toronto; J. H. Ross, Toronto; and W. D. Sheldon, Jr., Galt.

Mining Branch—Dr. D. R. Derry, Toronto; M. S. Fotherinham, Steep Rock Lake, Ontario.

*Appointed by Lieutenant-Governor in Council.

News of the Members

N. N. Life, was recently appointed to the position of city engineer of Port Arthur, Ontario, where he has been employed as assistant city engineer.

Mr. Life was born in Wembley, England, and is a graduate in engineering of the University of London. For a period following his move to Canada he was employed by Proctor, Redfern & Laughlin, Toronto, consulting engineers.

James F. Cutler, of the C. A. Dunham Co. Ltd., has been appointed manager of the district sales office in Hamilton. He joined the company on graduation from the University of Toronto in 1950. Since then he has been engaged in the Niagara Peninsula and South West Ontario areas.

M. C. Coutts, Sangamo Company Ltd., Leaside, Toronto, has been made vice-president of the company in charge of manufacturing. Prior to this promotion Mr. Coutts has been plant manager.

O. D. Johnston, president of Gooderham & Worts Ltd., Toronto, and a past-president of the Association of Professional Engineers of Ontario, was elected president of the Association of Canadian Distillers at their annual meeting recently held in Ottawa.

Mr. Johnston graduated in chemical engineering in 1923 from the University of Toronto, following service in the Canadian Army in World War I. In 1937 he joined the Gooderham & Worts organization as manager of the industrial division. In 1942 he was made vice-president and shortly thereafter rose to the presidency of the company. During 1954 he was one of three Ontario professional engineers elected as fellows of the Chemical Institute of Canada.

H. J. A. Chambers, of Modern Tool Works Ltd., Toronto, has been appointed president of the company at a recent meeting of the company's board of directors.

Latterly Mr. Chambers who obtained his degrees of Bachelor and Master of engineering at the University of Toronto, was president and general manager of Standard Machine & Tool Co. Ltd., Windsor. Prior to this he was vice-president and general manager of the Hamilton Bridge Co. Ltd.

J. W. P. Draper has been appointed general manager of Bestobell Canada Ltd., 4 Bestobell Road, Toronto 14, Ontario.

Early in January, Mr. Draper will leave for a visit of several months in England.

As of December 31, 1954, the partnership of Thomas and Wardell, Toronto consulting engineers, has been dissolved.

M. F. Thomas will practice under his own name at 74 Rivercrest Road, Toronto. The practice of **A. W. Wardell** will be continued under the name of A. W. Wardell & Associates, with office at 3341A Bloor Street West, Toronto 18.

A. Ross Dawson, who has been manager, plant engineering, Oakville division, Ford Motor Company of Canada Ltd., has been appointed to the position of manager, engineering services.

In his new position, which became effective on December 1, Mr. Dawson will have jurisdiction over both manufacturing and plant engineering departments.

L. E. Paradise, of Toronto, is now on the engineering staff of the Department of Highways of Ontario. He was formerly with the Consumers Gas Company of Toronto.

J. J. Offut, of the A.P. Green Fire Brick Company has been moved from Weston, Ontario, to Mexico, Missouri, where the organization's parent plant is located. Mr. Offut is a graduate of the Missouri School of Mines and has been with the A.P. Green Fire Brick organization for a number of years. Since 1946 he has been general manager of the Canadian company at Weston.

Geoffrey F. Langfield, of St. Catharines, has joined Packard Electric Co. Ltd., as transformer engineer. He was earlier with Canadian Comstock Co. Ltd., also in St. Catharines.

A. E. Harold Fair has moved from Toronto to Boston Mass., where he is executive vice-president of Brown Company, 150 Causeway Street, Boston.

Mr. Fair, a graduate in chemical engineering of the University of Toronto, was president of Alliance Paper Mills, Ltd.

Manuel A. Silva has moved from Ottawa, where he was chief engineer of Canadian Aero Services, Ltd., to Caracas, Venezuela. He is manager of the department of aerogeophysics and photogrammetry of Porte & Perfetti, geologists and mining engineers in Caracas, Venezuela.

Frank W. Kingdon has left the Ontario Paper Co. Ltd., at Thorold, to join the firm of S. M. Peterkin Co. Ltd., consulting engineers of St. Catharines, Ontario.

H. G. Willmets, of Ottawa, has relinquished the position of chief mechanical engineer, Director of Works, Department of National Defence, and has become associated with the firm of Stadler, Hurter & Company, consulting engineers of Montreal, which he will represent in Ottawa.

Alberta

Why a Professional Engineer?

During the past fifteen years the membership of the various professional engineering associations across Canada has increased tremendously. The demands of the last war, the industrial development of Canada, the veterans' educational grants, etc., encouraged many men to enter the engineering colleges and thus the profession of engineering. Canada has needed and is using all these technical men and the needs are ever increasing. Modern society in general requires more and more technically trained men and women. Why, then, should this ever expanding group of engineers belong to an Association of Professional Engineers?

The British North America Act delegated the responsibility of regulating the practice of professional men and women, such as engineers, doctors, dentists, etc., to the Provincial Government, not the Dominion Government. The men that formulated these laws recognized that certain fields of endeavor such as engineering and medicine, which were based upon well established and socially accepted scientific principles, had to provide an indispensable social need. Since these professions had to provide an indispensable social need, it was necessary to ensure that those who practice as professional men be required to have the necessary scientific knowledge and to have developed a scientific technique which is the result of tested experience. The Province of Alberta could have set up a system for licensing engineers much as they have done for automobile drivers, but instead they enacted "The Engineering Profession Act." This Act delegates the responsibility for regulating the practice of engineering to the engineers themselves and the body of engineers that has this responsibility is known as "The Association of Professional Engineers of Alberta". Thus, as the needs of society for engineers increase, so does the obligation and the responsibility of the professional associations increase — obligations to society itself, to the engineers themselves and to the prospective engineers entering our universities.

The Association of Professional Engineers of Alberta having accepted this responsibility is administering this responsibility. In addition, it is doing many other things for its members. In order that we may all have a better understanding of the role of the Association and give more guidance to the Council of the Association, I would ask that you give serious thought to the work of the Association and in particular read the recent publication "Information about the Association of Professional Engineers of Alberta". At the annual meeting in March we would then be better able to discuss the activities and future policies including the question of "Plan for Unity".

Membership

Membership continues to increase with more than 170 new registered members since March making a total of over 1,500. E.I.T. membership stands at 165, with 55 student members, and approximately 110 licencees; making a total membership of over 1850.

Annual Meeting Directives

The annual meeting last March requested Council to conduct a further salary survey. This will be carried out this year through Dominion Council on a Dominion wide basis. The salary questionnaire forms are a different colour for each Province and will therefore enable a breakdown to be given on a provincial basis.

The annual meeting also requested that Council set up a committee to study the question of education in Alberta. This committee was set up early in the spring and have been working diligently since that date.

The annual meeting's resolutions re Plan for Unity were passed on to Dominion Council and E.I.C. They have resulted in committees being set up by both the Dominion Council and the E.I.C. to work on this proposal. These committees have both been active but no report is expected back until sometime next spring.

Dominion Council

The Dominion Council continues to work steadily towards uniform registration, uniform examination syllabus, and uniform transfer of membership.

Committee on Education in Alberta

J. G. Dale, chairman of the central education committee has reviewed their work to date. Mr. Dale explained that the committee planned on setting up local committees in various localities throughout the Province wherever interest could be aroused. He has also reviewed the brief which was presented to the legislative committee on education last spring and some of the discussion and problems which the committee have considered so far.

Committee on Public Relations

E. K. Cumming, chairman of the public relations, editorial and convention committee, urges members to send in comments, news of engineering projects, and pictures to the office so that they may be used in *The Alberta Professional Engineer*. He further urges the members to suggest topics for the forum for the annual meeting. Mr. Cumming suggests that public relations is telling others how and what you do. He suggests that members should be willing and prepared to explain the purpose and reasons for the Association and the E.I.C. They should be willing to tell their friends about professional engineering. Mr. Cumming has on hand a tape-recording of a sample radio program which is being considered by the committee.

Mr. Campbell has questioned the possibility of booklets being prepared on "Proper Engineering Practice". Dean Hardy believes that the keeping of the membership informed on publications along this line is a large undertaking, and the chairman has suggested that this is another reason for our plan for unity. This might facilitate better service to the membership in this respect.

Can We Teach Engineering Without Mathematics?

To most of us who are professional engineers, this is a ridiculous question. It is not so ridiculous when it is realized that during the last twenty years the time spent in the four high school years on mathematics has been reduced by one half. It is just possible that at the end of the next twenty years the high school student will not be studying mathematics at all! This is only one of the many changes that have been made in the high school curriculum.

One of the most important attributes of a learned profession, which distinguishes it from a trade, is the interest that members of the profession take in the general and professional education of their fellow members. It is not enough that they should concern themselves with professional ethics or the welfare of the profession as a whole— manual trades do that as well. It is its concern about the increase in the body of professional knowledge and the proper training and education of young members of the profession that earns a true learned profession its name and reputation.

Members of the engineering profession are quite rightly concerned with the calibre of professional instruction as offered at the university. Any changes that take place either in the curriculum or in the standards of instruction should be, and are, watched with a view to preventing any reduction or deterioration in standards.

But the standard of instruction at university is to a great extent dependent upon the instruction offered at elementary and high schools throughout the country. A structure is no more sound than the foundation on which it rests. Are we satisfied with the background in education as supplied to our potential engineers by the educational system of the country?

For the past twenty years, at least, the education of our youth both at the elementary and high school levels, has been severely criticised by parents, employers, and citizens in general both in the United States and in Canada. Books are being written, magazine articles appear regularly and a heated debate is being waged in the newspapers. The lines seem to be quite clearly drawn between the supporters of what is known as "progressive" or "modern" education and the so-called "traditionalists".

Members of the Association cannot remain indifferent to this controversy As citizens, parents, employers of graduating engineers and primarily as members of the profession, they have a duty to find satisfactory answers to the following questions:

1. Is there a serious problem in connection with the education of our young people either relating to the subject matter taught in schools or in the way it is presented?

2. If we agree that there is a problem which is of concern to the members of the Association, what is it specifically?

(a) Is it primarily in the co-ordination between the high school and the university curricula?

(b) Is it in the reduction in the standard of instruction in high school subjects?

(c) Was the problem created by the adoption of a new ("progressive", "modern") system of education, which is said to neglect the basic subject matter (the three "R's")?

(d) Does the problem lie in the philosophy of education which in attempting to give everybody a high school education, must of necessity strike a rather mediocre standard of achievement?

(e) Is the main fault in the preparation of teachers?

3. What solution can you suggest to the problem, as you see it?

(a) Should more subject matter be added to the courses at the university?

(b) Should a grade XIII be added to the high school course?

(c) Should an extra year be added to the course at the university?

(d) Should an intermediate school such as a community college be organized that can supply its better graduates to the university and the others to technical or trade schools?

(e) Should more academic courses be available in high schools?

There are many other suggestions for solution to the problem. Naturally, the solution will depend on the nature of the problem. The statement of the problem, the assembly of the facts, their study and the finding of a solution is a large undertaking. It is clear that members of the Association, if they have the interest of our young people and the future of the profession at heart, should be willing to assist in this effort.

British Columbia

Brief presented to the Minister of Labour concerning amendments to the Industrial Conciliation and Arbitration Act by the Association of Professional Engineers of the Province of British Columbia.

In December it was noted in these columns that engineers-in-training in a large B.C. company had won a victory against union domination when, by an agreed secret ballot, they voted overwhelmingly to reject membership in the company union. The following is the brief (slightly condensed) presented to the Minister of Labour suggesting amendments to the Industrial Conciliation and Arbitration Act. This proposed amendment was first submitted in December of 1953 and will be before the B.C. Legislature again this year.

The Association of Professional Engineers of the Province of British Columbia respectfully submits that the Industrial Conciliation and Arbitration Act should be amended so as to exclude from its operation persons registered or enrolled under the provisions of the Engineering Profession Act.

At the present time Section 2 of the Act defines 'employee' as follows:

"'Employee' means a person employed by an employer to do skilled or unskilled manual, clerical or technical work, but does not include

a) A person employed in a confidential capacity or a person who has authority to employ or discharge employees;
b) A person who participates in collective bargaining on behalf of an employer, or who participates in a consideration of an employer's labour policy;
c) A person serving an indenture of apprenticeship under the "Apprenticeship Act";
d) A person employed in domestic service, agriculture, horticulture, hunting or trapping."

The Industrial Conciliation and Arbitration Inquiry Board which held hearings on the suggested amendments to the Act in 1951 recommended in its report that this definition should be changed to:

"'Employee' means a person employed by an employer to do skilled or unskilled manual, clerical or technical work, but does not include

a) A manager or superintendent, or any other person who, in the opinion of the Labour Relations Board, exercises management functions, or is employed in a confidential capacity in matters relating to labour relations;
b) A member of the medical, dental, architectural, engineering or legal profession qualified to practise under the laws of the Province of British Columbia, and employed in that capacity;
c) A person serving an indenture of apprenticeship under the "Apprenticeship Act";
d) A person employed in domestic service, agriculture, horticulture, hunting or trapping.

If the recommendation of the Inquiry Board is accepted, and the Industrial Conciliation and Arbitration Act is amended accordingly, Registered Professional Engineers would be excluded from the provisions of the Act. This suggestion is not new, nor against the principles of trade unionism, and should provoke no opposition.

Under the Dominion Enactment and under the Labour Legislation of all the Provinces of Canada, except British Columbia, Prince Edward Island and Saskatchewan, the requested exclusion is found.

Therefore, British Columbia, along with the very small province of Prince Edward Island and the small province of Saskatchewan (with respect to population) are out of line with the rest of Canada. From the point of view of professional engineers neither Prince Edward Island nor Saskatchewan are of serious account since in the former province there is no registering body for professional engineers, and in the latter there is a very small number of professional engineers; but in British Columbia the matter is of much consequence. The number of engineers in the respective provinces is as follows:

British Columbia	1,444
Alberta	1,043
Saskatchewan	370
Manitoba	491
Ontario	11,176
Quebec	4,851
New Brunswick	319
Nova Scotia	550
Newfoundland	63

In Newfoundland the Engineering Profession Act was just enacted in 1952.

The Council of the Association of Professional Engineers of the Province of British Columbia is not in any way opposed to trade unionism, but with the I.C. & A. Act as presently constituted, arguments have arisen which cause some dissension. Under the present wording of the Act the question must be determined in each individual case as to whether or not an engineer is or is not employed in a confidential capacity, or is a person who has authority to employ or discharge employees.

The Pulp and Sulphite Union at Powell River in 1944 attempted to enrol the employee engineers of the Powell River Company as union members, but the engineers unanimously decided not to join the union, and are not now members. Engineers of the Consolidated Mining and Smelting Company at Trail, which forms the largest single group of employee engineers in British Columbia, are not connected in any way with the union. Engineers in the employ of the City of Vancouver do not, and have not, belonged to the union. There are some sixty Engineer Employees of the B.C. Electric Co. Ltd. in Vancouver who are forced to belong to the Office Employees' Association because they joined the union some years ago when it was a voluntary social organization, but now by virtue of certification, union membership is obligatory.

In a ballot taken by the Labour Relations Board in 1952, fifty-nine ballots were sent out to members of this group, of which fifty-four ballots were returned, every one of which was in favour of separation from the union.

Some reasons why the Council of the Association of Professional Engineers feels that the members of the Association should be excluded from the terms of the Act are as follows:

1) A Professional Engineer's first responsibility is to the public. It is his duty to ensure that a high standard of engineering is maintained and developed in the Province. If he allows any other consideration to outweigh this first duty, he has no moral right to continue in practice.

2) A Union seeks standardization of reward, and Professional Engineers feel that reward, beyond a proper minimum, should be related to integrity, technical ability, good judgment, energy and devotion to work. These factors cannot be measured by trade union standards.

3) Incentive pay is generally opposed by unions. Without incentive, a profession becomes less attractive, less efficient and less progressive. Moreover, if an engineer is to function, professionally, he must have a greater measure of personal freedom than is possible for a member of a trade union.

4) Where engineers are members of an industrial union they are submerged in a large narrow group with whom they share few problems in common. Working conditions tend to be applied for the large general group, rather than for individual groups, such as engineers, who have their own problems which require separate consideration. The same consideration applies, though we think in a lesser degree, to certain skilled workers who feel themselves better served by a craft union.

5) In belonging to a union, Engineers may be forced into a dual incon-

sistent relationship. If they belong to a union, they owe the usual duties and obligations to the union, and the officers thereof, and are subject to its disciplinary action. They are obligated to pay union dues and assessments. Under the Engineering Profession Act of this Province, in order to practise they must belong to the Association of Professional Engineers of the Province of British Columbia, and are subject to the discipline of that Association, and the rights and obligations as members, and to payment of the fees set out by the Council.

6) A Professional Engineer must be in close relation to, and at all times, no matter what the consequences, be faithful to the interests of his employer. The penalty for breach would be cancellation of his membership, and therefore the right to practise as a Professional Engineer. This is covered in the Code of Ethics as set out in By-law 12 of the Association, whereby an Engineer must act in professional matters for each client or employer as a faithful agent or trustee.

7) A Professional Engineer cannot properly be confined to stated hours of work. His duties frequently require lengthy hours in a day or week, with sometimes very few hours in a day or week. The Profession requires many hours of additional work by way of study or preparation, which may be done at home or in the office or by viewing other jobs.

8) There is a most important relationship between a junior and a senior engineer. The latter is almost invariably in an executive position. The junior must look to his senior for his special training and aids to his professional development. Where the junior belongs to a union, this relationship is weakened.

9) In a case of a strike, the relationship may again come into direct conflict. The Professional Engineer owes a direct duty to the employer to preserve and maintain the material and equipment and to keep it in operation. This duty may conflict with his personal desires, or with the union affiliation, if he has one, but that is one of the obligations of a profession.

The considerations mentioned above do not apply to skilled or unskilled, manual, clerical or technical workers, whose majority decision would bind the professional engineers. It has been found salutary in the whole of the rest of Canada, with the exception of less than five hundred Professional Engineers out of a total of over 20,000, to exclude Professional Engineers from the terms of the I.C.&A. Act, and it is therefore requested that the Minister of Labour recommend to the Provincial Legislature at its next session, that the suggested amendments to the I.C.&A. Act be enacted.

Thus far in this brief we have been dealing with Professional Engineers, or those who are qualified to practise independently in this Province. There is, however, another group of members of this Association who have not yet reached the status of Professional Engineers, but who are tending towards that category, and these are known as "Engineers-in-Training." The Council of the Association of Professional Engineers feels that these men also should be excluded from the terms of the I.C.&A. Act.

These engineers-in-training are University graduates in applied science or men with the equivalent of university graduation, who are engaged in the practice of professional engineering, usually under the direct guidance of a registered Professional Engineer. They are required, in order to reach the status of Professional Engineer, to obtain at least four years' practical experience, subsequent to graduation, and to submit satisfactory written evidence of this qualifying experience. There are 1,302 engineers-in-training enrolled in the Association of Professional Engineers of British Columbia. These men are bound by the same code of ethics as a fully qualified member of the Association, and it is our submission, therefore, that they should not be required to belong to a trade union for the same reasons as Professional Engineers should not be required to belong.

It should be pointed out that the engineer-in-training in British Columbia requires the same qualification as a full member for entry in the Corporation of Professional Engineers of Quebec, and one of our engineers-in-training, who has had one year practical experience after graduation could be admitted to full membership in Ontario. Therefore, if these men were practising in one of these provinces, in which almost 80 per cent of the engineers in Canada are concentrated, they would be excluded from the provisions of the Labour Legislation in those provinces.

Referring to paragraph (c) of the section of the present Act, defining "Employee," it is requested that consideration be given to amending this paragraph to read in the following vein:

> "(c) A person serving an indenture of apprenticeship under the "Apprenticeship Act" or is training for the medical, dental, architectural, engineering or legal profession, and is enrolled as such with the British Columbia registering body for that profession."

It is requested that the Minister of Labour consider this brief and recommend to the Provincial Legislature at its next Session the enactment of these suggested amendments, namely that the definition of "employee" be amended (1) so as not to include members of the medical, architectural, engineering or legal profession, as recommended in the report of the I.C.&A. Inquiry Board in 1951; (2) so as not to include persons in training for these professions.

All of which is respectfully submitted this 21st day of December 1953.

Engineers-in-the-News

J. D. Hartley has been promoted from assistant superintendent to superintendent of the zinc department of the Consolidated Mining & Smelting Co. at Trail.

H. P. Ellis is now logging manager of the Pacific Pine Co. Ltd. at New Westminster. He was previously with Crown Zellerbach Canada Ltd.

D. A. MacKinnon and **R. Rome** are retiring from the City of Vancouver engineering department after a combined seventy-one years of civil engineering experience. At the time of their retirement, Mr. MacKinnon was deputy city engineer and Mr. Rome was assistant city engineer.

H. R. Shawk, who has been with the Caribou Engineering Co. since 1953, has now embarked upon individual consulting practice in process design and engineering in the petroleum, petrochemical and chemical fields. Mr. Shawk has had extensive experience in the petroleum and chemical industries and feels there is need for that background in Western Canada.

T. A. J. Leach has been promoted to chief engineer, water rights branch, Department of Lands & Forests.

D. A. MacLean will take over the position of chief hydraulic engineer left vacant by Mr. Leach. Mr. MacLean was formerly hydraulic engineer with the water rights branch.

A. L. Van Den Brandeler, who has been the western district engineer (Canada) of The Pre-Load Engineering Co. Ltd., has accepted a position with Bechtel-Mannix-Hester Co. at Calgary. He will be engaged in the design of the trans-Canada gas pipeline project.

S. P. Oakes will be leaving the B.C. Engineering Co. on February 1st to take up a new position with **A. B. Sanderson,** bridge consultant, in Victoria.

A. D. Cronk, until recently sales representative with Railway & Power Engineering Corp. Ltd. and C. M. Lovsted & Co. (Canada) Ltd., has accepted the position of special representative, technical sales, Pacific zone, The Barrett Co. Ltd. In this capacity he will be largely responsible for all technical sales for the Barrett Co. in British Columbia and Alberta.

F. E. Ladner, special representative, technical sales, Pacific zone, The Barrett Co. Ltd., has been promoted to assistant sales manager, built-up roofing and technical sales, Pacific zone, of his company. In this capacity he will be responsible for all built-up roofing and technical sales for his company in British Columbia and Alberta.

R. S. E. Serenius, who has been research assistant at the dept. of chemistry, U.B.C., has accepted a position as chemical engineer with the Powell River Company.

D. W. Richardson is now with Heat and Power Engineering Ltd. He previously ran his own business handling building materials at Kamloops.

F. Battistella is now employed by the City of Edmonton power plant. He was previously with Colin Allan, electrical contractor, at Edmonton.

L. H. Sylte will be joining the Clayburn Co. Ltd. at Abbotsford very shortly. He was previously employed with the Socony-Vacuum Oil Co. of Canada Ltd.

T. A. G. Beeching has accepted a position with Bohna & Miller. He had previously been engaged in electrical field work on the Kemano powerhouse with B.C. International Engineering Ltd.

R. C. B. Henderson has accepted a position on the engineering staff of the Aluminum Co. at Kemano. He had spent the past four years at Kemano with the Morrison-Knudsen Company.

W. W. Maybank has rejoined the firm of MacLeod-Cockshutt Gold Mines Ltd. He is now in charge of exploration at head office in Toronto.

W. E. Corry has been appointed hydraulic engineer with the Dominion-Provincial Board, Fraser River basin. He was previously hydraulic engineer with the water rights branch, Dept. of Lands and Forests.

W. Thorsboll has left for a new position in California. He was formerly at Kemano with the B.C. International Engineering Co.

Personals

News of the Personal Activities of Members of the Institute

W. J. W. Reid, M.E.I.C., president since 1948 of the Otis Elevator Company Limited, the Canadian associate of the Otis organization, has been appointed vice-president in charge of foreign operations with headquarters in New York.

W. J. W. Reid, M.E.I.C.

A 1924 electrical engineering graduate of the University of Toronto, Mr. Reid served with the Royal Canadian Engineers during World War I. He has been associated with the Otis Elevator Company since 1921, having held a number of important positions. In 1941 he was appointed manager of munitions in charge of the company's war production. He was loaned as director of the gun division of the Department of Defence Production in 1952.

Mr. Reid has served as a vice-president of the Engineering Institute and as president of the Association of Professional Engineers of Ontario.

John R. Montague, M.E.I.C., director of engineering for the Hydro-Electric Power Commission of Ontario, has been elected 1955 president of the Association of Professional Engineers of Ontario.

Mr. Montague's association with the Commission dates back to 1918, during which time he has been responsible for the design of almost every hydro power plant in the province, including the recently-opened Sir Adam Beck No. 2 development at Niagara Falls.

A native of Niagara Falls, Mr. Montague graduated from the University of Toronto in civil engineering in 1914, and received early training with such firms as the Laurentian Power Company at Beaupré, Que.; the International Waterways Commission in the Niagara area, and the old Ontario Power Company at Niagara Falls. He also served two years as superintendent of construction for the Raymond Concrete Pile Company of Montreal and New York. He joined the Ontario Hydro in 1918 as a design engineer and at first worked at Niagara but later in Toronto.

Besides planning and building complete power plant extensions, he was responsible for investigation of numerous power and storage sites, and river diversions.

In his capacity of director of engineering which he has held since 1948, Mr. Montague supervises the activities of some 1,200 Ontario Hydro personnel, including more than 300 fellow professional engineers.

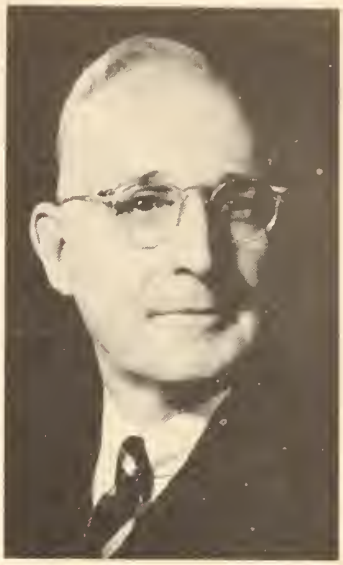
T. A. Lindsay, M.E.I.C., director and vice-president (sales) of Phillips Electrical Company (1953) Limited, has been appointed to the position of executive vice-president. He will be responsible to the Board for the executive operation and general administration of the company.

T. A. Lindsay, M.E.I.C.

A native of Belfast, Mr. Lindsay came to Canada with his parents in 1922. He lived in Winnipeg and graduated with a B.Sc. degree in electrical engineering from the University of Manitoba in 1933.

After some experience in mining and electrical construction work, he joined the staff of Phillips Electrical Works Limited and later transferred to Canadian Telephones and Supplies Limited, serving as manager of the company's offices in Regina, Winnipeg, Edmonton and Ottawa.

Dr. J. M. Thomson, M.E.I.C., who has served as general manager of Ferranti Electric Limited in Toronto since 1947, and as vice-president and general manager since 1948, has been appointed president of the company, succeeding the late A. B. Cooper, M.E.I.C.



Dr. J. M. Thomson, M.E.I.C.

Mr. Thomson was born in Couva, Trinidad. He received his B.A.Sc. and M.A.Sc. degrees from the University of Toronto in 1923 and 1933 and in 1937 he obtained his Ph.D. degree from the same university.

In 1950 Mr. Thomson served as a member of the Advisory Council of the Canadian Welding Bureau, a division of the Canadian Standards Association.

Lloyd T. Holmes, M.E.I.C., has been appointed deputy minister of the Department of Highways of the Province of Saskatchewan.

Mr. Holmes was born near Assiniboia, Sask. After attending the local rural school and the Assiniboia High School, he completed one year at the Montana School of Mines, and then transferred to the University of Saskatchewan where he graduated in civil engineering in

Lloyd T. Holmes, M.E.I.C.

1945. During his undergraduate years he was employed during vacations with the Department of Transport on airfield construction and with the Federal Department of Agriculture, P.F.R.A., on irrigation surveys.

Mr. Holmes joined the Saskatchewan Department of Highways as resident engineer in the construction branch in 1945. He was appointed supervising engineer in the Regina area early in 1949, and became construction engineer in the summer of the same year. He received his appointment as chief engineer in 1952. His present appointment became effective in November, 1954.

He is a member of the Association of Professional Engineers of Saskatchewan.

A. W. G. Clark, M.E.I.C., the first Canadian to be elected to the presidency of the American Concrete Pipe Association, has this year travelled extensively and made numerous speeches on the Association's behalf.

President of British Columbia Concrete Pipe Company Limited in Vancouver, Mr. Clark heads all of the committees of the Association in actual or ex-officio capacity and attends most of the meetings. According to Howard F. Peckworth, the Association's managing director, Mr. Clarke has done more than any other to make the concrete pipe manufacturers of the United States aware of the potentialities of Canada and of the outstanding relationships between the two nations.

Mr. Clark addressed the Association's Fourth Annual Short Course School of Instruction in St. Louis, Missouri. While there, he reported on progress made in Washington, D.C., in the recognition of roughness differentials between concrete and corrugated pipe and on the progress made thus far in establishing national criteria for bedding and backfilling of concrete pipe culverts. He also reported on the Association's executive committee meeting held in Jasper Park around the first of September, 1954.

A. W. G. Clark, M.E.I.C.

After the St. Louis meeting, Mr. Clark made an extensive tour of the Southeastern part of the United States and attended the meeting of the Southeastern Concrete Pipe Association in Charleston, South Carolina.

He will preside over the 47th Annual Convention of the Association in Boston on March 9 to 12, 1955. It has been noted that some of the most enthusiastic participation at the meetings and some of the outstanding research done in the concrete pipe industry have come from the Canadian member companies.

C. H. Drury, O.B.E., M.E.I.C., has been appointed vice-president and manager of Canadian General Transit Company, Limited, succeeding E. W. Wilson who is retiring. Mr. Drury was formerly vice-president in charge of purchasing for Canadian Car and Foundry Company Limited.

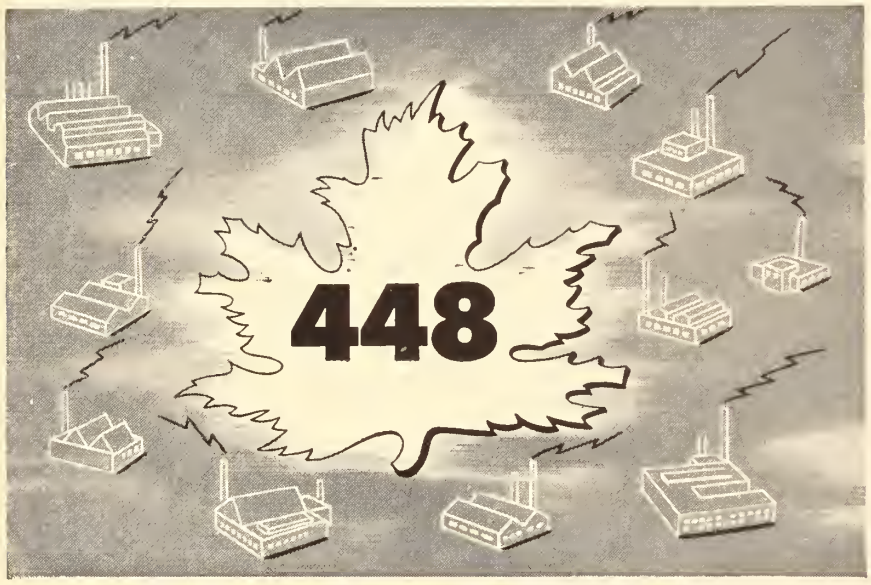
He obtained his chemical engineering degree from McGill University, and after service overseas during World War II, attended the Harvard Graduate School of Business, graduating as Master of Business Administration. He rejoined Canadian Car and Foundry, serving in various capacities in sales engineering and management as a vice-president of the corporation.

Mr. Drury is president and director of Quebec Industries Limited, and a director of Canadian General Transit Company Limited, the Provincial Transport Company, and Cancargo Aircraft Manufacturing Company Limited.

J. E. Harris, M.E.I.C., project manager of Dow Chemical of Canada Limited in Sarnia, has been elected chairman of the Sarnia Branch of the Institute for the year 1955.

Mr. Harris was born in Vancouver. After attending Kitsilano High School, he received his B.A.Sc. degree in chemical engineering from the University of British Columbia in 1938. In 1942 he obtained his M.A.Sc. degree from the same university.

He joined Canada Roof Products in 1938, and two years later entered the Harris Paint and Wallpaper Company as technical and sales engineer.



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J. E. Harris, M.E.I.C.

Mr. Harris became associated with Dow Chemical of Canada, Limited in 1942 as instrument engineer, and has progressed through the positions of maintenance superintendent, works engineer and construction manager to his present position of project manager.

He is chairman of the board of the Sarnia General Hospital, and a member of the Sarnia Chamber of Commerce and of the Association of Professional Engineers of Ontario.

Group Captain C. V. Trites, R.C.A.F., M.E.I.C., has been transferred from Bois le Roi, France, to Montreal where he is chief of the construction division of the Royal Canadian Air Force.

Group Captain Trites received his engineering education at Dalhousie University and was afterwards employed in the engineering department of Canadian National Railways and the New Brunswick Department of Highways. At the outbreak of World War II he was associated with Boeing Aircraft of Canada Limited in Vancouver, and in 1942 was commissioned in the construction engineering branch of the Royal Canadian Air Force.

H. L. Briggs, M.E.I.C., general manager of the City of Winnipeg's Hydro Electric System since 1951, has joined the B.C. Power Commission in Victoria as general manager and chief engineer.

Mr. Briggs, a native of Killarney, Man., graduated in electrical engineering from the University of Manitoba in 1938. He was associated with the Winnipeg system from that time until his present appointment, and held successively the positions of electrical draughtsman, assistant to the chief operator, relay engineer, operating engineer, assistant general manager and general manager.

He is a past councillor and chairman of the Winnipeg Branch of the Institute. He is also a past president of the Manitoba Electrical Association, a member of the American Institute of Electrical Engineers, the Winnipeg Chamber of Commerce, and a director of the Industrial Development Board of Greater Winnipeg.

H. L. Briggs, M.E.I.C.

Ernest Lavigne, O.B.E., M.E.I.C., former fire commissioner for the Province of Quebec, has been librarian of Ecole Polytechnique since April, 1954.

Mr. Lavigne graduated in civil engineering from Ecole Polytechnique in

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1916. Two years later he became associated with the Department of Public Works and Labour in Quebec and subsequently went into private practice. He held the position of fire commissioner of the province since 1926.

Mr. Lavigne is a past-president of the Corporation of Professional Engineers of Quebec, and served as councillor of the Engineering Institute in 1945, 1946 and 1947.

Leo McLaren, M.E.I.C., formerly assistant district engineer of the Department of Public Works of Canada in Rimouski, Que., has been appointed district engineer in Quebec City.

A civil engineering graduate of McGill University, class of 1924, Mr. McLaren joined the Department of Public Works in 1944 as senior assistant engineer. He became acting district engineer later in the same year and was appointed assistant district engineer in 1947.

J. E. Pickering, M.E.I.C., has recently been transferred by the Du Pont Company of Canada Limited from the position of senior engineering assistant at the Maitland Works to that of industrial sales development representative in the textile fibres division in Montreal.

Mr. Pickering joined Canadian Industries Limited in Montreal in 1952, previous to which he was employed by Price Bros. and Company Limited at Jonquière, Que.

He is a 1946 mechanical engineering graduate of the University of Saskatchewan.

Lt.-Col. R. J. Carson, M.E.I.C., has been appointed command engineer at Western Command headquarters in Edmonton.

Col. Carson has previously served as command engineer officer with Eastern Command in Halifax, and as G.S.O. 1 to the chief engineer of the Canadian Army.

He is a graduate of the Royal Military College, class of 1936, and of Queen's University, class of 1937.

H. J. A. Chambers, M.E.I.C., has been named president of Modern Tool Works Limited in Toronto.

H. J. A. Chambers, M.E.I.C.

A B.Sc. and M.A.Sc. graduate in civil engineering of the University of Toronto, class of 1924 and 1925, Mr. Chambers is also president and general manager of Standard Machine and Tool Company Limited in Windsor, Ont.

He is a member of the Society of Automotive Engineers and of the American Society of Tool Engineers.

J. W. Tomlinson, M.E.I.C., general manager of the Saskatchewan Power Corporation, has been appointed assistant sales manager of Trans-Canada Pipe Lines Limited in Calgary. He will be located at Trans-Canada's sales headquarters in Toronto.

J. W. Tomlinson, M.E.I.C.

Mr. Tomlinson brings to his new post five years' experience gained as general manager of the Saskatchewan Power Corporation. He was one of the leaders in the development of the Saskatchewan natural gas industry, as it was during his term of office that the gas utility phase of the Corporation's activities was established. As general manager, he negotiated and carried out contracts for step-out drilling to establish natural gas reserves; he negotiated the contracts for construction of the gathering system in the gas fields, and the construction of over 100 miles of high pressure gas pipeline. Contracts for the construction of the gas distribution systems for one city and eight towns were also his responsibility, as was the contract for the sale of natural gas to the City of Saskatoon. In addition, he was vice-chairman of the government-appointed Advisory Committee on Natural Gas Development in Saskatchewan.

Mr. Tomlinson was born in Winnipeg. He graduated from the University of Manitoba in 1930 with a B.Sc. degree in electrical engineering and went immediately into the utility field. He joined the Winnipeg Electric Company as assistant construction engineer and rose to assistant distribution superintendent in 1933. In 1935 he became assistant general superintendent with the Manitoba Power Commission. He became chief engineer, and subsequently, assistant general manager before joining the Saskatchewan Power Commission as assistant general manager in 1947.

Frank H. Midgley, M.E.I.C., who recently became a Life Member in the Institute, has been elected alderman on the city council of Galt, Ont., for another two-year term.

Mr. Midgley retired from active engineering work with Canadian Pacific Electric Lines in Preston, Ont., in 1951

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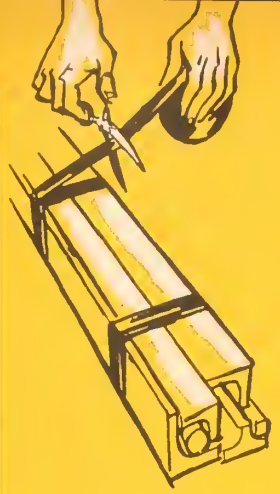

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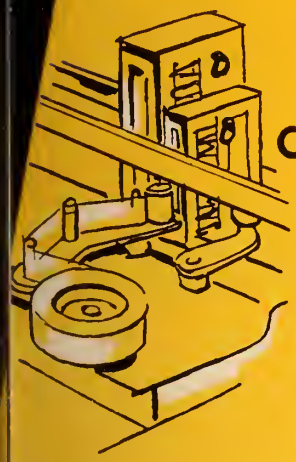

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after 36 years of service with that company.

He served as councillor of the Institute representing the Kitchener Branch in 1950.

M. B. M. Lawson, M.E.I.C., former professor in the School of Architecture of the University of Toronto, has been appointed executive director and secretary-treasurer of the City of Toronto Planning Board.

Previous to his association with the University of Toronto, Mr. Lawson was on the civil engineering department staff of the University of British Columbia.

He received his B.Sc. and diploma in civil engineering from the Royal Technical College in Glasgow in 1943.

R. V. Tomkins, M.E.I.C., director of industrial minerals research with the Saskatchewan Department of Mineral Resources, has joined Aggregates and Construction Products Limited in Regina.

Mr. Tomkins received his B.Sc. degree in chemical engineering from the University of Saskatchewan in 1944 and immediately afterwards joined the staff of the National Research Council as assistant research engineer in the applied biology division.

He joined the Department of Natural Resources in Regina in 1947, becoming director of the resources utilization branch in February, 1953, and director of industrial minerals research in August, 1953.

J. Roderick Wallace, M.E.I.C., has been appointed chief metallurgist of Dominion Iron and Steel Limited. He was previously director of research and development for the laboratory department in Sydney, N.S.

J. R. Wallace, M.E.I.C.

Mr. Wallace was born in Westville, N.S. He graduated in metallurgical engineering from McGill University in 1940. He first started working at the Sydney steel plant during vacations and was employed as a labourer in the open hearth department in 1939. In 1940 he joined the permanent staff and remained there until his enlistment in 1942. After the war he returned to the open hearth department and was appointed observer. He transferred to the coke ovens department, and became assistant superintendent. In 1946 he was appointed assistant director of research and development.

Mr. Wallace is a member of the Canadian Institute of Mining and Metallurgy, and served as chairman of the Cape Breton Branch of the Engineering Institute in 1953-4.

William M. Stewart, M.E.I.C., deputy minister of the Department of Highways and Transportation for the past two years, and a staff member of the department for 17 years, has retired from his government post.

Mr. Stewart joined the provincial department of highways in 1937 as a resident engineer. In 1942 he was promoted to maintenance engineer, and seven years later to chief engineer. In 1952 he was appointed deputy minister.

Mr Stewart was born in Hamilton, Ont., and received his elementary and high school education in that city. He graduated with an enginering degree from the University of Toronto in 1909. Following post-graduate studies at the university, he went to Saskatoon where he was in private engineering practice until joining the provincial government in 1937.

Mr. Stewart received his commission in 1910 as a Dominion and Saskatchewan Land Surveyor. He is a member of the Association of Professional Engineers of Saskatchewan.

James Edwin Thom, M.E.I.C., has joined the staff of H. H. Angus and Associates, consulting mechanical engineers, in Toronto.

Previous to joining the company, Mr. Thom was mechanical engineer on the staff of Page and Steele, architects of Toronto.

He graduated from the University of Toronto in mechanical engineering in 1932. Two years later he became associated with Imperial Oil Limited at the Regina refinery, and in 1941 was appointed plant engineer with Defence Industries Limited at the small arms ammunition works in Montreal. At the close of the war he became resident engineer on construction work with Canadian Industries Limited in Kingston. He was named in 1947 assistant superintendent on construction at the University of Toronto.

Mr. Thom is a member of the Association of Professional Engineers of Ontario.

G. A. Kirner, JR.E.I.C., of the N.B. International Paper Company in Dalhousie, has been elected chairman of the Northern New Brunswick Branch of the Institute succeeding G. A. Robb, JR.E.I.C., who has joined Atomic Energy of Canada Limited at Chalk River, Ont.

Mr. Kirner was born in Montreal. He attended Westmount High School after which he completed three years in the faculty of commerce at Sir George Williams College. After the war he attended McGill University, graduating with a civil engineering degree in 1950.

After summer undergraduate experience as instrumentman and estimator with the Foundation Company of Canada, he began his full time engineering career with the New Brunswick International Paper Company in Dalhousie.

P. J. Slattery, M.E.I.C., has been appointed co-ordinator of naval specifications in the Directorate of Engineering Standards and Naval Specifications, Department of National Defence.

Mr. Slattery was previously specifications supervisor with the Directorate of Interservice Development in the same department.

A. G. Herr, M.E.I.C., chief draughtsman and director of Packard Electric Company Limited in St. Catharines, Ont.,

Arthur G. Herr, M.E.I.C.

has retired after 39 years of service with the company. He will continue as a director of the company, a post which he has held for the past 20 years.

Mr. Herr is a member of the Association of Professional Engineers of Ontario.

J. Cooper Antliff, M.E.I.C., former general assistant to the chief engineer of Hydro-Quebec, has been appointed statistician and rate research engineer.

Mr. Antliff, a 1923 graduate of McGill University, was associated with Montreal Light, Heat and Power previous to the formation of Hydro-Quebec.

C. C. McLaren, M.E.I.C., has been appointed resident sales engineer with Brown Boveri (Canada) Limited in Winnipeg where he will serve the Manitoba and Saskatchewan territories.

C. C. McLaren, M.E.I.C.

Mr. McLaren received his degree in mechanical engineering from Cambridge University in 1931. He is a membe

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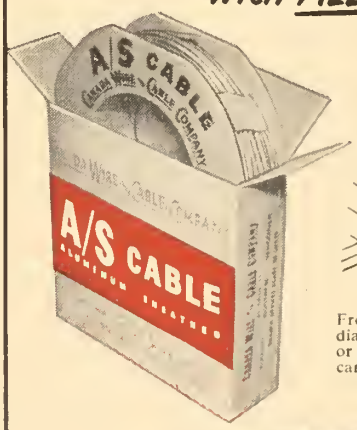

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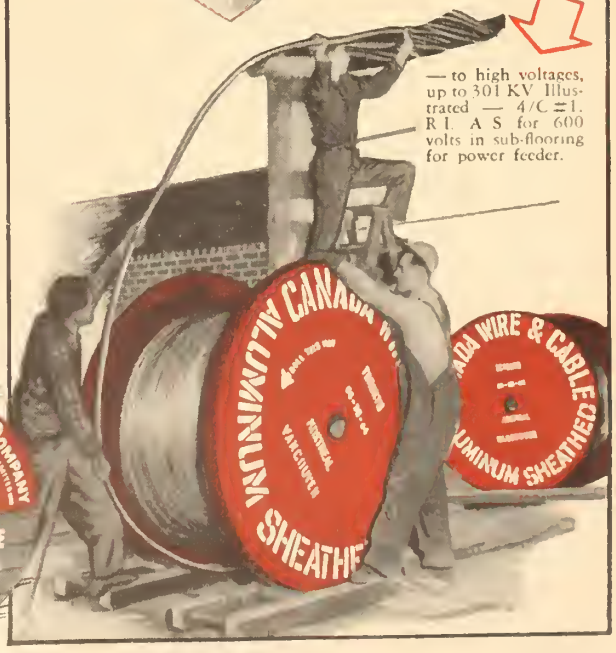

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of the Association of Professional Engineers of Ontario.

R. A. Wyman, M.E.I.C., is on the staff of the industrial minerals division of the Department of Mines and Technical Surveys in Ottawa.

Before joining the department he was associated with Aluminium Laboratories Limited in Arvida, first as research engineer and then as supervisor of mineral dressing research.

Mr. Wyman is a B.Sc. graduate of the University of Manitoba, class of 1934.

J. W. Paterson, M.E.I.C., who has served as woodlands manager of the E. B. Eddy Company since 1937, has been appointed vice-president in charge of woodlands.

Kenneth R. Pattison, M.E.I.C., formerly assistant city engineer with the City of Saskatoon, has been appointed city engineer, succeeding **D. A. R. McCannel,** M.E.I.C., who will retire in May of this year after 42 years' civic service.

Mr. Pattison received his civil engineering degree from the University of Saskatchewan in 1942.

A. M. McQuarrie, M.E.I.C., has been transferred from International General Electric Company in Schenectady, to Buenos Aires, Argentina.

Mr. McQuarrie was previously general manager of the company's services division in Schenectady. Prior to that appointment he was works engineer at the Quebec Works of Canadian General Electric Company in Quebec City.

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He is a 1941 electrical engineering graduate of the University of Alberta.

Edgar Lion, M.E.I.C., has joined Montrose Builders Inc. of Montreal as chief project engineer. Previous to this appointment he was for seven years associated with Louis Donolo, Inc. as engineer and chief estimator.

Mr. Lion is a graduate in civil engineering of McGill University, class of 1945.

C. R. Usher, M.E.I.C., has set up his own company in South Burnaby, B.C., under the firm name of Usher Laboratories Limited, consulting chemical engineers. The company of which Mr. Usher is president also specializes in laboratory service on petroleum products and general analysis, and manufactures solvents and chemicals on a limited scale.

Mr. Usher, who was previously associated with Imperial Oil Limited in Regina, is a 1947 chemical engineering graduate of the University of Saskatchewan.

J. B. Sweeney, M.E.I.C., has been promoted to the position of assistant to the division manager of Consolidated Paper Corporation Ltd. in the Port Alfred division.

Previous to this appointment, Mr. Sweeney was assistant to the general superintendent of the Laurentide division.

Mr. Sweeney is a chemical engineering graduate of the University of Saskatchewan, class of 1941.

W. A. Wyszkowski, M.E.I.C., previously associated with the Toronto Transportation Commission, has joined the staff of DeLeuw, Cather & Co. Ltd. in Toronto.

A civil engineering graduate of the Warsaw Polytechnic, Mr. Wyszkowski was supervisor of plans with the Commission.

H. B. Tafelmacher, M.E.I.C., has been transferred by Aluminum Company of Canada Ltd. from Shawinigan Falls to Montreal. Previous to his transfer he was metallurgist on the staff of the technical department.

Mr. Tafelmacher graduated in mechanical engineering from the Federal Institute of Technology in Zurich in 1946.

R. Reid Scott, M.E.I.C., of Bathurst Power and Paper Co. Ltd. in Bathurst, N.B., has joined the engineering department staff of Fraser Companies Limited in Edmunston, N.B.

Mr. Scott is a 1948 electrical engineering graduate of the University of New Brunswick.

B. Paul Wisnicki, M.E.I.C., who graduated in mechanical and aeronautical engineering from Lwow University, Poland, in 1936, is now structural engineer on the staff of the St. Lawrence River Joint Board of Engineers.

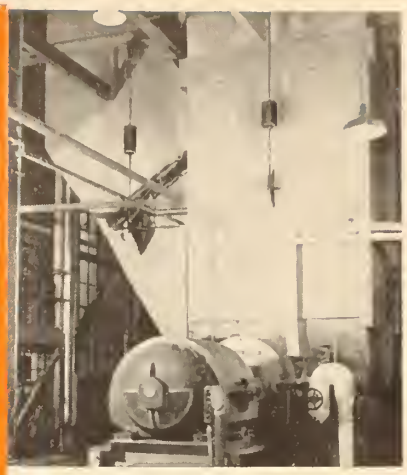
He was previously assistant professor at the University of British Columbia and also a partner in Porter, Chard, Wisnicki, architects and engineers, in Vancouver.

W. R. Sadler, M.E.I.C., formerly on the staff of General Construction Co. (Alberta) Ltd. in Lethbridge, is now associated with Superior Masonry Products Ltd. in Lethbridge.

Previous to joining the General Con-

Base for supporting refinery tower, provided with Grinnell Spring Hangers for flexible support.

Grinnell Spring Hangers on large vessel of catalytic crocking unit in oil refinery.



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Precompression* assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.

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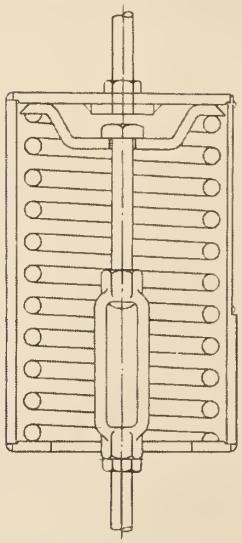
- 18 sizes available from stock — load ranges from 53 lbs. to 12,000 lbs.
- Easy selection of proper sizes from simple capacity table.
- Installation is simplified by integral load scale and travel indicators.

*Precompression is a patented feature.



VARIABLE SPRING HANGER FIG. B-268

Fig. B-268, Type A, is designed for attachment to its supporting member by screwing a rod into a bushing in the top cap af the hanger. Adjustment of the hanger load is accomplished by turning the turnbuckle on the lower hanger rod until the hanger picks up the load and the lood indicator points to the desired position. Six other types of attachment are available.

Grinnell Variable Spring Hangers are also available in half sizes (Fig. B-82); and in double spring sizes (Fig. B-98).

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struction Company, Mr. Sadler was associated with the Department of Public Works of Alberta as resident engineer in the highways branch, and with Alberta Transit Mix Concrete Co. Ltd. as chief engineer.

Ross E. Clarke, M.E.I.C., has been named inspecting engineer with the Ontario Department of Highways. Previous to this appointment, he was division engineer with the Department in Stratford, Ont., and in North Bay, Ont.

A graduate civil engineer of Queen's University, class of 1935, Mr. Clarke has been associated with the Department since 1946, prior to which he was resident engineer with the Department of Transport.

Frank A. Ross, M.E.I.C., has been appointed assistant to the Montreal branch manager of British General Electric Company Canadian Limited. He was formerly chief estimator of Bepco Canada Limited in Montreal.

Mr. Ross obtained his higher national certificate in electrical engineering from the Birmingham Central Technical College in 1947.

R. H. King, M.E.I.C., is founder and president of Panel Controls Limited which has recently entered the switchgear and control equipment manufacturing field in Montreal.

Mr. King was born in England and received his electrical engineering degree from London University in 1937. During World War II he was commissioned

R. H. King, M.E.I.C.

in the Royal Electrical and Mechanical Engineers and was in command of mobile workshops serving throughout Europe and the Middle East. He came to Canada in 1950 and joined Bepco Canada Limited, subsequently becoming head of the switchgear estimating department.

J. G. Myrdal, JR.E.I.C., is associated with International Engineering in San Francisco, Cal. He was previously employed on Kemano powerhouse and switchgear installation.

Mr. Myrdal is a 1951 graduate in electrical engineering of the University of Manitoba.

C. H. Baker, JR.E.I.C., has recently been transferred from Montreal to Exshaw, Alta., as plant engineer with Canada Cement Co. Ltd. Previous to his transfer he held the position of kiln supervisor.

Mr. Baker is a 1951 graduate in engineering physics of Queen's University.

Edwin W. Rendell, JR.E.I.C., has been transferred by T. C. Gorman (Nova Scotia) Ltd. from North Sydney to Halifax.

He is a civil engineering graduate of the Nova Scotia Technical College, class of 1951.

R. H. Reynolds, JR.E.I.C., has been transferred to the Calgary branch of Babcock-Wilcox and Goldie-McCulloch Limited from the Galt, Ont., office which he joined as sales engineer in 1953.

Mr. Renvolds was associated with Canadian General Electric Company Limited in Toronto upon graduation in electrical engineering from the University of Alberta in 1951.

J. D. Flintoft, JR.E.I.C., has been appointed assistant to the general superintendent of the Canadian Pacific Railway Company in Calgary. Previous to this appointment he was with the company in Winnipeg.

Mr. Flintoft graduated in civil engineering from McGill University in 1951.

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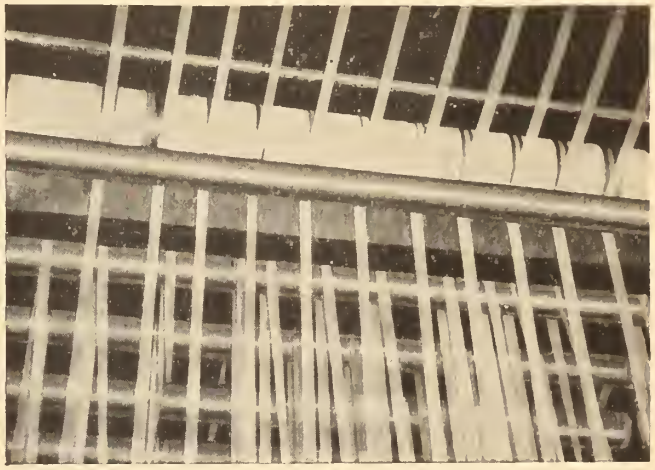

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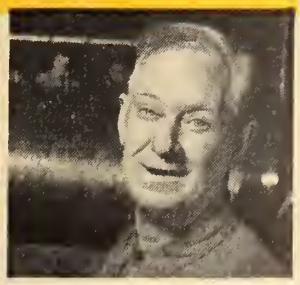
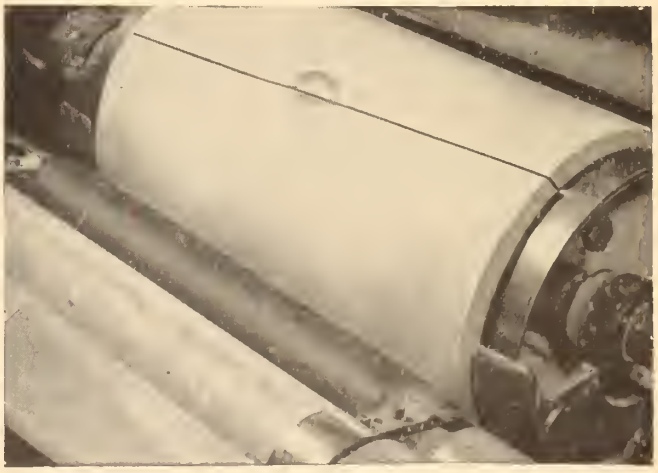


Another member of the 25-year Club is Alfred McKeown who has worked in the Mill Room since 1924.



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Robert A. Dunn, JR.E.I.C., is design engineer in the precast division of Cooksville Company Limited in Toronto.

A graduate in civil engineering of McGill University, class of 1951, Mr. Dunn was previously associated with Dominion Tar and Chemical Limited of Toronto and with Fraser-Brace Engineering Company of Montreal.

R. F. Murfitt, JR.E.I.C., a 1951 graduate in civil engineering of the University of British Columbia, has been appointed plant engineer by Peerless Rock Products Ltd. in Calgary. He was formerly district engineer with the Department of Public Works in Golden, B.C.

A. J. Ceresino, JR.E.I.C., is associated with Canadian Radio Manufacturing Corporation as industrial engineer in Toronto.

Mr. Ceresino received his B.A.Sc. degree in engineering and business from the University of Toronto in 1951.

A. L. Lemoine, JR.E.I.C., formerly signals draughtsman on the staff of the Canadian Pacific Railway Company in Winnipeg, has joined the air services branch of the Department of Transport in Winnipeg.

Mr. Lemoine graduated in electrical engineering from the University of Manitoba in 1951.

Thos. E. Smith, JR.E.I.C., has recently joined the industrial division staff of M. M. Dillon & Company Limited, consulting engineers of London and Toronto.

After graduating in electrical engineering from the University of British Columbia in 1951, Mr. Smith was employed by Northern Electric Company Limited in Montreal. A year later he joined the staff of the Atlas Steels Corporation of Welland where he served on the design and layout of electrical equipment for two years.

T. E. Smith, JR.E.I.C.

Mr. Smith is a member of the Association of Professional Engineers of Ontario and of the American Institute of Electrical Engineers.

H. Fealdman, JR.E.I.C., has been appointed assistant general manager of the Ontario Road Builders' Association of Toronto.

A graduate of Cambridge University, Mr. Fealdman was engaged in industrial, consulting and research engineering before coming to Canada in 1952 when he joined the Hydro-Electric Power Commission of Ontario. While with the Commission one of his main interests was the development of prestressed concrete in Canada.

H. Fealdman, JR.E.I.C.

He was secretary of the Organizing Committee of the Canadian Conference on Prestressed Concrete held in Toronto in January, 1954, and he also presented a paper, "An Introduction to the Theory of Prestressed Concrete" at that conference.

Much of Mr. Fealdman's research work has been published in the British technical press.

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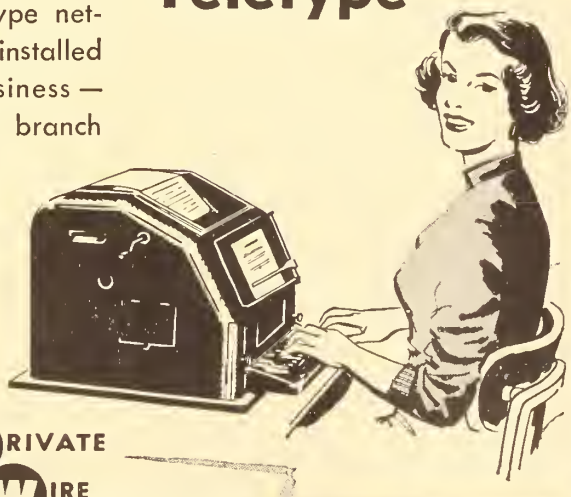

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E. S. Bengston, Jr.E.I.C., has just completed a two-year training course with the English Electric Company in St. Catharines, Ont., and has been appointed assistant district service engineer in the company's Calgary branch.

Mr. Bengston graduated in mechanical engineering from the University of British Columbia in 1952.

J. Looyestein, Jr.E.I.C., has joined the engineering staff of the City of Calgary. He was previously engaged in surveying work with P.F.R.A. in Vauxhall, Alta.

Mr. Looyestein is a graduate in civil engineering of Delft University, class of 1952.

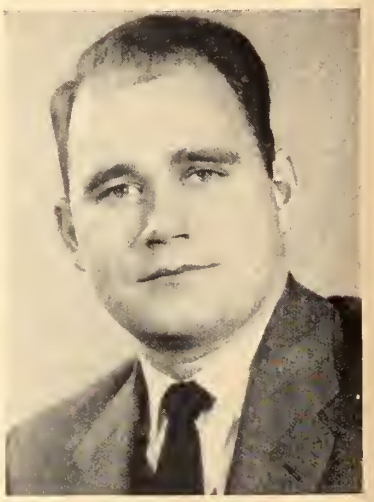
William Reginald MacLean, Jr.E.I.C., is on the staff of the Trans-Canada Highway in Field, B.C. Previously he was associated with the Department of Public Works and Highways in Charlottetown.

Mr. MacLean is a civil engineering graduate of the Nova Scotia Technical College, class of 1952.

Thomas A. Lambe, Jr.E.I.C., is assistant research engineer in the division of engineering of the British Columbia Research Council in Vancouver.

Mr. Lambe is a 1952 electrical engineering graduate of the University of British Columbia.

W. D. Parsons, Jr.E.I.C., is associated with Compania Minera Choco-Pacifico, a gold and platinum dredging operation in Call, Colombia, and he has recently been appointed mechanical superintendent in charge of mechanical maintenance, plant construction, land and water transportation.



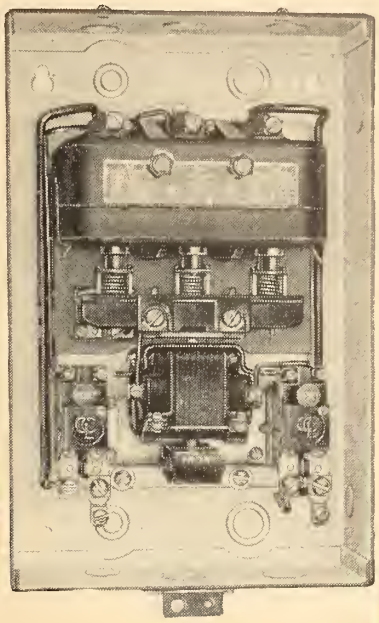
W. D. Parsons, Jr.E.I.C.

A native of Chandler, Que., Mr. Parsons received his schooling in East Angus and Shawinigan Falls, and was granted his B.Eng. degree in mechanical engineering by McGill University in 1952. Upon graduation he joined the engineering department of Abitibi Power and Paper Co. Ltd. in Sturgeon Falls.

During 1953-54 he served on the branch executive as Sturgeon Falls representative of the Nipissing and Upper St. Lawrence Branch of the Institute, and during the previous year was active on the papers, membership and entertainment committees.

Type "CY" AC Magnetic MOTOR STARTER

Everything you want in a starter IS HERE



SIMPLE INSTALLATION
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EASY INSPECTION
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MINIMUM MAINTENANCE
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UNSURPASSED PERFORMANCE

- ✓ No filing . . . dressing or cleaning of contacts!
- ✓ No tools required to inspect contacts!
- ✓ Easy to change moving contacts!
- ✓ Stationary contacts changed quickly!
- ✓ Remove only two screws and one pin to change coils!
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- ✓ Power circuit contacts available with springs . . . in complete packaged service kits for ease in stocking!

MAGNETIC FIELD QUENCHES ARC!

C.C.L. . . . type "CY" starters . . . sizes 2 and 3, employ an entirely new principle of arc interruption. The arc is extinguished by the effect of a blow-out coil, concentric with the contact. The magnetic field quenches the arc either by lengthening or confining it. Due to forced rotation, the arc moves continuously from a hot to a cold spot, thereby minimizing burning or pitting of contacts. The ingenious design of the arc chamber prevents carbonization and the accumulation of hot gases between wiring terminals . . . minimizing phase-to-phase failures. Size 1 is not magnetic but is built with the same mill-type construction as the larger sizes.

Specializing exclusively in the manufacture of a complete line of A.C. and D.C. Electric Motor Control.

Canadian Controllers Limited
TORONTO - CANADA

SALES REPRESENTATIVES
RAILWAY & POWER ENGINEERING Corporation Limited
NEW GLASGOW • QUEBEC • MONTREAL • NORANDA
OTTAWA • NORTH BAY • TORONTO • HAMILTON
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William A. Turmeau, JR.E.I.C., who graduated in mechanical engineering from the University of Edinburgh in 1952, is on the staff of the air installations office of the United States Air Force at Goose Bay, Labrador.

Prior to this appointment he was employed in the mechanical design department of Northern Electric Limited.

B. A. Grecoff, JR.E.I.C., formerly assistant resident engineer with the Quebec Hydro Electric Commission on the Bersimis development, has been appointed field engineer with the St. Lawrence Seaway Authority in the Lachine section.

Mr. Grecoff is a 1952 civil engineering graduate of the University of Manitoba.

James J. Abel, JR.E.I.C., is on the staff of J. B. Parkin Associates as structural engineer in Toronto.

A 1952 civil engineering graduate of the University of Toronto, Mr. Abel was previously structural engineer with C. P. Brzozowicz in Toronto.

George S. Williams, JR.E.I.C., is now manufacturing methods engineer with Northern Electric Co. Ltd. in Montreal. Previous to this appointment he was in England as an Athlone Fellow during which time he followed a course in production engineering in the aero-engine division of Rolls Royce Limited and at the University of Birmingham.

Mr. Williams graduated from McGill University in mechanical engineering in 1952.

R. C. Miller, JR.E.I.C., who was previously associated with Alexander Construction Limited in Edmonton, has joined the Larwill Construction Company in Calgary.

Mr. Miller undertook his civil engineering study at the University of Alberta, graduating in 1953.

A. H. Austin, JR.E.I.C., former field engineer with Stone & Webster Canada Limited in Trail, B.C., has joined the Hydro-Electric Power Commission of Ontario in Toronto as design engineer.

Mr. Austin graduated in civil engineering from the University of Toronto in 1953.

Clarence R. Thompson, JR.E.I.C., a civil engineering graduate of the Nova Scotia Technical College in 1953, has joined the staff of Dr. D. B. Steinman, consulting engineer, of New York. He was previously associated with Ebasco Services Inc.

Gordon W. Spratt, JR.E.I.C., field engineer with the City of Regina's waterworks department, has been awarded a Miron Fellowship in Concrete Studies, and has returned to McGill University for his master's degree in civil engineering.

Mr. Spratt received his B.Eng. degree in civil engineering from McGill University in 1953.

Jacques Lavigne, JR.E.I.C., was recently appointed project engineer with Sogemines Limited and Kemet Limited of Montreal.

A 1953 civil engineering graduate of McGill University, Mr. Lavigne was previously draughtsman with Surveyer, Nenniger and Chenevert Ltd. of Montreal.

Douglas A. Law, JR.E.I.C., who received his B.Sc. degree in mechanical engineering from Queen's University in 1953, has joined the staff of Northern Electric Company Limited in Belleville, Ont.

Bruce H. White, JR.E.I.C., has been appointed equipment engineer in the special contracts department of the Bell Telephone Company of Canada in Montreal.

He is an electrical engineering graduate of Queen's University, class of 1953.

Murray E. McRae, S.E.I.C., previously associated with Storm Construction Co. Ltd. in Toronto, has been appointed township engineer of Terrace Bay, Ont.

Mr. McRae graduated in civil engineering from McGill University in 1953.

William A. Giles, S.E.I.C., a 1954 graduate in mechanical engineering of the University of Toledo, is employed as assistant production engineer on the staff of the United States Gypsum Company in Genoa, Ohio.

Robert F. Gurr, S.E.I.C., who graduated in mechanical engineering from Queen's University in 1954, has joined the general engineering department staff of Aluminum Company of Canada Limited in Montreal.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

J. Reginald Freeman, M.E.I.C., former senior assistant engineer with the Department of Public Works of Canada in Saint John, New Brunswick, passed away at St. Joseph's Hospital in Saint John on December 16, 1954.

Mr. Freeman was born at Milton, Queen's County, Nova Scotia, on March 29, 1881. After attending high school and the academy in Liverpool, Nova Scotia, he obtained his railway engineering study through the International Correspondence School and in 1902 began his career as chainman and rodman with the Department of Railways and Canals. In April of the following year he was commissioned deputy crown land surveyor for the Province of Nova Scotia. He was employed for a year and a half as rodman on the construction of the western division of the Halifax and Southwestern Railroad, and also served as instrumentman for the late A. True, M.E.I.C., and as resident and assistant bridge engineer for a year on the James Bay Road. In 1906 he was appointed resident engineer on the Transcontinental Railroad.

Mr. Freeman joined the Department of Public Works of Canada in Halifax in 1909, remaining there until 1924 when he was transferred to Saint John. He occupied the position of senior assistant engineer until his retirement in 1946.

He joined the Engineering Institute of Canada as a Student in 1904, transferring to Associate Member in 1910 and to Member in 1918. Mr. Freeman was granted Life Membership in the Institute in 1941.

Alfred Douglas Creer, M.E.I.C., former registrar of the Association of Professional Engineers of British Columbia, passed away in Vancouver on September 8, 1954.

Mr. Creer was born in Halifax, England, on May 24, 1878. He received his education at St. Peter's in York and at Yorkshire College in Leeds, and began his engineering career at the age of 16 in the H. Leethams Mills in York and as an articled pupil to the York city engineer. In 1898 he joined the staff of James Mansergh and Sons as engineering assistant, becoming chief assistant resident engineer on the Exmouth main drainage works in 1901. During the next eight years he served as company resident engineer on the Rochdale waterworks pipe line and on the Plymouth main drainage works. He opened his offices as consulting engineer in York in 1909.

He came to Canada in 1911 and that same year was appointed assistant engineer in the department of works of the City of Toronto. A year later he went to Vancouver where he joined the staff of Vancouver and District Joint Sewerage and Drainage Scheme with which he held the post of chief engineer from 1913 until 1917. In 1918 he began his long career as a consulting engineer in Vancouver.

Mr. Creer, one of the original members of the Association of Professional Engineers of British Columbia, was appointed registrar of the Association in 1941 and served as such for eight consecutive years. He was instrumental in starting *The Blue Print,* the original journal of the British Columbia Engineering Society. He was appointed to life membership in the Association in 1948. He was also a member of the Institution of Civil Engineers.

He joined the Engineering Institute of Canada in 1911 as an Associate Member, transferring to Member in 1914. He served as chairman of the Vancouver Branch in 1928-29, and in 1942 was granted Life Membership in the Institute.

Orville Rolfson, M.E.I.C., Ontario and dominion land surveyor in Windsor, Ontario, passed away in hospital there in July, 1954.

Mr. Rolfson was born at Blytheswood, near Leamington, Ontario, on February 26, 1885. In 1903 he entered the School of Practical Science (University of Toronto), and graduated with honours in mining engineering in 1906. He obtained his degree from the university in 1907.

During his undergraduate days he was employed in machine shop work with the Pere Marquette Railway at Walkerville, Ontario; as rodman on Michigan Central Railway construction; chainer on a northern Ontario survey; and on local work with Owen McKay of Walkerville.

Upon graduation in 1907 he became assistant to A. G. Stacey on a dominion land survey in the railway belt of British Columbia, and the following year fulfilled the requirements for his commission as a dominion land surveyor. In 1908 he became a fellow in surveying at the University of Toronto.

During 1909 and 1910 he was placed in charge of miscellaneous subdivision parties under the Surveyor General, and in 1911 was responsible for a party running the twenty-second base line in the Peace River block. The following season he ran nearly 400 miles of base line north of the province of Manitoba.

Mr. Rolfson served with the Canadian Expeditionary Forces with the rank of lieutenant from 1916 until the close of World War I, and afterwards returned to his private practice as civil engineer and land surveyor in Windsor.

He joined the Engineering Institute as a Student in 1907, transferring to Associate Member in 1912 and to Member in 1940. Mr. Rolfson attained Life Membership in the Institute in 1951.

Charles Joseph Harrison Townsend, M.E.I.C., former vice-president of the Russell Construction Company Limited of Toronto, passed away on September 30, 1954.

Mr. Townsend was born in London, Ontario, on April 19, 1885. He graduated from the School of Practical Science (University of Toronto) in 1904, and received his B.A.Sc. degree from the university in 1905. In 1917 the university granted him the degree of Civil Engineer.

In 1905 Mr. Townsend joined the Canada Foundry Company in Davenport, Ontario, as draughtsman, and two years later became checker and designer with the McMyler Manufacturing Company in Cleveland, Ohio. During 1908 and 1909 he was assistant to the mechanical engineer of The Arnold Company, engineers and constructors in Chicago, and the two following years was employed on design, construction and installation of machinery with the Federal Brass Works and the Liquid Carbonic Company, both of Chicago.

During 1912 to 1914 he was a member of the firm Wilson, Townsend and Saunders in Moose Jaw, Saskatchewan, which was engaged in the construction of reinforced concrete structures, foundations and buildings. The following two years he was engaged in contract work under his own name, during which time he was responsible for the pumping station in Toronto, the sewage disposal and waterworks in Leaside, and two Canadian Pacific and Grand Trunk Railway bridges in Toronto.

Mr. Townsend was appointed chief engineer of the Dominion Shipbuilding Company in Toronto in 1918 and was responsible for the erection of buildings, installation of equipment, purchases contracts and operation.

The following year he became a member of the firm Russell-Townsend Company of Toronto, which was subsequently changed to the name Russell Construction Company Limited. He was for many years vice-president of the firm.

Mr. Townsend joined the Engineering Institute as an Associate Member in 1912, transferring to Member in 1922.

Thomas Stanley Mills, M.E.I.C., formerly chief engineer of the engineering and construction service in the Department of Mines and Resources, died on December 3, 1954.

Mr. Mills was born in Kingston, Ontario, on January 26, 1889. He received his B.A. degree in 1910 and his B.Sc degree with honours in civil engineering in 1911 from Queen's University. In 1915 he was commissioned as a dominion land surveyor.

Mr. Mills began his engineering career as resident engineer on the construction of the Niagara River boulevard in 1910 and the following year served in the same capacity on water supply construction at St. Thomas, Ontario. In 1913 he was appointed assistant city engineer in Prince Albert, Saskatchewan. The year following he was principal assistant on various land surveys in British Columbia, Alberta and Saskatchewan.

He entered the parks branch of the Department of the Interior in Ottawa in 1915 as assistant engineer and by 1920 had been promoted successively to the positions of acting head office engineer, acting chief highway engineer and assistant chief engineer. He was appointed to the post of chief engineer in the engineering and construction branch of the Department of Mines and Resources in 1936 and was responsible for the organization, administration and supervision of all major engineering and architectural works for the national parks of Canada and historic sights, Indian reserves, the Northwest Territories and the Yukon. He also administrated the federal contribution to the provinces for approach roads and tourist highways, portions of which became basic parts of the Trans-Canada Highway. Mr. Mills retired in 1949 after 37 years in the public service.

He was a member of the Association of Professional Engineers of Ontario, the Professional Institute of the Civil Service of Canada, and was formerly a member of the Association of Asphalt Paving Technologists, the American Concrete Association and the Canadian Good Roads Association.

Mr. Mills joined the Engineering Institute of Canada as an Associate Member in 1919 and transferred to Member in 1926. He would have attained Life Membership in the Institute on January 1, 1955.

Arthur E. West, M.E.I.C., manager of operations with Canadian Bridge Company Limited in Walkerville, Ontario, died on December 23, 1954.

Mr. West was born in Ridgetown, Kent County, Ontario, on October 21, 1886. After attending the Howard Township Public School, he furthered his education by means of high school, correspondence and home study.

In 1908 he began his engineering career in the blueprinting and tracing department of Whitehead and Kales in Detroit, and joined the staff of the structural draughting department of Canadian Bridge Company Limited in 1909. He served as checker of structural details for three years and was promoted to squad foreman, which position he held for four years. In 1918 he became assistant manager of construction, and the following year was appointed chief draughtsman. In 1923 he was named manager of operations, the position he held at the time of his death.

Mr. West was a member of the Association of Professional Engineers of Ontario and was very active in the Industrial Accident Prevention Associations, being past chairman of the Essex-Kent division and director of the Steel Erectors Association for a number of years.

He joined the Engineering Institute of Canada as an Associate Member in 1922, transferring to Member in 1930. He was active in the formation of the Border Cities Branch, serving as chairman in 1930 and as councillor in 1931-1932.

Albert Lloyd Huber, M.E.I.C., vice-president in charge of engineering for Link-Belt Limited in Toronto, passed away on December 13, 1954.

Albert Lloyd Huber, M.E.I.C.

Mr. Huber was born in Kitchener, Ontario, on March 19, 1895. He was educated at the Collegiate Institute in Ottawa, and received his mechanical engineering education through the International Correspondence Schools.

He began his engineering career with Ottawa Car Works in 1913 and previous to his enlistment in the Royal Flying Corps in 1917, was associated with Lloyd Blackmore and Company and with Gas Engine and Power Company.

Upon his return from overseas he joined Consolidated Shipbuilding Corporation as chief draughtsman, and in 1922 transferred to the General Motors Corporation in Oshawa where he was employed as chief draughtsman and in the planning department until 1928. After two years as sales engineer with Webster Inglis Limited, he joined Link-Belt Limited in Montreal as chief engineer of the eastern division. In 1946 he was transferred to Toronto as vice-president and chief engineer.

Mr. Huber joined the Engineering Institute as an Associate Member in 1938 and transferred to Member in 1940.

Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

Situations Vacant

CHEMICAL

CHEMICAL ENGINEER or chemist with experience in analysis of metals. Working knowledge of spectographic techniques and practical physical chemistry preferred. Qualified to set up and operate laboratory for control of foundry analysis. File No. 5026-V.

TWO SALES ENGINEERS wanted with plant maintenance experience to sell corrosion resistant cements, coatings, pipes, tanks, etc. We prefer chemical engineers and require one each for Quebec and Ontario. Salary and expenses plus profit sharing. File No. 5071-V.

CHEMICAL ENGINEER or chemist, required preferably with experience in paint, printing inks, rubber or plastics industries. To sell chemicals, oils and colours in Toronto district. Apply fully in writing to file No. 5084-V.

SALES REPRESENTATIVE, required to handle Canadian business of leading chemical manufacturer, working out of New York City with considerable travel in Canada. Age preferably within the range of 25-40 years, university graduate, preferably with degree in chemistry, chemical engineering or agriculture. Good sales experience in agriculture and industrial field would be desirable. Must be American or Canadian citizen. File No. 5102-V.

CIVIL

THE CITY OF HAMILTON requires an assistant engineer. Must be a professional engineer holding a degree of civil engineering as recognized under the Professional Engineers Act of Ontario. Applicant should have a minimum of ten years experience in the design, construction and supervision of engineering projects particularly as related to a large municipality. Will be required to assist and to work in close co-ordination with the city engineer. This position offers an attractive salary, future security and an opportunity for advancement. Reply stating age, experience, education, and relevant information. File No. 5009-V.

STRUCTURAL DESIGN ENGINEER, $6,420 to $7,200, department of Public Works, Ottawa. Details and application forms at nearest Civil Service Commission Office, Post Office, or National Employment Office. Quote Competition 54-1259. File No. 5015-V.

ESTIMATOR REQUIRED with experience in the estimating of the fabrication and erection of structural steel. Location Ontario. File No. 5047-V.

CHIEF DRAUGHTSMAN required. Thoroughly experienced chief draughtsman for structural steel plant. Complete details of educational and employment background and salary required. File No. 5047-V.

SALES ENGINEER for promotion and sales in professional field with background in structures and construction required by firm specializing in prestressed and precast concrete throughout Canada. Position offers salary and commission, participation in company's hospitalization and pension plans. Applicants should give full details including age, education and background, experience, marital status, salary requirements. File No. 5049-V.

ESTIMATOR experienced in industrial buildings, bridges and heavy construction required by expanding firm operating throughout Canada. Position offers salary, participation in company's hospitalization and pension plans. Applicants should give full details, including age, education and background, experience, marital status, salary requirements. File No. 5049-V.

DESIGN ENGINEERS wanted by a rapidly expanding firm specializing in prestressed and precast concrete throughout Canada. Several years experience in reinforced concrete is required. Positions offer salary, participation in company's hospitalization and pension plans. Applicants should give full details including age, education, experience, marital status, salary requirements. Personal interview will be arranged with selected applicants. File No. 5049-V.

CIVIL ENGINEER required by pulp and paper company situated in the Maritime Provinces. He will be in charge of lay-out in the field and also design and draughting in the office. File No. 5053-V.

CIVIL ENGINEERS are required for assignment in numerous fields including structural design, hydraulics, hydrometrics, public health engineering, highway construction, general engineering, surveying. Civil Service Commission, Ottawa, File No. 5066-V.

SENIOR STRUCTURAL ENGINEER. Rapidly expanding structural consulting firm offers excellent opportunities to experienced senior and intermediate engineers who must have first class qualifications, references and a high degree of intelligence. There are responsible positions offering excellent remuneration to capable and ambitious persons. Those confident of their ability should reply. File No. 5069-V.

GRADUATE CIVIL ENGINEER required by the city of Lethbridge, Alberta, with eight or more years experience in structural design work, also having some experience in sewerage and waterworks engineering. Applicants in their first letter are requested to submit full details of education; experience; age; physical condition; height, weight; marital status; place of birth; length of residence in Canada; natural born or naturalized citizen; references; salary expected; when available; recent photograph. Application will be received by the City Engineer until February 28th, 1955. File No. 5107-V.

PROFESSOR CIVIL ENGINEERING, for appointment September 1st, 1955, to direct and supervise and give undergraduate and post graduate instruction in specified field in civil engineering. Salary range $5900 to $6600 with superannuation, hospital insurance and other benefits. Applicant should be university graduate, preferably with postgraduate training and should have had several years practical experience in responsible engineering work. Location Halifax, N.S. File No. 5110-V.

CIVIL ENGINEER, recent graduate, to act as sales engineering representative for reputable and well recognized company in building products and specialty field. Must have strong inclination toward aggressive sales. Real opportunity for recognition and advancement to the right individual. Territory Montreal, Quebec and Maritimes. File No. 5113-V.

PROFESSIONAL ENGINEER. Fully experienced in municipal engineering, required by a firm of consulting engineers. Applicant must be capable of taking full charge of the design of sewage treatment plants, sewerage systems, water supply and distribution, be fully competent to write specifications, and meet and discuss problems with municipal councils and engineers, and supervise the work of contractors. Work will be in Ontario from Toronto Office. Full details as to experience, education, and references required in first letter. File No. 5116-V.

GRADUATE ENGINEER with extensive experience in general structural design including heavy concrete structures to direct the work of design and detailing group in the Montreal office of an established firm of utility consultants. Applicants must have a thorough knowledge of Canadian building materials and construction practices. File No. 5119-V.

ELECTRICAL

GRADUATE ELECTRICAL ENGINEER to work in electrical department of paper mill in the Province of Quebec as assistant to the electrical superintendent. Paper mill experience desirable but not prerequisite. Applicant to write giving age, education, experience and salary requirements. File No. 5027-V.

ELECTRICAL SALES ENGINEER required by manufacturer of switchboards high and low tension, panelboards, bus ways and switches to cover Toronto district. Opportunity for the right man to become district sales manager. File No. 5034-V.

YOUNG ELECTRICAL ENGINEER to be employed as sales engineer in the storage battery division of manufacturer located in Montreal. File No. 5038-V.

TWO GRADUATE ELECTRICAL ENGINEERS with at least 10 years experience, design, operation and maintenance of distribution facilities desirable, required by rapidly growing utility location South America. Portuguese useful but not required to start. Reply stating age, education, experience, personal particulars, and minimum salary expected. File No 5041-V.

GRADUATE ELECTRICAL ENGINEERS — senior—at least 10 years field experience with operating U.S. Canadian Company. Junior—3 years experience. Permanent position long established consulting organization New York. Some travel Latin America necessary future. Knowledge of Spanish or Portuguese useful, not essential. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5042-V.

FIVE JUNIOR ELECTRIC ENGINEERS required by Western Utility. Two engineers for hydro-generating stations, one engineer for communications and relay and plant meter-

WANTED

Courtaulds (Canada) Limited have vacancies at Cornwall for graduate mechanical engineers aged 24-28. Duties will cover design, construction and maintenance of all types of rayon machinery. Applications should be made to the secretary, Courtaulds (Canada) Limited, Cornwall, Ontario.

ing, one engineer for sub-station and local distribution systems, and one engineer for system planning and design division. File No. 5044-V.

ELECTRICAL ENGINEER required by transformer manufacturing company in Manitoba. Applicants should have a degree in electrical engineering preferably from a Canadian University, be interested in design work and have worked for a utility or manufacturing company for one or two years. Reply giving details of experience, age, qualifications and proposed salary. File No. 5046-V.

ELECTRICAL DESIGN ENGINEERS to do layout of aircraft electrical machines from design data and to produce wiring diagrams to design AC and DC generators and motors, regulators and protective devices. Require a degree in electrical engineering or equivalent plus 2 to 4 years industrial experience preferably in aircraft field, for expansion programme of light engineering company manufacturing aircraft engine components. Location Ontario. Reply with full particulars, stating approximate starting salary. File No. 5051-V.

ELECTRICAL DEVELOPMENT engineers to work on aircraft electrical systems, ignition units, DC generators, rotary converters and various small aircraft electrical apparatus. Require a degree in electrical engineering or equivalent plus two to 4 years industrial experience preferably in aircraft field for expansion programme of light engineering company manufacturing aircraft engine components, located in Ontario. Reply giving full particulars, stating approximate salary required. File No. 5051-V.

AN ELECTRICAL ENGINEER required to design telephone cable. Prefer an experienced man but will be pleased to review applications from anyone interested in learning this field. Permanent position and salary will depend upon experience and qualifications. Location Ontario. File No. 5052-V.

ELECTRICAL ENGINEER required in Edmonton, Alberta, who has graduated from a recognized Canadian University, and who has 3-10 years industrial experience in a chemical plant or refinery. He will deal mostly in equipment used in the manufacture of petrochemicals and synthetic fibres. Duties will include design, layout and estimating. File No. 5057-V.

JUNIOR ELECTRONIC DESIGN ENGINEER, required by electronic tube manufacturer to design cathode ray and receiving tube testing and allied equipment. Location Toronto. File No. 5063-V.

ELECTRICAL ENGINEER preferably 25-35 years of age, with some sales experience required as sales engineer for industrial motive power battery line with long established reputable firm. Good salary and prospects for promotion. Duties will involve some travelling. All applicants should state qualifications and salary expected. File No. 5064-V.

EASTERN ONTARIO UTILITY, requires graduate electrical engineer to fill the position of distribution engineer. Duties to include distribution planning and layout for improvement of voltage conditions and expansion of present system. Design and layout of substations and assist in supervision of operating force. Applicant preferably should have one or two years electrical distribution experience. Write giving age, education, personal particulars and salary desired. File No. 5065-V.

ELECTRICAL ENGINEERS are required to fill over 50 positions, particularly in the electronics field, for work involving the design and development of communications equipment. Requirements also exist for those interested in electrical machinery, lighting and distribution systems. Civil Service Commission, Ottawa. File No. 5066-V.

ELECTRICAL SALES ENGINEER for Toronto office, leading U.K. manufacturer electrical plant. Must have minimum five years sales experience. Age under 30 years. File No. 5067-V.

ELECTRONICS ENGINEERS required by large manufacturing firm with plants in Eastern Ontario and the Montreal area. Positions available in the development of communications equipment or field maintenance engineering. Out-of-town trips of short duration required on some assignments. Reply in confidence including age, education, experience and salary requirements. File No. 5070-V.

SENIOR ENGINEER required by prominent manufacturer for sales, liaison, and technical administration in connection with guided missiles, radar and fire control projects. This is a responsible position for which considerable technical experience in electronics or electrical engineering as well as proven administrative ability are necessary. Opportunity for advancement is unequalled and depends solely on ability. File No. 5073-V.

TWO JUNIOR ELECTRIC ENGINEERS are required by a prominent mobile communications manufacturer located in Toronto. Both must be graduates in communications or general electronics option and have had about one year's experience in the electronic field preferably in the radio communications branch. One is required to work on production engineering in a technical liaison capacity. The other opening is for an application engineer in the systems development group. Reply giving full personal resume, experience, education and salary desired to File No. 5075-V.

ELECTRICAL ENGINEER required by repair shop in Quebec City. Repairs on electric motors, construction work, selling motors and controls, ball bearings, drives, belts, industrial hoses and electrical tools. Position offers, after some experience, management of whole firm. Must be bilingual. File No. 5077-V.

TWO ELECTRONICS ENGINEERS required in Toronto. Applicants should be graduate electrical engineers or physicists, with two or three years experience in design of electronic circuits. File No. 5085-V.

ELECTRICAL ENGINEER with 2 to 3 years experience, required for sales department of Toronto switchgear specialist. Knowledge of switchgear application desirable. File No. 5088-V.

GENERAL MANAGER required for the Saskatchewan Power Corporation operating a rapidly expanding province-wide electrical utility and an extensive gas utility. Headquarters Regina. Kindly state fully background and experience including previous training in and knowledge of electrical and gas utilities and industrial and public relations. State also salary expected and date available. File No. 5093-V.

ELECTRICAL ENGINEER, with four years general experience in substations and industrial layout of large motors, mining experience preferred. Write stating experience and qualifications to File No. 5095-V.

ELECTRICAL ENGINEERING DRAUGHTSMAN or electrical engineer, required for consulting engineer's office. Experience required in commercial and residential design, layout, etc. Permanent position. Please write advising experience to File No. 5096-V.

ELECTRICAL ENGINEER, graduate with at least 5 years experience protective relay work with electric operating utility company. Relay studies, system development studies and general technical electrical operating and design work. Permanent position long established consulting organization. Headquarters New York. Some travel Latin America. Knowledge of Spanish or Portuguese desirable, not essential. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5108-V.

ELECTRICAL DRAUGHTSMAN, required in Montreal by naval architects office. Age 25 to 35 with technical and all around experience. Applicant would have to be of good personality and reasonable executive ability to work in as assistant electrical engineer and eventually chief electrical engineer. File No. 5111-V.

ELECTRICAL ENGINEER, graduate with at least 5 years experience protective relay work with electric operating utility company. Relay studies, system development studies and general technical electrical operating and design work. Permanent position long established consulting organization. Headquarters New York. Some travel Latin America. Knowledge of Spanish or Portuguese desirable, not essential. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5117-V.

GRADUATE ELECTRICAL ENGINEERS — one senior — two juniors — Senior at least 10 years experience — Junior 3 to 5 years experience in electrical design, operation and construction of steam, hydro plants and substations. Permanent position with long established consulting organization for public utility operating companies located Latin America. Headquarters New York. Some travel necessary in future. Knowledge of Spanish or Portuguese useful not essential. Salary commensurate with qualifications. Good opportunity. Reply stating age, education, experience and personal particulars. File No. 5118-V.

MECHANICAL

GRADUATE MECHANICAL ENGINEER required to work on steam power plant design. Applicant must have at least five years experience on the design and layout of modern high pressure, high temperature control stations. The company is now actively engaged in extensive plant extensions of 25 and 45MW size, the latter 900 lbs. on a long term basis, opportunity is offered for advancement in both technical and executive lines of public utility work. Salary paid will be according to ability, academic qualifications and experience. Apply giving age, training experience and approximate salary required. Location Maritime Provinces. File No. 5037-V.

MECHANICAL ENGINEER required by long established Montreal manufacturing firm to take over duties of plant engineer. Duties involve usual plant maintenance, machine shop, etc., also product development and tool design. Applicant must be English speaking and preferably between the ages of 25-35. Position offers good future and carries usual benefits including pension plan. Please reply in detail stating experience, education, etc. All replies received will be kept in confidence. File No. 5036-V.

MECHANICAL PLANT ENGINEER required by operating division of service organization. University graduate preferred having 5 to 10 years experience in operation and betterment of steam plants operated by U.S. or Canadian public utilities. Location New York, some travel. Spanish desirable but not essential. Reply by letter giving age, education, experience, personal data and minimum salary acceptable. File No. 5043-V.

MECHANICAL ENGINEER required by manufacturer of wire and cables located in Ontario, for plant engineering department. Preferably one who can do machine design work. Permanent position and salary will depend upon experience and qualifications. File No. 5052-V.

MECHANICAL ENGINEER required in Edmonton, Alberta, who has graduated from a

Senior Geologist

Required By

Sask. Dept. Mineral Resources

A senior geologist (Precambrian). Salary range: $397-$481 per month.

Applicants require university graduation in geology or petrology as well as several years professional geological experience and membership in C.I.M.M. and Association of Professional Engineers: To take charge of geological survey parties for approximately six months each year and to prepare reports and other duties the remaining six months.

Information and application forms can be obtained from

Public Service Commission,
Room 328,
Legislative Building,
Regina, Saskatchewan.

recognized Canadian University, and who has about 3-5 years experience in a chemical plant or refinery. He will deal mostly in equipment used in the manufacture of petrochemicals and synthetic fibres. Duties will consist of general engineering, which will include design, layout and estimating. File No. 5055-V.

A MECHANICAL ENGINEER is required as maintenance superintendent at a 2,000 bed mental hospital in Weyburn, Sask., operated by the Saskatchewan Department of Public Health. The duties include planning and supervising the maintenance, repair and construction of buildings, grounds, roads, equipment and utilities. The employee would be responsible for the generation of electricity and supply of steam, and the operation of water and sewage systems. Considerable experience in buildings, maintenance and construction desirable. Qualifications should permit registration as a professional engineer. Starting salary $397.00 per month with automatic annual increases to $481.00 per month. Benefits—3 weeks annual sick leave, 3 weeks holiday with pay, excellent superannuation scheme. File No. 5060-V.

MECHANICAL ENGINEER to be services engineer for large manufacturing plant in Eastern Ontario. Work will involve supply, distribution and use of plant services including steam, water refrigeration, compressed air, vacuum, ventilation and air conditioning Duties will include control of all services departments and distribution systems, supervision of maintenance of services equipment, and studies, estimates, and reports on services distribution and consumptions. Must be graduate engineer, age 28 to 35, with several years of practical experience with supply of plant services. Must have the ability to take over leadership of a group and be prepared to make his own decisions and be responsible for them. Preferably should also have first class stationary engineer's certificate. Position will be permanent and offers excellent opportunity for advancement to the right man. Applications should contain all necessary personal data, and full information about previous engineering experience. Reply stating experience and other relevant information to File No. 5062-V

OPPORTUNITIES ARE AVAILABLE to mechanical engineers at Ottawa and other centres across Canada, on assignments involving the design and installation of heating, ventilating and refrigeration equipment; the design and construction of power house equipment, dry-docks, lift and swing bridges; research on stress analysis and fatigue properties of metals as well as on thermodynamics and gas dynamics. Civil Service Commission, Ottawa. File No. 5066-V.

TWO MECHANICAL ENGINEERS to work in mechanical goods sales division. The men we are looking for should be recent graduates who have an interest in sales work. Will receive training to become familiar with products and then move to technical sales. They will deal with problems related to products in most of the larger well known industries. Being a large well known firm, we can offer a good future with better-than-average employee benefits. File No. 5068-V.

GRADUATE MECHANICAL ENGINEER, with 3-5 years experience to work as project engineer. Located in Head Office in Montreal, but may be called upon to travel to plants in Eastern Canada. He will be responsible for design and installation of a wide variety of industrial equipment and processes and for new plants or additions to existing plants as they expand. Training will be provided, so actual experience in this field is an asset but not essential. File No. 5068-V.

PLANT MAINTENANCE ENGINEER required by large manufacturing firm in Montreal for mechanical-electrical project design, construction and maintenance operations relating to buildings and building equipment. University graduates with some previous experience in plant engineering work preferred. In your reply, please include particulars as to education, age and approximate salary required. File No. 5070-V.

VACANCIES CREATED by new developments offer interesting positions for mechanical engineers on Canada's leading design team. Applications from qualified persons are being considered for analytical and applied design work on full systems and flying control systems, including electro-hydraulic servo mechanisms, aircraft experience desirable but not essential. Salary commensurate with experience and ability. Replies held in confidence. Reply by letter in first instance giving resume of education and experience, with salary expected. Location Ontario. File No. 5076-V.

MECHANICAL ENGINEER with five or more years experience in industry, preferably pulp and paper, for duties involving organization of improvements, job schedules, machinery maintenance and some mechanical draughting. File No. 5081-V.

A LARGE MANUFACTURER In The Eastern Townships requires an engineer with maintenance background interested in industrial engineering, or vice versa. This is a newly created position to review and expand maintenance control procedures for a diversified maintenance work force—an expanding field with tremendous scope. Initiative and ability to present ideas effectively are essential qualifications. File No. 5094-V.

ENGINEER REQUIRED with at least ten years experience in the diesel engine field preferably in application engineering. Age between 35 and 45 years. Must be Canadian graduate. The salary will be above the average for positions of this type and the development prospects are good. Location Montreal. File No. 5100-V.

MECHANICAL ENGINEER required for development and product design of optical equipment. Applicant should be not less than 30 years old, with at least 5 years experience in the optical field. Plant location Eastern Townships. Salary commensurate with experience and qualifications. File No. 5103-V.

MECHANICAL ENGINEER required for development and design of precision mechanisms of control equipment. Must be graduate engineer, above 30 years of age and considerable experience. Must have the ability to take over leadership of an experimental group and be prepared to make decisions. Salary commensurate with experience and qualifications. File No. 5103-V.

ASSISTANT PROFESSOR MECHANICAL ENGINEERING for appointment September 1, 1955, to give undergraduate instruction in the thermal power and allied subjects. Salary range $4100 to $5000 with superannuation, hospital insurance and other benefits. Applicant should be university graduate with some years practical experience in steam power work. Location Halifax, N.S. File No. 5110-V.

MISCELLANEOUS

RESEARCH CHEMICAL OR MECHANICAL ENGINEER required by pulp and paper research institute of Canada for research in unit operation and chemical reactions involved in new processes for pulp and paper manufacture. Necessary qualifications include a Bachelor's (or higher) degree in chemical or mechanical engineering and 1-5 years of pertinent experience. This offers an opportunity to gain experience in the planning, executing and reporting of engineering research projects. Salary will be commensurate with previous training and experience. Applicants should address a comprehensive resume of qualifications and career. File No. 5007-V.

THE DEFENCE RESEARCH BOARD requires electronics engineers and physicists for employment in Ottawa, Ontario. Duties: for the electronics engineers the work will be in connection with the technical administration of a development programme. The duties will include secretarial committee work contractual negotiations, liaison work, etc. There are vacancies for physicists interested in research and development on the more fundamental aspects of electronic components, e.g., dielectrics and magnetic materials. Qualifications: electronics engineers should have technical experience in the field of electronic components. Salary: starting salaries will be in the range of $3,600-$5,750, depending upon qualifications and experience. Employee benefits: there is generous provision for vacation and sick leave, superannuation and group hospital medical insurance plans, and a five day week. How to apply: application forms will be sent to qualified applicants on receipt of letters outlining qualifications and experience. Please write mentioning 54-DRP-4 to File No. 5008-V.

ASSISTANT PROFESSOR of draughting. Royal Military College of Canada, Kingston, Ontario. Salary up to $5,400 per annum. Civil or mechanical engineer preferred. Further information may be obtained by writing the Civil Service Commission, Ottawa. Quote Competition 54-2008. File No. 5014-V.

CHEMICAL OR METALLURGICAL ENGINEER, class '48-'52, sales experience preferred for technical sales with growing industrial division of world-wide organization manufacturing centrifuges, heat exchangers, pumps, vibrating screens for use throughout industry. Location Ontario or Quebec. File No. 5029-V.

DETAIL AND ASSEMBLY tool designers required for extensive aircraft program. Experience desired: 10 years experience in sheet metal fabrication industry with five years on aircraft tool design. Location Ontario. File No. 5031-V.

CIVIL OR ELECTRICAL ENGINEER. University graduate of two or three years' experience in civil or electrical fields and above average literary ability. Permanent employment in Ottawa with well known industrial association. Pension plan. File No. 5039-V.

SOIL MECHANICS ENGINEER required by Vancouver engineering firm. Post graduate training essential. Two to four years practical experience preferred but not absolutely necessary. Excellent opportunity leading to responsible position for engineer with initiative and personality. Reply stating age, education and experience. File No. 5045-V.

TWO MECHANICAL OR ELECTRICAL ENGINEERS required by elevator manufacturer located in Montreal to act as sales and or service engineer. Applicants should be recent graduates, no previous experience necessary. Must be bilingual. Age 30 years or under. File No. 5050-V.

YOUNG ENGINEER or metallurgist with experience in the light metals field, either in a light metals development laboratory or as a technical service representative for a base producer of light metals. Required by large Canadian organization establishing a market for magnesium in Canada to work out of Toronto. After suitable training with parent company he will be given full responsibility and authority to increase the market. Top salary open. File No. 5056-V.

METALLURGICAL ENGINEER for shift production work in non-ferrous smelter. Excellent opportunity for recent metallurgical graduate. Supply full particulars regarding qualifications and salary expected to File No. 5059-V.

SALES ENGINEERS graduates in chemical, electrical, mechanical, mining or metallurgical engineering—between the ages of 25 and 35, with at least 3 years industrial selling experience—required by well-known Montreal manufacturing firm with branches from coast-to-coast selling a wide range of mechanical equipment to the chemical, oil and gas, mining, marine, power, pulp and paper, metal and other industries in Canada. Reply in confidence giving a complete resume of your qualifications and experience. All replies will be acknowledged. File No. 5061-V.

RESEARCH OFFICERS, graduates in chemical, metallurgical and mining engineering and in engineering physics are needed for both fundamental and applied research at Ottawa and Chalk River, Ontario. Ample opportunity is provided in these posts to present and publish papers and to take part in technical conferences and forums both national and international. File No. 5066-V.

MECHANICAL, ELECTRICAL AND CHEMICAL ENGINEERS are required for 35 positions at Ottawa to undergo training in patent law and regulations and then to assume the responsibility for the examination of applications for patents in the field of engineering and for making recommendations for the award or denial of patents. Civil Service Commission, Ottawa. File No. 5066-V.

ENGINEERS REQUIRED FOR DEVELOPMENT and product design of microwave test equipment, magnetic amplifiers, transistor circuits, fire control systems and other servo operated instruments for both military and commercial application. The continuing expansion of work in our engineering department offers opportunities for both junior and intermediate engineers. Previous experience in manufacturing operations is desirable, and supervisory ability would be an asset. File No. 5072-V.

YOUNG CIVIL OR MECHANICAL ENGINEER required by a pulp and paper company in Quebec. Applicant should have a minimum of three years experience in engineering and maintenance preferably in the pulp and paper industry. Applicant should be fluent in either French or English and should be able to get along in both. Replies should outline qualifications, experience, age and salary expected. File No. 5078-V.

THE NATIONAL RESEARCH COUNCIL, Ottawa, requires graduates in engineering physics, mechanical or electrical engineering to work on the design and development of special instrumentation equipment and data processing systems. Three positions are open in the flight research section and one in the high speed aerodynamics lab. This work calls for an imagination and original approach to a large variety of advanced instrumentation and electro mechanical design problems. Initial salary in the range of $3,750-$5,750 per annum depending on qualifications. Apply by letter to the employment officer Sussex Street, Ottawa, Ontario, quoting file ME 361 and listing complete details on education and experience. File No. 5080-V.

SASKATCHEWAN DEPARTMENT of mineral resources require petroleum geologists and petroleum development officers. Salary ranges $339-$413 and $326-$397 respectively. Both groups will perform duties in the conservation of oil and gas resources. The geologists' duties will be professional level in field and office, the petroleum development officers' will be largely field duties in connection with

drilling operations. University graduation required. File No. 5082-V.

AN INTERESTING POSITION is open in our new Research Department. We require a graduate engineer from a recognized university with experience in adhesives, coatings, rubber plastics or related fields. Remuneration will be negotiated. Replies will be given all applicants who send a complete resume of their educational background, work ability, personal data and references, and a recent picture. File No. 5083-V.

INTERNATIONAL MANUFACTURER expanding its research facilities in Canada requires a competent paper engineer for research and development work on pulp, fine papers, paper specialties and shipping containers. This position with a future is open only to graduate chemical engineers from a recognized university who have at least three years industrial experience in pulp and paper. Remuneration will be negotiated. Replies will be given all applicants who send a complete resume of their educational background, work ability, personal data and references and a recent photograph. File No. 5083-V.

THE NATIONAL RESEARCH COUNCIL, Ottawa, Canada, requires a university graduate to investigate problems in aircraft icing. Duties will include tests in flight as well as in icing tunnels and development work in cooperation with commercial aircraft firms. Experience in aeronautical engineering problems and aircraft performance is desirable. Initial salary in the range of $3750 to $5750 per annum depending on qualifications. File No. 5086-V.

CHIEF ENGINEER required by progressive manufacturer supplying equipment to utilities and large industrials. Must have experience and maturity to counsel staff and administer department. Technical background in design and development of electrical filter circuits together with mechanical design experience in manufacturing industry is most desirable. Remuneration commensurate with qualifications. File No. 5089-V.

SCIENTISTS AND ENGINEERS with The Defence Research Board for challenging positions, with ample opportunity for advancement are available at several locations in Canada Physicists, engineering physicists, electrical engineers, mechanical engineers, mathematicians, statisticians, chemists, biological and social scientists. There is also a requirement for trained scientists for work in operational research and scientific information. Qualifications: applications are invited from Canadian citizens or British subjects, graduates with a good academic record in science or engineering from a recognized university, preferably with post-graduate training. Proven scientific ability experience desirable. Salaries will be commensurate with qualifications and experience. Write outlining your qualifications to File No. 5092-V.

AIRCRAFT SALES MANAGER REQUIRED. Applicants must have a good aviation background and should not be more than 40 years of age. Preference will be given to those having an aeronautical engineering qualification. The position is a permanent one and available immediately. The successful candidate will he required to travel extensively in Canada, U.S.A. and the U.K. and will be resident in Montreal. Initial salary will depend on qualifications and experience, in addition, the company provides group pension and insurance plans and other benefits. Applications (six copies) giving full details of training, qualifications and experience and the names of three persons to whom reference may be made should be sent to File No. 5097-V.

SALES ENGINEER, experienced in concrete work. Territory province of Quebec. Bilingual preferred but not essential. Permanent position if satisfactory. Please reply giving details of experience, salary required, etc. Apply to File No. 5098-V.

HYDRAULIC TURBINE SALES ENGINEER wanted. Must be thoroughly familiar with all phases of turbine design and application problems. Proven record of good administrative and sales ability essential. Selected applicant to open office and represent in Canada one of the world's foremost water turbine manufacturers. Total turbine horsepower manufactured to date by this firm exceeds 10 million horsepower. This firm has not heretofore been directly represented in Canada but present long-range plans are predicted on obtaining right man who can secure reasonable share of Canadian market. Five figure starting salary will be commensurate with experience and proven ability. Give full details with first letter which will be considered strictly confidential and no investigation made thereof without prior consent of applicant. File No. 5101-V.

THREE RECENT GRADUATE engineers required at our plant in Ontario, with experience as follows: some experience in design of machinery and equipment; some electrical experience, or electrical engineer with mechanical experience; experienced in machinery and equipment design—new and maintenance—in charge of draughting room. File No. 5104-V.

OPPORTUNITIES FOR SENIOR ENGINEERS and technicians for permanent positions in rapidly expanding research organization located in Toronto. Senior engineers should be experienced in electro-mechanical, electronic, servo-controlled and computing instrumentation. Salaries open. Write detailing education, qualifications and experience. All inquiries will be treated in strictest confidence. File No. 5105-V.

MECHANICAL OR ELECTRICAL ENGINEER, age 25-35, required by large organization in Montreal for planning, maintenance and administrative duties connected with properties occupied by company in particular very large head office building. Opportunities for promotion and enlargement in scope of duties within same and related fields. Staff benefits generous and comprehensive. Reply giving details, education, experience and personal data. File No. 5106-V.

APPLICATIONS INVITED WITH university graduation in Engineering and several years experience in field and office petrolcum engineering work; to perform supervisory and professional duties related to draughting of sound conservation practices regulations; estimation of reserves; and general reservoir management. Location Western Canada. File No. 5109-V.

ELECTRICAL OR MECHANICAL ENGINEER, recent graduate required to act as sales engineer for manufacturer of electrical motors, industrial pumps, hoists and ventilating equipment, located in Montreal. Bilingual preferred. Salary plus commission. File No. 5114-V.

PROFESSOR AND HEAD OF THE DEPARTMENT OF POWER ENGINEERING, required by The Institute of Science, Bangalore. This is one of the foremost institutions of India. As head of the department, to administer the power engineering department and coordinate the activities of the four sections of electrical engineering, mechanical engineering, civil and hydraulic engineering, and high voltage engineering. Qualifications: a degree in electrical engineering of a recognized University, practical training in well-known electrical manufacturing concerns or large power projects and or power supply organizations. Duration of appointment, one year renewable. Salary between the equivalent of $8750 and $9500 per annum (national income tax reimbursed if levied), depending on qualifications and experience, plus family allowances. File No. 5115-V.

WANTED AT ONCE SALESMAN with experience in pipes for use in waterworks or sewerage systems. Experience in the installation of these pipes desirable but not essential. Please reply stating age, experience, educational qualifications and salary expected. Our employees are informed of this advertisement. File No. 5126-V.

STUDENT SUMMER EMPLOYMENT

Companies desiring the services of engineering students and students requiring engineering employment during the summer months are invited to make their requirements known NOW.

EMPLOYERS:

Send particulars of vacancies, locations, salaries and name of company official to be contacted.

STUDENTS:

Send details of former experience, type of work and location desired. State dates of availability.

Address all correspondence to:

Employment Service,
The Engineering Institute of Canada,
2050 Mansfield Street, Montreal 2, Que.

NOTICE

The City of Prince Albert (pop. 19,000) requires an assistant engineer. Must hold an engineering degree, preferably civil, from a recognized university. Position offers varied experience, future security, and an opportunity for advancement. Salary $325 to $375 per month, depending on qualifications.

Reply stating age, experience, education and relevant information, to

J. W. Oliver,
City Commissioner,
Prince Albert, Sask.

Situations Wanted

GRADUATE ENGINEER with six years varied experience in the pulp and paper industry available for position as assistant superintendent in sulphate pulp mill or paper mill. Married, 29 years of age, will locate in United States or Canada. File No. 163-W.

ELECTRICAL ENGINEER P.Eng., Ont. Jr.E.I.C., with post graduate business administration training. 7 years sales and manufacturing experience at responsible level. Presently in sales administration, functions including formulation of sales policies, supervision of sales, sales promotion, sales forecasting, etc. Seeks responsible position in sales administration (industrial Market). File No. 2975-W.

MECHANICAL ENGINEER, B.Sc., Queen's, P.Eng., Ontario, married, 2 children, with 9 years experience; two years design and maintenance in modern newsprint mill, five years design of steam power generating plants with large consulting company, two years and currently utilities engineer with design engineering and construction company. Familiar with equipment and operation of 900 lh. 750F power plants; stoker, pulverized fuel and gas firing, coal and ash handling, water pumping and treatment for steam and process use, large air compressors, instrumentation and control, code piping, chemical plant services, heating and ventilating. Recently completed start-up of 4½ million dollar project in Western Canada. Seeking responsible position with industry, government agency, or consulting group. File No. 2990-W.

GRADUATE ENGINEER, S.E.I.C., B.Sc., Alberta 1949, age 28, married veteran, mine surveyor (Alberta). Experienced in underground and surface surveying, underground and open pit mining, road construction and maintenance. Desires position with responsibility, preferably in city. File No. 3275-W.

MECHANICAL ENGINEER, Jr.E.I.C., U. of S. 1950, age 27, single. Four years experience in design and layout of steam boiler plants. Have also acted as residential engineer on some installations. Seeking interesting position with possibilities in mechanical or power field. File No. 3495-W.

MECHANICAL ENGINEER, Jr.E.I.C., 1950 graduate University of Saskatchewan. Excellent practical background combined with sales and administrative ability. Thoroughly familiar with the pulp and paper, automotive and farm implement industries. Able to work well with others. No objection to travel and will accept a position anywhere in Canada or U.S.A. Please reply to File No. 3536-W.

MECHANICAL ENGINEER (M.E.I.C.), age 36, married. Experience: 2 years designer draftsman, 3 years industrial engineering, methods and production control. Trained in time and motion study and certificate as MTM practitioner. Desires responsible position in industrial engineering methods or plant management. File No. 3900-W.

STRUCTURAL ENGINEER, 36, married, M.E.I.C., P.Eng., B.Sc. Eng., A.M.I.C.S., A.M.I. Struct. E. with extensive experience in design of reinforced concrete, structural

steel, and wood structures (schools, factories, hospitals, industrial containers, foundations, office buildings, etc) seeks responsible position in Toronto area. Preferably junior partnership or associateship. File No. 4041-W.

CIVIL ENGINEER, P.Eng., M.E.I.C., desires ½ day employment in Toronto. 19 years experience in architectural, structural and town planning designs. File No. 4182-W.

ELECTRICAL ENGINEER, age 29, with 3 years experience in heavy industry, 2 years in communications, test course graduate, desires responsible work in West, preferably Edmonton area. File No. 4349-W.

ELECTRICAL ENGINEER, B.Eng. (Hons.) M.A.Sc., M.E.I.C., P.Eng., age 36, married and presently completing ninth year as a professor of electrical engineering. Has taught many different courses on senior and graduate levels with emphasis on power. Broad general experience in construction, public utility engineering and as a naval officer. Has done considerable consulting work of a general nature. Seeks appointment which should offer a broad challenge, be conducive to personal growth and in keeping with background proffered. File No. 4402-W.

CIVIL ENGINEER, M.Sc. 1931, Technical University of Warsaw, A.M.I. San.E., M.E.I.C., P.Eng. (Man. & Sask.), war veteran, age 49, over 15 years experience in hydraulic works, water supply and sewerage, formerly residing in Great Britain and one and one half years in Canada. At present employed as city assistant engineer. Seeks position with a municipality or firm which offers a good opportunity for advancement. Location secondary, available in one month notice. File No. 4443-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.) B.Eng. 1952, age 30,, married, with two years of experience on plant maintenance in a chemical plant, also one year experience in industrial engineering, 3 summers general workshop practice including overhaul of diesel engines. Desires work on plant maintenance or production. File No. 4453-W.

YOUNG ELECTRICAL ENGINEER interested in learning the generation and distribution field with a consulting engineer, contractor or utility. Presently working in a large petrochemical plant on all phases of the electrical system. Will send resume on request. File No. 4510-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng, 1951 graduate, N.S.T.C. Experience in plant engineering (one year) and design (three years). Desires position with increased responsibility. File No. 4559-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng., ten years experience of mechanical and chemical plant design, installation and maintenance. Presently holding management position heading design team on specialized machinery and equipment. Seeks position where initiative, responsibility and organizing ability are used to the fullest. Would consider the commercial aspect of engineering. File No. 4568-W.

MECHANICAL AND INDUSTRIAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), 5 years experience in paper mill plant engineering and layout, structural steel design, foundations, buildings, heavy machinery installation, piping and process investigations. Above includes drafting, detailing, cost estimations, and construction supervision. Have also had 2 years experience in townsite engineering and development, lot surveys and related work. Available for engineering appointment immediately. File No. 4614-W.

CIVIL ENGINEER, P.Eng., Jr.E.I.C., 1951 graduate. Seeks part time employment in Montreal. Experience in design of R.C. structures, field work in construction and general maintenance in chemical processing industry. Some drafting. File No. 4627-W.

ELECTRICAL ENGINEER, M.E.I.C., McGill 1943, married. Experience in electronic communication and power principally in sub-station design. Desires position with responsibility. Speaks French and English fluently. File No. 4628-W.

GRADUATE ENGINEER, 1941 Civil M.E.I.C., age 25, married with family. Considerable experience as job engineer and superintendent. Have a responsible position in a growing construction firm, seeking similar position preferably in Ontario. Particulars willingly supplied. File No. 4629-W.

MECHANICAL AND METALLURGICAL ENGINEER, Jr.E.I.C., P.Eng. Dipl. Ing., age 39, married, no children. 10 years experience in various phases of metal fabricating processes: machining, stamping, deep drawing, forging, casting, heat treating, etc. Desires position with a progressive company to take care of all technical problems combined with supervision, cost reduction program, methods improvement and general development of plant facilities. File No. 4632-W.

MECHANICAL ENGINEER, S.E.I.C., B.Engineer with honours McGill 1953. Presently located in Montreal. Thorough background of machine shop experience, production planning and allied engineering office problems. Some experience also in surveying field work. Desires part time employment evenings and Saturdays in draughting, calculating, surveying, tutoring mathematics and sciences or as consultant in production planning and control problems. File No. 4634-W.

MECHANICAL ENGINEER, M.E.I.C., age 34, married. 10 years experience in drafting, piping layouts, estimating, inspection and plant maintenance in petroleum refinery. Desires position in industrial plant or refinery. Location Alberta or British Columbia interior. Available on one months notice. File No. 4637-W.

CIVIL ENGINEER, P.E., M.E.I.C. Thirty years experience includes natural gas development, gas transmission, distribution design service on customers premises, rehydration, oil fogging, reconditioning. Desires position in industry or consultant. File No. 4638-W.

MECHANICAL ENGINEER, B.E. Saskatchewan 1953-V, P.Eng. (Ont.), S.E.I.C., Member S.A.E., age 23, married. 1½ years experience in automotive industry including one year training plan, purchasing and material handling. Present duties consist of liaison between management and engineering design sections, planning of new parts depots, floor layouts, equipment purchases and coordination of new construction projects giving considerable administrative experience. Desires position in Western Canada with opportunity for advancement. File No. 4639-W.

CONSTRUCTION EXECUTIVE available early Spring. Presently in senior management capacity. Proven record of high profits; able to initiate, organize and administer large volume of business. Mature judgment in financial matters and high level negotiations. Extensive experience in estimating, tendering, costing, and project supervision. Author of technical articles. Age 45, married. Professional Engineer (Ontario). M.E.I.C., would join construction company or allied industry as senior executive investing some capital if required. File No. 4640-W.

ELECTRICAL ENGINEER, U.N.B., 1953; S.E.I.C.: Athlone Fellow 1953; age 23, married. Presently in final year of graduate apprenticeship with the British Thomson-Houston Company, Rugby, England; apprenticeship concentrated on light and heavy rotating machinery, control gear, and electronic control equipment. Additional experience (including summer work) in switchgear, protective relaying, transformer testing, power transmission problems, and drafting; senior thesis "Symmetrical Component Analysis". Seek position concerning power system engineering in any part of Canada or abroad. Available for work in October, 1955. File No. 4641-W.

CHEMICAL ENGINEER, B.Sc.,(Ch.E.) M.E.I.C., M.A.I.Ch.E., 42, single, Canadian and U.S. resident; equal knowledge of English and German; experience: 12 years consisting of research and development in fuel technology, and process and project engineer in petroleum refinery engineering. Desires overseas assignment in petroleum refinery process or project engineering. Available immediately. File No. 4642-W.

CIVIL ENGINEER, Jr.E.I.C., B.Sc. (C.E.) Sask. 1953, age 25, single, presently employed in design, estimating and supervising of construction of irrigation projects, seeks new position. Preference for city engineering department or consulting firm engaged in municipal work. Preferable, but not necessarily, Western Canada. File No. 4643-W.

ENGINEERING AND BUSINESS MANAGEMENT background, Jr.E.I.C., Queen's civil 1952. Will graduate from Harvard Graduate Business School in June 1955 after training in labour relations, control, finance, production and marketing. Work experience includes construction engineering, surveying and mapping work and one summer preparing reports on capital expenditures for a large utility. Job objective is responsible work in the producing department of a manufacturing, construction, mining or transportation organization. Size of company is not paramount. File No. 4644-W.

STRUCTURAL AND CIVIL ENGINEER Jr.E.I.C., P.Eng. European University graduate in structural engineering (1947), age 34, family, 6 years Canadian experience mainly in field work and supervision in industrial and residential construction projects, also as office engineer and designer. Seeks permanent position in line with education and experience with a well established firm in Southern Ontario, preferably Toronto. Willing to accept the position of a Junior designer where hard work and ability would lead to greater responsibility and advancement. Available on short notice. References. File No. 4645-W.

MECHANICAL ENGINEER, B.Sc. (M.E) honours, Manitoba 1949, P.Eng. Jr.E.I.C., age 28, experience heating and ventilation, mechanical power transmission, power plant, design, drafting and construction supervision. Desires position design and development, plant engineering or consulting. Hard worker, conscientious. Preferably Niagara or Southern Ontario. File No. 4646-W.

ELECTRICAL ENGINEER, B.Sc. (Eng.) London University, England 1950. Single, age 36. Experienced public utility also applications and development of protective relays with well known British manufacturers. Seeks position anywhere in Canada, public utility preferred. File No. 4647-W.

METALLURGICAL ENGINEER Master of Science degree, registered professional engineer having applied experience in almost every phase of metallurgy—heat treatment: foundry work—non ferrous, cast iron; steel melting and rolling, etc. Will take complete responsibility for every assignment. Seeks position of group leader or supervisor in manufacturing development field. File No. 4648-W.

CIVIL ENGINEER, Jr.E.I.C. registered in British Columbia, would take responsible position in construction or development work. Past experience includes: design and supervision of permafrost installation, project engineer or heavy construction, construction methods and estimating, town engineering, as well as several years practical construction experience. Would prefer position in western provinces; very interested in permafrost work. File No. 4649-W.

MECHANICAL ENGINEER Jr.E.I.C., P.Eng. (Ont.), B.Sc. M.E. 1953, Canadian, age 24, married, experience in sales, manufacturing methods and design. Desire work of definite mechanical nature, either engineering and/or sales. Toronto area preferred with moderate travel acceptable. File No. 4950-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C., veteran 2½ years RCAF, B.Eng., mechanical engineering, Saskatchewan '49. Age 32, married, 1 child. Administrative experience obtained at follows: 2 years as a field engineer in charge of parties on water storage and land surveys and related drilling operations; 1 year as an assistant to the heads in both the wood preparing and mechanical departments of a large paper mill; and in a large chemical plant 1 year as a devolpment engineer and 2 years of supervising in production departments. Desires a responsible challenging position with good future opportunities. Prefer Ontario or SW Quebec. File No. 4653-W.

INDUSTRIAL ENGINEER, Jr.E.I.C., B.A.Sc. mechanical engineering 1950, Toronto. Single, age 26. Three years experience with management consultant—plant layout, material handling, production planning, inventory control, preventive maintenance, and job evaluation. Position wanted with progressive company, giving responsibility and opportunity for advancement. Available immediately to locate anywhere in Canada. Resume and references will be furnished upon request. File No. 4654-W.

ELECTRICAL COMMUNICATION ENGINEER A.M.I.E.E. (England), graduate with diploma Leningrad University (Russia). Desires employment on maintenance, installation or development of radio, telephone or telegraph equipment. Ukrainian born, British subject. Recently arrived in Canada from England. Experience: 2 years in the Trunk Telephone Exchange in Leningrad (Russia). 2 years engineer in Telephunken Laboratories in Berlin (Germany) and main work 18 years in research and development of electronic communication equipment in the G.E.C. Laboratories (England). Detailed resume on request. File No. 4655-W.

CIVIL ENGINEER, P.Eng. (Que.) Jr.E.I.C., graduate N.S.T.C. 1952, age 25, married with one child, desires position to gain municipal engineering or town planning experience. 2½ years experience resident engineer highway construction for provincial government. Available on reasonable notice to employer. File No. 4656-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. B.Sc. (M.E.) 1953. 2½ years experience as maintenance engineer in pulp and paper industry. Married with 2 children. Desires position in Manitoba. Available on reasonable notice. File No. 4657-W.

INDUSTRIAL AND CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.) B.A.Sc. Toronto. Age 37. Experience in plant engineering; 3½ years in Canada, 5 years in Europe. Experience covers equipment layout, design of mechani-

(Continued on page 212)

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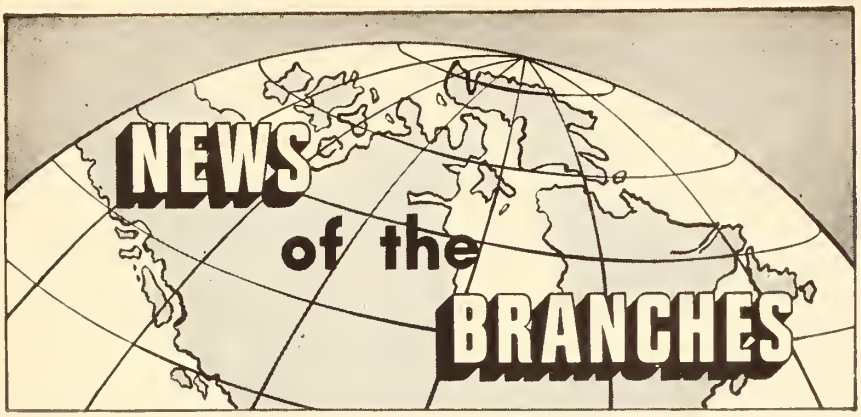

Activities of the Forty-seven Branches of the Institute and abstracts of papers presented at their meetings

Belleville

J. A. GRANT, M.E.I.C.,
Secretary-Treasurer

H. D. Rothwell Discusses Seaway Project

The Belleville Branch held its third meeting of the season on December 13 at the Masonic Temple with approximately 37 members and guests present.

The chairman, Mr. Drysdale, opened the meeting, and E. G. Gurnett introduced the guest speaker, H. D. Rothwell, who is the Hydro liaison officer on the St. Lawrence Seaway Project.

Mr. Rothwell gave a very interesting account of the problems facing the Hydro as a result of the raised water level. Plans for the re-location of town sites, highways and railways were illustrated with slides.

The appreciation of the audience was expressed by G. A. M. Bradford.

Calgary

WM. E. HAWKINS, M.E.I.C.,
Secretary-Treasurer

Andre Coyne Guest Speaker

A general meeting of the Calgary Branch was held at the Palliser Hotel on October 18, 1954.

In the business section of the meeting, the minutes of the general meeting of April 22, 1954, were read and adopted. The chairman urged the members to attend the Monday luncheon meetings and asked that they hand personal news regarding branch members to the publicity committee chairman.

The speaker of the evening, André Coyne, Hon. M.A.S.C.E., was introduced by the chairman. A noted French engineer, Mr. Coyne spoke on the subject "25 Years in Designing and Building Dams".

The address, well illustrated with coloured slides, was divided into three main parts: the general theory and design of arch dams, prestressing of dams, and architectural treatment of dams. It was substantially the same address given at other branches during Mr. Coyne's Canadian tour and reported in this Section earlier.

The Border Cities Branch held their third annual dinner dance in October and these pictures show some of those present at the Beach Grove Golf Club.

Top pictures from left to right: at the head table: Mrs. C. G. R. Armstrong, Mr. and Mrs. R. T. Waddington, Mrs. W. G. Mitchell, P. S. Dewar and Mrs. Dewar, Branch Secretary R. J. Trinder and Mrs. Trinder and C. G. R. Armstrong.

At right: Representatives of the Branch and the Ladies' Auxiliary, who assisted Earl Dykeman, chairman of arrangements for the dance. Left to right: P. S. Dewar, chairman of the branch who presided at the dinner, and Mrs. Dewar; R. T. Waddington and Mrs. Waddington, president of the Ladies' Auxiliary.

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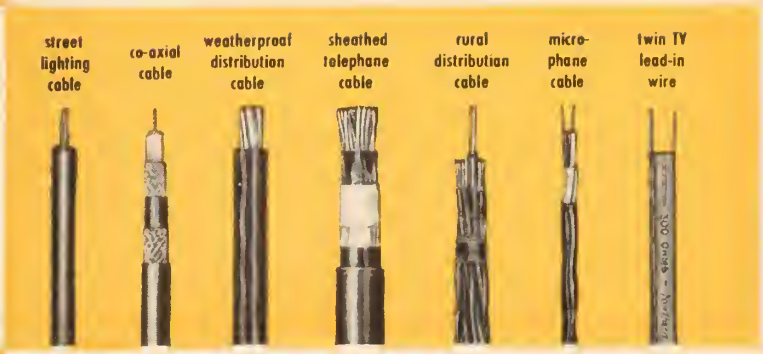

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E-2

A. W. Howard thanked Mr. Coyne on behalf of the audience, after a very active question period.

Central British Columbia

H. D. DeBeck, Jr.E.I.C.,
Secretary-Treasurer

General Secretary's Visit

Dr. L. Austin Wright, general secretary of the Engineering Institute, met on December 7 with a group of the Kamloops professional engineers at the home of M. L. Zirul, chairman of the Central B.C. Branch.

Among the interesting news given by Dr. Wright was the fact that the Engineering Institute has purchased full rights in Canada, of the film "Leonardo Da Vinci' depicting the life and work of the greatest of all engineers, a scientist, painter, sculptor and poet.

The film was awarded the Grand Prize Documentary at the Venice Film Festival and also won the Robert J. Flaherty Film Award for 1952. It played for 12 record weeks at the Guild Theatre, Radio City, New York, is in full color and is soon to be made available to theatres across Canada. Special arrangements will be made for university and high school students to see the film in the cities where it is shown.

Another note of interest was the news of the part the Engineering Institute has played in helping Ottawa celebrate the centennial of its formation. It is just one hundred years ago that the name of that city was changed from Bytown to Ottawa. The Engineering Institute has purchased a fountain which will be erected in honour of the engineer, Colonel By, who played a large part in the growth of the city. The city has agreed to look after the water supply and lighting of the memorial.

A third note touched on by Dr. Wright was the progress being made by the committees working on the possible amalgamation of the Engineering Institute of Canada and the Provincial Association.

Dr. Wright returned to Montreal via Calgary and other centres where he addressed branches of the Institute not touched by the annual visit of the president, D. M. Stevens.

Fredericton

Ira M. Beattie, M.E.I.C.,
Secretary-Treasurer

Noreen E. Donahoe, S.E.I.C.,
Branch News Editor

Professional Development

The Fredericton Branch held a meeting on "Professional Development" on December 14, 1954, at the Lord Beaverbrook Hotel. The guest speaker for this dinner meeting was Horace Pettigrove, who has had experience in the field of trade unionism and collective bargaining in the United States and Canada as well as in Europe.

Colonel Robert Cassidy, assistant project manager of Defence Construction Limited for Camp Gagetown, was chairman for the evening and introduced the guest speaker and the members.

Mr. Pettigrove, speaking on "Labour Relations," gave a brief history and explanation of trade unionism and collective bargaining. He stressed the importance of these in the free world and the part they play in international and labour relations. He mentioned that technical development has been more prevalent to date than improvement in the handling of the labour. In his opinion it should be a requirement of professional personnel to have a better understanding of labour relations as well as knowledge of the technical aspects of business.

Mr. Pettigrove discussed the evaluation of labour in the free countries. He compared the regimentation of peoples under government control with the system of collective bargaining in which labour receives benefits and the employee receives protection. He also pointed out that the parties directly affected by labour disputes are better qualified than outsiders to make decisions and to comment on methods of handling disputes as under collective bargaining.

Finally Mr. Pettigrove discussed the specific types of unions existing in Canada, their powers and their limitations; the geographical breakdown of union: i.e. federal, provincial or more local. He described what each type was interested in obtaining for its members, the part that law plays in a dispute, and more fully discussed "the strike."

A discussion of the subject took place among the members and a question and answer period followed.

Huronia

L. Morgante, Jr.E.I.C.,
Secretary-Treasurer

Corrosion in Action

On November 16 last the members of the Huronia Branch heard an interesting talk by R. J. Law, chemical engineer, of the corrosion engineering section of the International Nickel Company of Canada Limited. Mr. Law, an expert on corrosion, brought with him three reels of colour film which demonstrated corrosion in action. These films have been shown to a great many audiences in the United States and also to a few in Canada and are recommended to other branches.

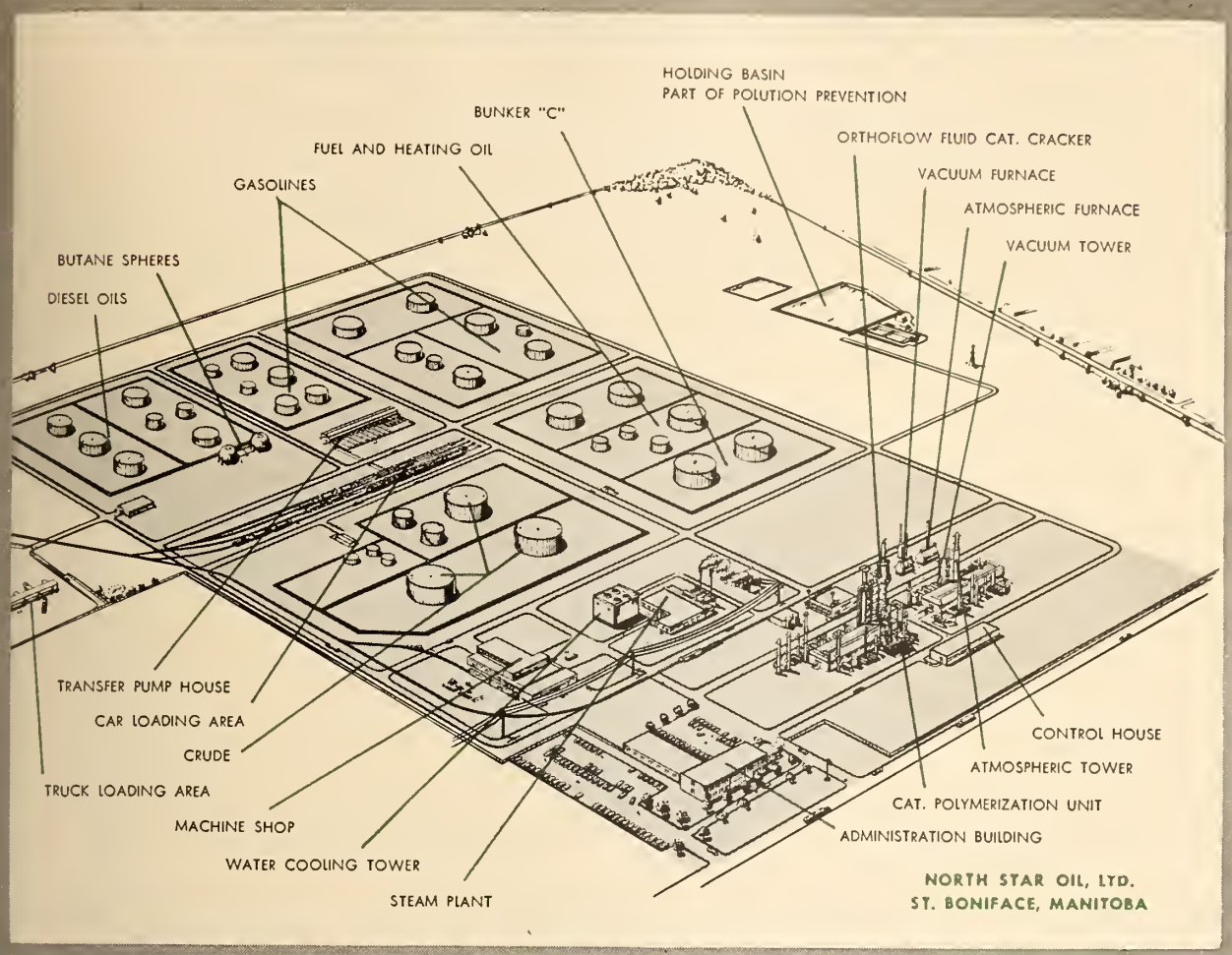
Corrosion is a very important subject. It was surprising to learn that in the United States some six billion dollars is spent annually in fighting corrosion. The films discuss corrosion from first principles, pointing out how corrosion is linked up with electric currents.

R. L. Hearn Guest Speaker

On Thursday, December 9, a very interesting meeting was held in Orillia when R. L. Hearn, chief engineer and general manager of the Hydro-Electric Power Commission of Ontario gave a talk on the St. Lawrence power project.

Mr. Hearn made the statement there is nothing more important in our way of life today than electric power, both as regards industry and home life. He pointed out that it was only recently that power shortages in the hydro system had been overcome; as a matter of fact the year 1954 is the first year that hydro has had any reserve of power. This has been due to the unprecedented growth in demand.

Mr. Hearn's talk was in reality a brief history of the Hydro. Since the year



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The first annual dinner dance of professional engineers, an event sponsored jointly by the Niagara Branch of the E.I.C. and the Niagara Chapter of the Association of Professional Engineers, ws held on October 15, 1954. The top picture shows head table guests, from left to right, as follows: C. H. Killoran, Mrs. C. H. Watson, T. C. Keefer, Mrs. H. C. Tucker, T. M. Medland, Mrs. J. E. Quist, P. E. Buss, Mrs. W. L. Sagar, J. E. Quist (not visible), W. L. Sagar (standing), Mrs. P. E. Buss, Mrs. T. M. Medland, H. C. Tucker, Mrs. T. C. Keefer, Mrs. C. H. Killoran, C. H. Watson. There is a general view of the dinner in the second picture.

1945, the Ontario Hydro have spent one billion dollars on capital assets. Their capital assets prior to 1945 were only $400 million. Now they are $1,400 million. Hydro is proud of the fact that 85 per cent of this money came from Canada. The Hydro has at present a total of 60 generating stations and 20,000 employees. The average load growth since the year 1922 has been 5.7 per cent yearly. It is expected that future growth will proceed on about the same basis. This means Hydro must continue to find more and more power.

Immediately after the war years, new plants on the Ottawa River staved off power shortages for a while. Then Hydro put in emergency steam plants, and the great new Niagara development is expected to carry it through until the St. Lawrence Seaway Power Plant comes into production in the year 1958. After the St. Lawrence, it is likely the Commission will have to revert to thermal means of producing power. Atomic power is being looked into very thoroughly. However, Mr. Hearn feels that it may be ten to 15 years or more before atomic power becomes efficient as other means.

Mr. Hearn stressed the value and importance of power tie-in with United States lines. This means that we can sell off peak water power instead of letting water simply go over the dam, and thus save coal in the United States plants. It also means that the Canadian system can depend on United States steam plants for emergency purposes.

St. Lawrence Project

Regarding the St. Lawrence power project, the problems involved have been chiefly political. The engineering problems are relatively simple when compared to say the recent Sir Adam Beck power plant No. 2 at Niagara. The St. Lawrence project will be huge. There will be a tremendous amount of work to do, but the engineering problems will not be particularly complicated.

Hydro has guaranteed the Province of Quebec that the natural flow of the river will not be changed, and for this reason they are putting in a control dam at Iroquois.

The power plant will have an installed capacity of 2,200,000 horsepower, half of which will belong to the United States and half of which will belong to Canada. There will be 32 power units, half belonging to each country. An interesting innovation regarding this power plant is that the superstructure will be eliminated. Each generator will be simply covered by what Mr. Hearn called an aluminum can. They will have a 400-ton gantry crane over the top of these generators so that when they want to remove a unit they simply have to lift off the can, take out the generator and then it is moved along to either end of the dam into a relatively small building. There will be a small building located on the United States side and also one on the Canadian side.

The cofferdams are presently under construction and the contracts for excavation will be let shortly after the first of the year, as well as for the power houses. As an indication of the size of this project, some 61 million yards of earth will have to be excavated

Five thousand people will have to be moved from the area to be flooded, including 50 farms, 32 miles of highway and 22 miles of railroad.

This was one of the most successful meetings that the Huronia Branch has had to date. Some 60 were present and from as far away as Penetang, Owen Sound, Midland and Barrie.

Hamilton

A. F. Barnard, Jr.E.I.C.,
Secretary-Treasurer

F. Gue, Jr.E.I.C.,
Branch News Editor

E.I.C. Hosts to Chemical Institute

The meeting of the Hamilton Branch was held on December 9, 1954, at McMaster University.

W. A. Wheten, chairman of the Branch, presented Mr. Don Switzer, chairman of Hamilton Branch of the Chemical Institute, who thanked the Engineering Institute for inviting them to this meeting.

Dr. I. R. Tait Discusses Plastics

W. J. W. Reid, president of Otis Elevator Co. Ltd., introduced the speaker, Dr. Irving R. Tait, consulting engineer, Canadian Industries (1954) Limited.

Discussing the impact of new plastics on engineering, Dr. Tait said that these man-made materials make up a large family, each member of which has its special advantages. The raw materials from which plastics are made are capable of being variously combined to give a wide range of properties in the end products.

Dr. Tait's paper will be published in full in an early issue and therefore will not be reported here.

H. A. Cooch, of Canadian Westinghouse, thanked Dr. Tait.

A movie on "The Design and Production of Bakelite Products" was shown.

While refreshments were being served, Dr. Tait and his associate M. Wilkinson, answered questions from the audience.

There was an attendance of approximately 100. Of this number 35 were members of the Chemical Institute.

Kitchener

J. F. Runge, M.E.I.C.,
Secretary-Treasurer

J. L. Fair, M.E.I.C.,
Branch News Editor

Television Studio Tour

The ladies were included in the December meeting which took the form of a tour of the television studios of station CKCO in Kitchener. Mr. A. G. (Sandy) Day supervised the tour, explaining and demonstrating some of the techniques used in handling the studio equipment in the production of a live show.

The visitors had an opportunity to see the control room in action and view some of the equipment necessary to maintain the quality of the broadcast, from film, network, or the local studio. Probably the most amusing event was the march past the TV camera and the spontaneous compliments on the "actors" as they appeared on the screen.

After leaving the studio the group reassembled at the Officers' Mess, Knollwood Park, for a social hour.

Lethbridge

R. D. Hall, Jr.E.I.C.,
Secretary-Treasurer

P. Harding, Jr.E.I.C.,
Branch News Editor

President's Visit and Joint Meeting

The combined dinner meeting of the Alberta Association of Professional Engineers and the Engineering Institute of Canada was held November 26 at the Marquis Hotel in Lethbridge. The chairman of the meeting was L. A. Thorssen of Calgary, president of the Alberta Association of Professional Engineers.

The speaker for the evening was Dr. Donald McGregor Stephens, president of the Engineering Institute. Dr. Stephens stressed the necessity of Canadians selling their country to Canadians as well as to the four corners of the world.

Canada is producing about 1,300 engineers annually compared with the United States 29,000 and Russia's 39,500. This means that Canada is proportionately turning out less than five per cent of the number of engineers each year graduated by American universities. With the shortage of trained men in other parts of the commonwealth it would be difficult to obtain help from this source. Canadian universities could produce many more engineers, which could eventually allow Canada to be developed by more Canadian engineers.

Dr. Stephens noted that we need to put more clearly to youth the picture of Canada's past development and the breadth of Canada's future development.

The president was introduced by J. C. Neufeld and thanked by E. A. Lawrence.

Dr. L. Austin Wright, secretary of the Engineering Institute, outlined progress towards confederation of the Engineering Institute with the Associations of Professional Engineers. This would allow members of one body to automatically become members of the other. The atmosphere for confederation was favourable but the process would take some time to think out carefully all problems involved so that the great body of members would approve the idea. Dr. Wright felt that when it goes to the ballots it must get a sweeping majority and that time must be taken to tell the engineers about it.

Greetings from the City of Lethbridge were extended by Alderman C. J. Black.

Entertainment was provided in the form of recitations by A. J. Branch and music by Art Hunt, baritone, and Mr. and Mrs. George Brown.

Montreal

R. J. Harvey, M.E.I.C.,
Secretary-Treasurer

J. A. Paget, M.E.I.C.,
Publicity Chairman

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At a joint meeting of the Instrument Society of America and the Montreal

The Montreal Branch oyster party.

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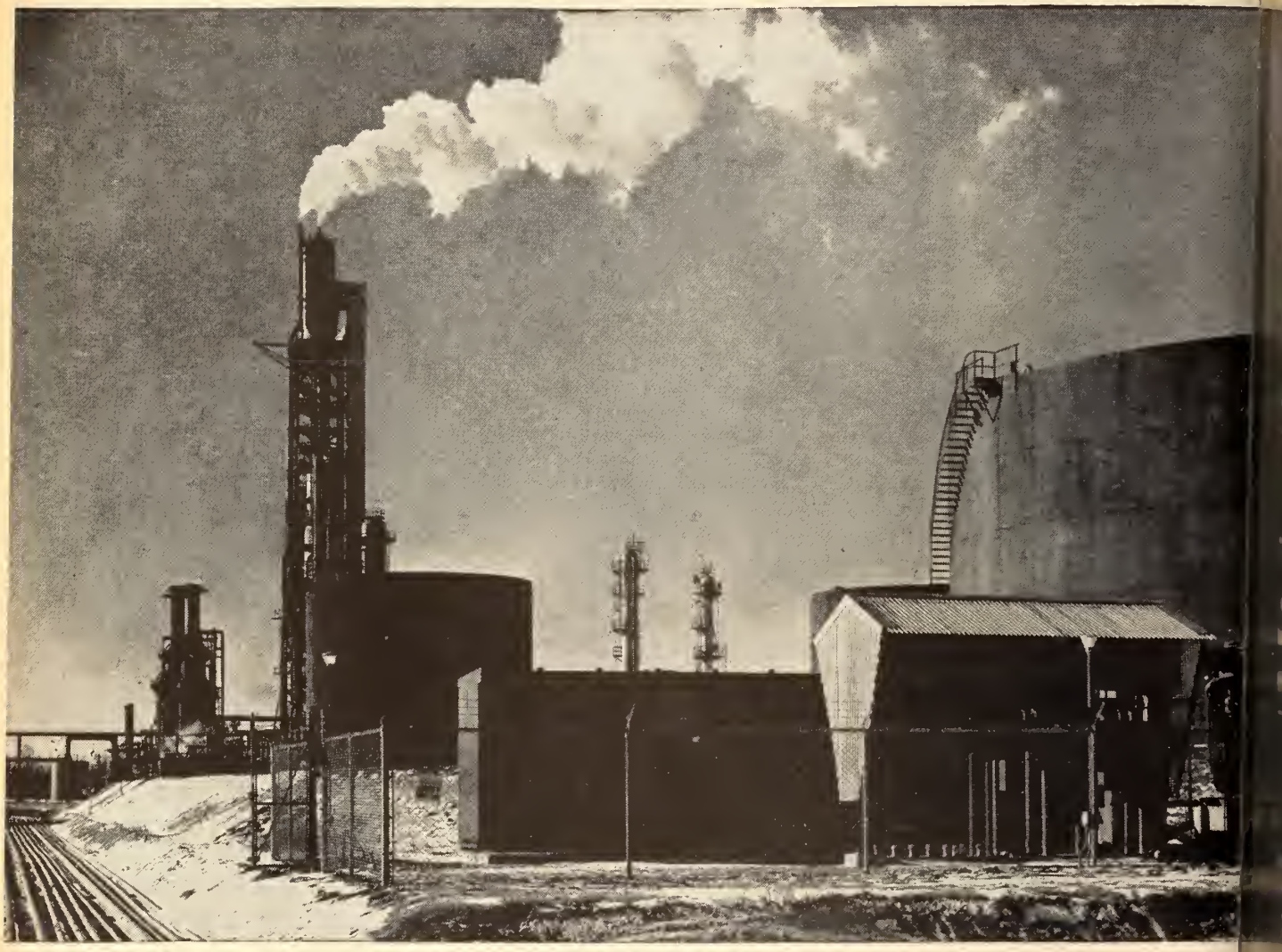
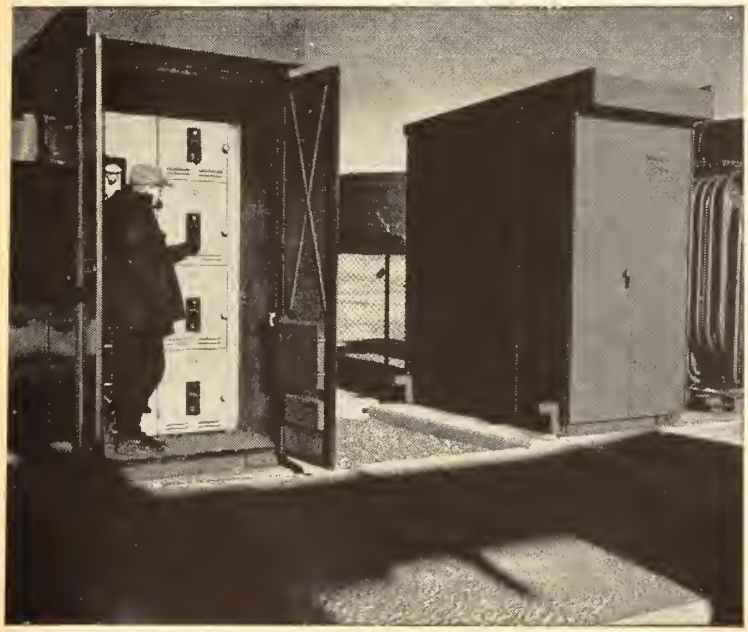
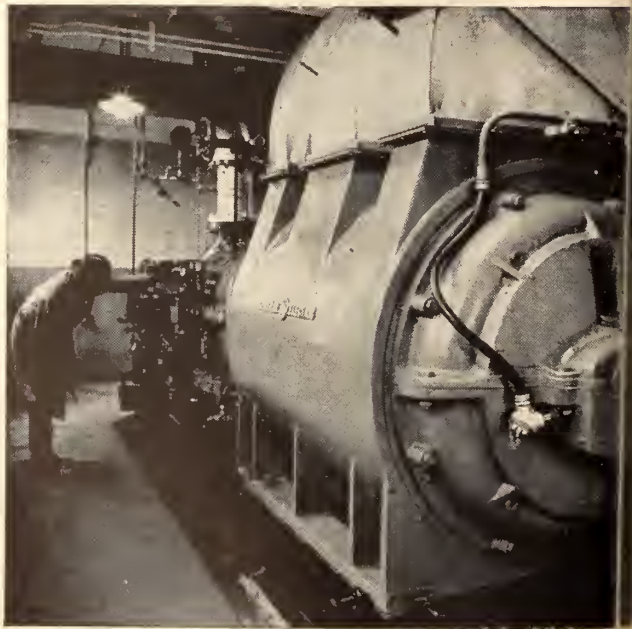


To increase operating safety, racked-up, low-voltage explosion proof G-E starters (right fareground) are located outdoors. They cantral small motors driving pumps used in the refining pracess. To their left are high voltage G-E Limitamp controllers for large motors, driving campressors, pumps and other equipment.

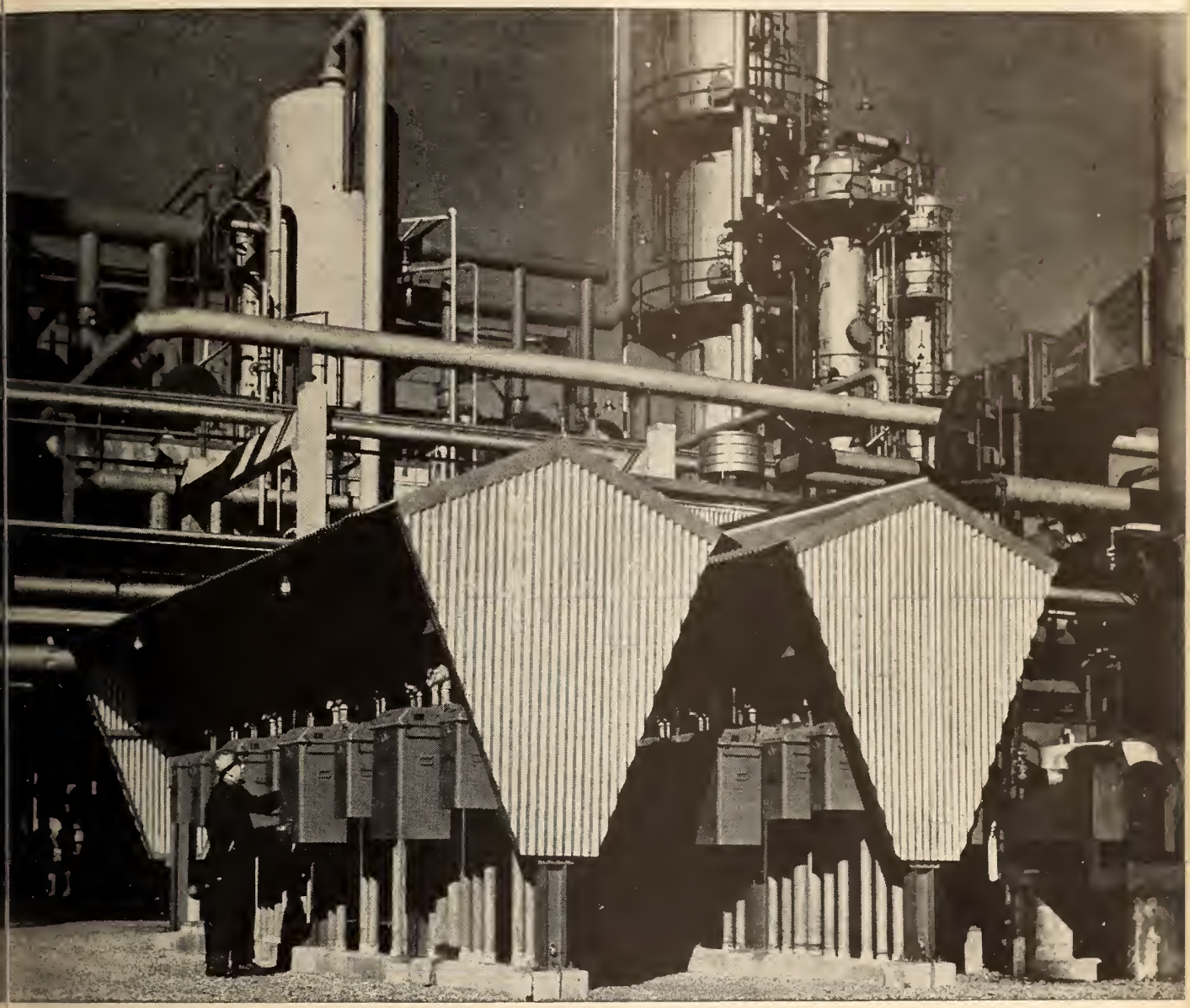


Outgoing feeders to the refinery area are exactingly controlled and protected by this highly efficient low-voltage air circuit breaker equipment. C-G-E electrical systems far refineries are engineered for utmost operating safety.



This massive G-E 1250-hp Motor powers the largest and most important drive in the pracess. Situated in the heart of the refinery, it drives the wet gas compressor of the cambination unit. To ensure safety In a hazardous area, duct-work supplies fresh cooling air to the motor

UN OIL'S first Canadian refinery



Small motors located throughout a maze of refinery equipment are controlled from this low-voltage control station. Accessibility of these racked-up explosion proof starters with oil-immersed contactors, permits greater control efficiency as well as increased ease of maintenance.

N OIL's first Canadian refinery, with a design apacity of 15 thousand barrels per stream day, C-G-E Engineers an excellent chance to 'show he remarkable efficiency of G-E Equipment in mlining refining operations. Most of the electrical pment was supplied by C-G-E, in close co-operawith Sun Oil engineers and the Catalytic Contion Company of Canada Ltd. By eliminating many pipes and fittings of steam power systems, G-E pment lops off a generous part of maintenance . . . 'snugs up' the equipment controls for easy vision. Add the advantages of longer equipment life, and C-G-E's acknowledged leadership in engineering electrical systems for petroleum refineries, and you will recognize the 'dollars-and-sense' wisdom of specifying G-E for refineries—or any industrial application. Simply contact any Apparatus sales office in C-G-E's nation-wide system, or the Apparatus Division, Head Office, 212 King St. W., Toronto.

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Branch, Dr. D. P. Eckman addressed a large audience on the subject of control valve operators. Dr. Eckman a widely known author in the control field was an associate professor at Case Institute and is associated with the Condflow Corporation.

Dr. Eckman began by explaining the important function of the valve as the link between the information-handling portion and the energy-handling portion of a control loop. He explained why the pneumatic valve operator was the most popular, and showed slides of the spring and diaphragm type, the spring and diaphragm type with positioner, the springless type, the piston and cylinder type and the rotary actuator type.

The speaker explained the field of application of each type and then showed curves characteristic of their performance. With these curves he easily and clearly demonstrated the need for a better method of performance description and showed how the principle of frequency response common in electrical work filled this requirement.

The matching of system components using frequency response methods was covered in detail and was very lucid and refreshingly quantitative. The speaker was very generous and proficient in his answering of questions.

The meeting chairman was E. Lehmann. The arrangements were by L. Martin, and Ted Yule thanked the speaker.

J. A. P.

The Super Constellation Aeroplane

Frank M. Francis, Super Constellation project engineer of Trans Canada Airlines, speaking at a Montreal Branch meeting outlined the background of the present Super Constellation aeroplane, and described previous Constellations and their sizes, weights and engine powers in comparison to the present design.

He described the structure of the Super Constellation, the hydraulic control systems, the air conditioning system, the conditioned water system, space layouts and passenger seating arrangements, the engines, and their recovery turbines.

Several questions were asked by the audience in connection with the aeroplane and were answered by Mr. Francis.

C. Heaney thanked the speaker and adjourned the meeting, which was arranged and presided over by H. N. Young.

T. M.

The Use of Electricity in Medicine

New and different forms of electrical treatment and diagnosis are constantly being developed, said Dr. John F. Davis at a joint meeting of the Montreal Branches of the E.I.C. and the American Institute of Electrical Engineers.

Dr. Davis graduated in electrical engineering from McGill in 1942 and worked on radar at N.R.C., later becoming involved in electrical problems of medical research. He returned to McGill and in 1950 graduated as an M.D. He is engaged in medical research at the Allan Memorial Hospital.

Dr. Davis described the part electricity plays in medicine. Electronic devices for diagnosis produce records that require extensive skilled analysis and are no substitute for the personal relationship between patient and doctor. The Allan Memorial Institute deals with mental disease and Dr. Davis explained the instruments used. "The value of brain wave recordings," said the lecturer, "is that they show up the abnormal sources of electrical activity such as brain tumors, epileptic foci, scars and other lesions in the brain as well as the gradual senescence or aging of brain activity which accompanies cerebral arterial sclerosis. These are of great interest to psychiatrists.

The meeting was arranged by R. D. V. Merritt and D. King was chairman.

J. A. P.

Les problèmes de l'ingénieur-conseil au Canada

La première séance en langue française de la Branche de Montréal fut tenue dans les locaux de la rue Mansfield, mardi le 23 novembre 1954. Ce sera sans doute une date historique puisque le succès fut éloquent et à la fin de l'assemblée une motion fut passée pour que les séances de langue française deviennent un apanage régulier des programmes.

M. Henri Gaudefroy, directeur de l'Ecole Polytechnique, présenta le conférencier M. P. A. Salbaing. Dans son allocution M. Gaudefroy souligna la compétence du conférencier qu'une longue carrière, aussi diversifiée que fructueuse, prépara au poste important de directeur de la division du génie et de la construction qu'il occupe à la compagnie Air Liquide de Montréal.

Cette première assemblée technique en langue française attira un bon nombre d'auditeurs. Le sujet traité était "Les problèmes de l'ingénieur-conseil au Canada".

Afin de faciliter l'exposé de son sujet M. Salbaing développe le cas de l'ingénieur-conseil dans le domaine chimique. Tout d'abord il retrace brièvement le tableau historique de l'apparition de la profession d'ingénieur chimique; il s'attaque ensuite aux problèmes variés que la profession a à résoudre.

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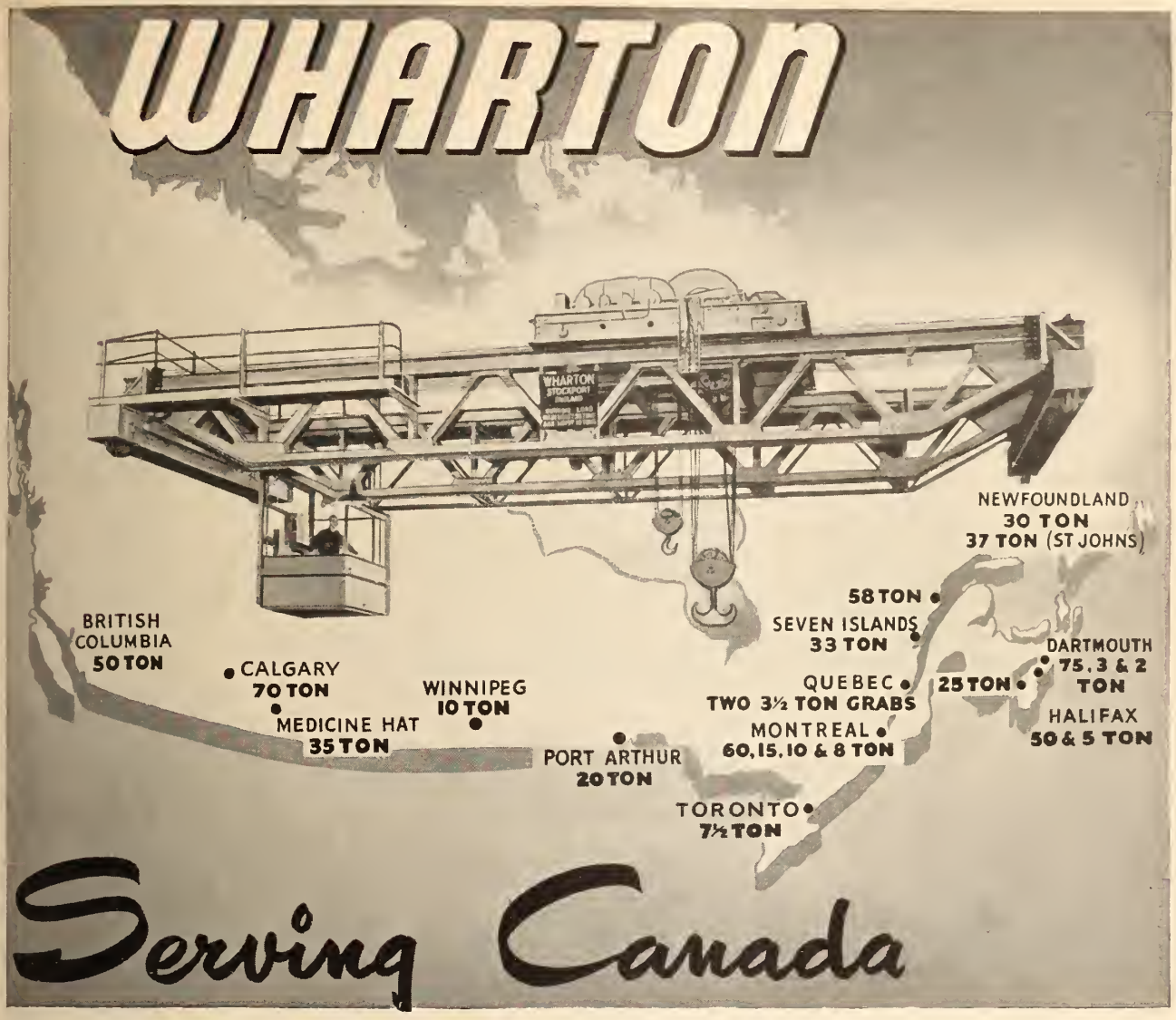

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etc.), les problèmes de la vente des services, les problèmes de structure interne comme charte d'organisation, les problèmes financiers et d'autres encore furent tour à tour passés en revue avec la description de méthodes judicieuses capables de surmonter ces difficultés. Tout particulièrement il analysa celles qui confrontent l'ingénieur-conseil dont la tâche serait d'installer une raffinerie pour les pétroles.

Comme conclusion M. Salbaing résuma ce que d'ailleurs sa conférence entière faisait ressortir, c'est-à-dire: "la position de l'ingénieur-conseil isolé devient de plus en plus précaire" particulièrement dans le domaine du génie chimique où des problèmes de toutes sortes doivent être maîtrisés. D'autre part, il semble "qu'un avenir brillant s'annonce pour les sociétés d'ingénieurs-conseil"; dans ces groupements on peut se permettre les services de spécialistes pour chaque phase particulière du projet tout en conservant l'unité par l'intermédiaire d'une ingénieur en chef.

L'intérêt qu'a suscité cette conférence fut souligné par le nombre de questions posées. C'est à regret et à cause de l'heure avancée que M. Gaudefroy demanda à M. Jules Mercier de clore la séance en remerciant le conférencier.

M. B.

The Toronto Subway

On Tuesday, November 9, the Civil Section of the Montreal Branch held a meeting with Mr. J. Archambault, M.E.I.C. acting as chairman and Mr. W. H. Paterson, M.E.I.C., chief engineer of the Toronto Transit Commission, as guest speaker of the evening.

Mr. Paterson reported on eight months of operation of the Toronto Subway, giving data and facts which were of value and great interest to everyone present.

A point of particular interest is the reorganization of routing by the subway users. As it stands now, the subway replaces two lines which eight months ago had a combined hourly capacity of 18,000 passengers. In order to estimate the probable subway required capacity, a figure of 10 per cent increase was first considered, which was again increased before completion of the construction; and as it is now, after only eight months operation the increase is over 30 per cent.

Why do people ride the subway? The answers to this question provide fertile criteria for design: "because it is light, bright, clean; because it provides frequent, convenient and attractive service; because it saves time and money". One adds the safety features, and the design considerations are complete.

As Mr. Paterson pointed out, there is still room for improvement on transit performance, but operation during the first few months has already justified the wisdom and courage of those who conceived, planned and built the Toronto Subway.

After Mr. Paterson's address, a film was shown illustrating the different phases of the construction of Toronto's subway. A questioning period was then started, after which Mr. Simmons thanked the speaker in the name of all those present, and the meeting adjourned. Meeting arrangements were made by J. C. Brodeur, M.E.I.C.

P. H.

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352. B

Moncton

V. C. BLACKETT, M.E.I.C.,
Secretary-Treasurer

Dieselization of Canadian Railways

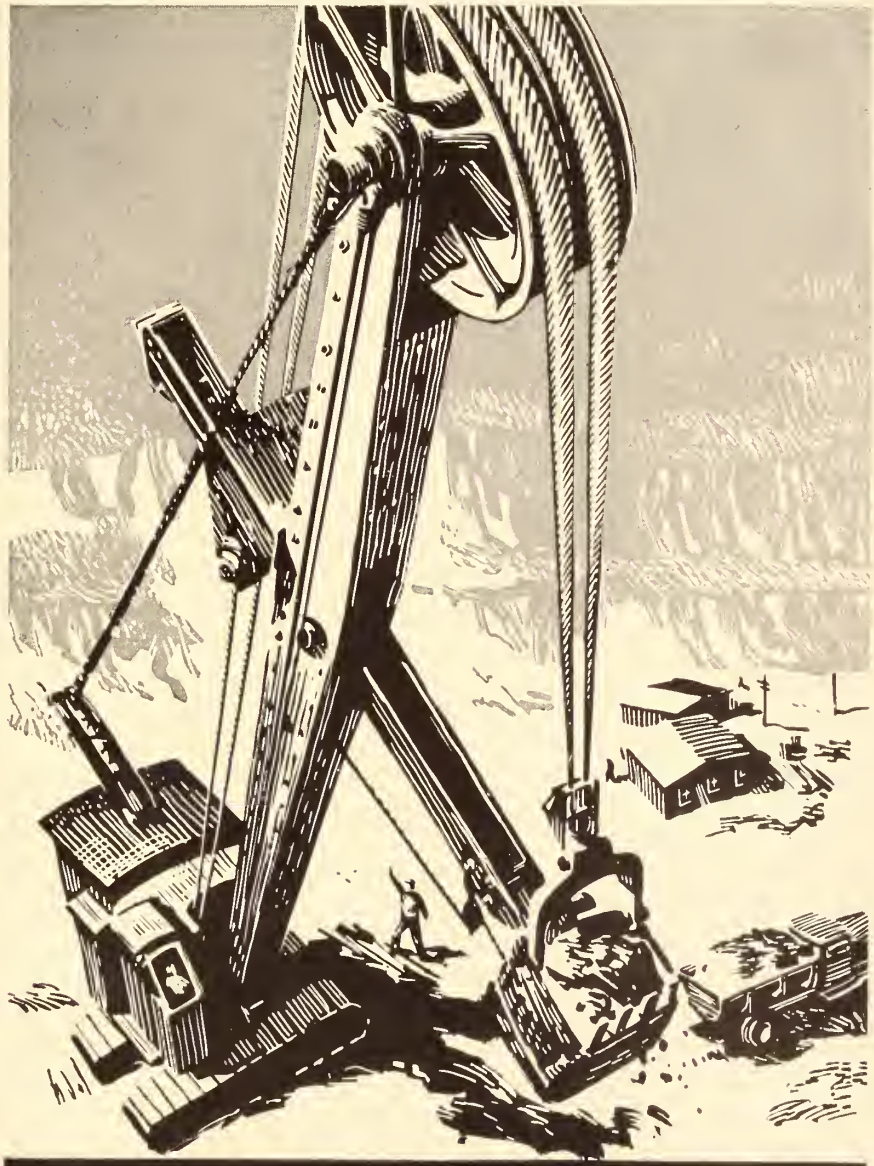
A dinner meeting of the Branch, held in the rooms of the Moncton Curlers Association, on November 15, was addressed by three Canadian National Railway engineers on the subject of "Progress in the Dieselization of Canadian Railways". M. F. K. Leighton, chairman of the Branch, presided. Grace was offered by Archie Gordon.

Frederick Holmes, transportation engineer, discussed the economics of dieselization. While no machine can operate 100 per cent of the time without repairs, the diesel should average 85 per cent as against 55 per cent for a steam engine. The greater availability of the diesel locomotive is therefore important, the speaker said, not only because it reduces the number of locomotives required, but also because it permits much longer runs to be made with one locomotive. As regards fuel costs, the internal combustion engine has a thermal efficiency of approximately 30 per cent as compared to 10 per cent for the steam engine. Furthermore, the handling and storage cost of liquid fuel is less than that of solid fuel.

B. E. Bayne, supervisor of diesel equipment, talked about the history of diesel-electric motive power. The Canadian National Railways, he said, was the first railway in North America to apply the oil-electric power plant to rail cars, and the first to build a diesel-electric main line unit on this continent. In 1925 several four cylinder cars were built in Glasgow, and later six cylinder types were added. Other models were manufactured by the Canadian Locomotive Company. These locomotives had a Beardmore engine which produced 1330 horsepower at 800 r.p.m.

The mechanical features of the diesel equipment now in use on the Atlantic region, some of which has been in operation for many years, the majority less than five years, were discussed by H. Taylor, regional supervisor of diesel equipment. Referring to diagrams and slides, Mr. Taylor gave interesting information about the various types of diesels in use throughout the Maritimes.

The three speakers were introduced, in turn, by R. F. Weir, T. H. Dickson and Keith Leighton, and were thanked by W. D. G. Stratton.



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Secretary-Treasurer

J. O. FLOWERS, JR.E.I.C.
Branch News Editor

Meeting in Newcastle

A general meeting of the Northern New Brunswick Branch was held in the new town hall at Newcastle on December 11, Chairman G. A. Kirner presiding, with 20 members in attendance.

The members were welcomed to Newcastle by Mayor P. E. Roy who expressed the wish that future meetings of the Branch would be held in Newcastle.

During the business period of the meeting the presentation of papers at the branch meeting was discussed. It was decided that these papers would be on both technical and non-technical subjects and a maximum of two papers would be presented at a meeting.

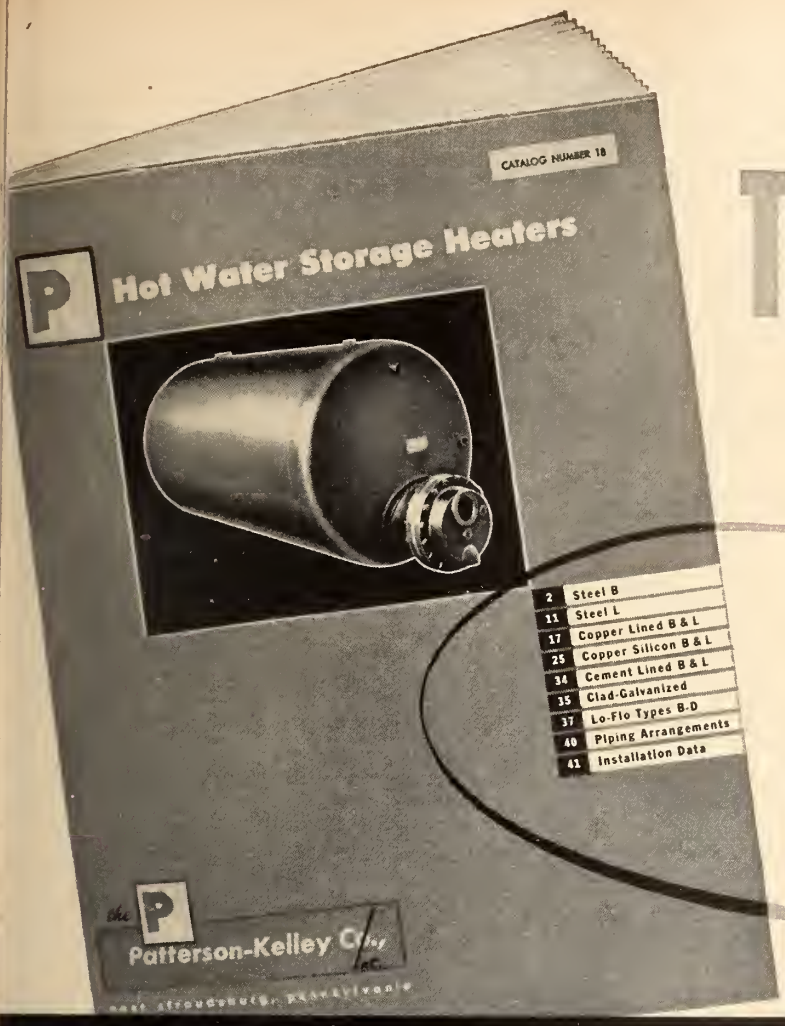
T. Creaghan Discusses Industrial Unit

G. J. Melanson introduced the first speaker of the evening, Mr. T. Creaghan, whose subject was "The Optimum Industrial Unit". Mr. Creaghan outlined the forces which determined the optimum size of any industrial unit, after market variations and fluctuations were accounted for. These forces; technical, managerial and financial were explained with examples and their interrelation shown as affecting the optimum size of unit. A discussion period followed in which the members showed considerable interest in the subject. The chairman thanked the speaker and then called on G. P. Milton to introduce the second speaker of the evening, Mr. C. K. Steeves.

C. K. Steeves Speaks on "Centri-Cleaner"

Mr. Steeves spoke on the "Centri-Cleaner", outlining its history, specifications and performance. He went on to explain the practical applications of the centri-cleaner and discussed the comparisons between units of different physical dimensions. A lively discussion period followed.

The chairman thanked the speaker and then announced the Mayor's offer



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of a conducted tour through the new town hall. This offer was accepted and the meeting adjourned to tour the building.

Nipissing and Upper Ottawa

E. A. Watson, M.E.I.C.,
Secretary-Treasurer

Discussion of Aero Instruments

The December meeting of the Nipissing and Upper Ottawa Branch of the Engineering Institute of Canada was held on December 8, 1954, in the Sturgeon Hotel at Sturgeon Falls. Thirty-four members and guests attended. J. W. Millar, branch chairman was in charge of the meeting.

G. L. Hood introduced the speaker for the evening, Mr. Ray Hogue. Mr. Hogue is a graduate in mechanical engineering of the University of Toronto. He is employed by the Sperry Gyroscope Company and is located at the North Bay Air Force base.

Mr. Hogue chose as his topic, "Aero Instruments", and dealt particularly with flight instruments. He followed through the development of the directional gyro compass pointing out its many advantages over the magnetic compass. The operation and principles of the horizon indicator, altimeters, airspeed indicator and zero reader were well explained.

Through the courtesy of Mr. Hogue and the Sperry Gyroscope Co. two sound movies were shown. The first entitled, "The Gyrosyn Compass", cleverly illustrated the principles behind the gyrosyn compass. Pictures taken during a test flight demonstrated its superiority over the magnetic compass and the directional gyro compass.

The second movie was "A Review of British Aviation in 1953". Most of the action took place at the Farnsborough Air Show. The audience was amazed at the variety in design of the many planes. It illustrated that the British are not lagging in new airplane development.

On behalf of those present Ed. Forsythe thanked Mr. Hogue for his efforts in presenting an interesting evening.

Saint John

J. W. G. Scott, M.E.I.C.,
Secretary-Treasurer

H. S. McCleave, M.E.I.C.,
Branch News Editor

Annual Meeting

The annual meeting of the Saint John Branch was held on December 14 at the Admiral Beatty Hotel with R. M. Richardson as chairman.

Following the reading of the executive report by Mr. Richardson and the financial report by J. A. B. Brenan the election of new officers was held and after the counting of ballots the following were declared elected:

T. C. Higginson, chairman; F. L. Doty, vice-chairman; J. G. Bishop, H. W. Townsend, and H. N. Day (to serve 1 year), executive members. J. J. Donahue is the fourth executive member, having one year of his two-year term to serve.

The lecture series on Professional Development is to be carried on again this year and it is hoped to reinstitute these lectures in the near future.

The industrial development of Saint John and the province will be the featured topic of discussions at many of the future meetings.

Ottawa

G. A. Sutherland, M.E.I.C.,
Secretary-Treasurer

C. E. Howard, M.E.I.C.,
Branch News Editor

Road Safety

"Research into Road Safety" was the subject of the talk given by Dr. W. Glanville, C.B., C.B.E., D.Sc., Ph.D., director of road research for Great Britain and past president of the Institute of Civil Engineers, to the Ottawa Branch at their luncheon meeting on November 11, 1954, in the Chateau Laurier.

Dr. Glanville was in America to study traffic conditions and highway research. He stated that in Great Britain, the chance of becoming a road casualty during the course of one's lifetime stands at one in three. Factors which

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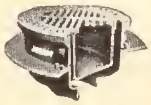

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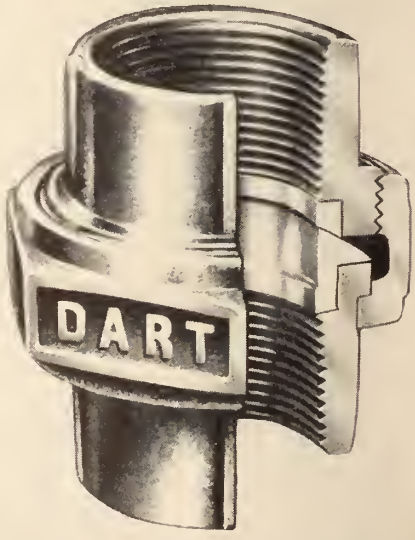

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bring about these and other frightening statistics are basically the same in both countries.

Reviewing the casualty position in Britain, Dr. Glanville said that one person in every 25,000 is killed each year. In Canada, the road death rate stands at one in 5,000. He claimed, rather grimly: "We kill three times as many pedestrians and three times as many motorcyclists as you do," while acceding: "You kill nearly twice as many drivers of motor vehicles as we do."

To place these facts in proper perspective, he pointed out that Britain had 3½ times the population, and 1½ times the number of vehicles in Canada. Britain's higher proportion of motorcyclist and pedestrian deaths was perfectly understandable when one considered the greater numbers of both in the old country.

Dr. Glanville wondered, however, why Canada should number so many car drivers among its dead. Perhaps it was, he said, because cars here were capable of higher speeds, had longer straight sections of highway upon which to prove this fact. Again, there were few level crossings in the U.K., and these had their own systems of traffic control, to make road-rail collisions almost impossible. Another possible factor was the greater mileage clocked up by North American cars, with the consequent lessening of ability to cope with existing road conditions.

The accident trend in Britain had shown steady "progress" upwards except during the periods of the two world wars, when road travel was limited and later, during the period of the great gas shortage in 1948. The Road Traffic Act of 1934 and the introduction of "zebra" pedestrian crossings had also slowed up the trend to some extent. "It is clear that for immediate and rapid reduction—since we cannot look to wars or economic crises to solve the problem—the only proved course is by taking active administration measures," said Dr. Glanville.

Dr. Glanville told briefly of the studies and surveys being carried out by this research body on cause and effect of recorded accidents. As a result of one of their findings, the average British motorcyclist now wears a crash helmet made of materials examined and tested by the Research Committee.

Dr. Glanville reported also on the experiments which were being made in Britain with non-skid road surfaces, and checks made on vehicles to establish their roadworthiness. Dr. Glanville was introduced by R. F. Legget and thanked by the Chairman R. E. Hayes.

Work of Colonel By Reported

On October 21, 1954, R. F. Legget, director of the Division of Building Research, N.R.C., spoke to the Ottawa Branch at a luncheon meeting arranged by the Junior Section. His subject was "Colonel By and the Rideau Canal."

He stated that after the war of 1812 there was need of a military communication between the St. Lawrence River at Kingston and the Ottawa River. Colonel By was selected by the Duke of Wellington for this canal project. The canal was started in 1826 and finished in 1832, which was a truly remarkable engineering feat. The canal was built through thickly wooded wilderness where there were no roads, by hand labour. Flies and fever were always present.

Colonel By was asked to survey the land around the start of the canal works and was first magistrate of the new community of Bytown. A very lucid account of the living conditions and the difficulties encountered during the building of the canal was given by Mr. Legget.

In 1831, Colonel By was called back to England to face charges of over expenditure of his estimates. While exonerated by the parliamentary committee, he was not given recognition for his accomplishments. He retired and four years later died of a broken heart; so it was stated. The Rideau Canal remains as an enduring monument to his greatness as an administrator and as an engineer.

Mr. Legget quoted the following from the book "The Canadas", published in 1840, by Sir Richard Bonnycastle: "If ever man deserved to be immortalized in this utilitarian age, it was Lieutenant Colonel By. In an unexplored part of the country, where the only mode of progress was the frail Indian canoe, with a department to be organized, workmen to be instructed and many difficulties to

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C. B. Crawford, who presided at the luncheon meeting, and Jim Pritchard, who thanked the speaker, are members of the Junior Section.

Sudbury

A. D. Finlayson, Jr.E.I.C.,
Secretary-Treasurer

N. H. MacKinnon, M.E.I.C.,
Branch News Editor

Pressure Treatment of Wood

Forty-five members of the Sudbury Branch of the Engineering Institute heard E. A. Thompson, vice-president and general manager of Canada Creosoting Company, speak on "the Pressure Treatment of Wood", at a dinner meeting held at the Granite Club on December 2, 1954.

Mr. Thompson, a member of the Montreal Branch of the Engineering Institute, a registered Professional Engineer of the Province of Quebec, and a director of the Forest Products Research Society, explained to the group that the first use of preservatives was recorded in the Bible, "Make thee an ark of gropher wood; rooms shalt thou make in the ark and shalt pitch it within and without with pitch" (Genesis VI-12).

Although there is a large number of preservatives used today, the most widely used is creosote. Since surface treatment does not provide permanent protection, pressure treatment is required in order to impregnate the entire surface to a depth satisfactory for the protection necessary.

With the aid of drawings Mr. Thompson illustrated the basic equipment in a pressure treating plant and explained the different operations involved in producing the different types and degrees of protection as may be required.

Using samples of untreated wood, he illustrated the different agencies that destroy wood, explaining that the most serious was that of decay when the wood is exposed to both water and air, and damage caused by marine bores in salt water.

Mr. Thompson explained the economy involved in treating wood timbers and illustrated how in the case of a railway cross tie a saving of 50 per cent can be effected by pressure treating with creosote.

Before closing, he covered briefly the many types of preservatives in use today and the associated advantages and disadvantages of each.

An active question period followed the address by Mr. Thompson who was introduced by Calvin Capp and thanked by George Charlap.

Vancouver

C. P. Jones, M.E.I.C.,
Secretary

André Coyne

On October 15, Mr. André Coyne, French consulting engineer, addressed a combined meeting of the Vancouver Branch of the Engineering Institute of Canada and the B.C. Engineering Society on "25 Years of Dam Building". His presentation included many black and white and colour slides as well as a colour film. Because of the diversified audience to which he was speaking, Mr. Coyne gave a broad account of the design and construction of a few of the seventy dams for which he has been responsible.

Mr. Coyne's address has been reported in detail in this section of the Journal by branches visited earlier in his Canadian tour.

Winnipeg

C. S. Landon, M.E.I.C.
Secretary-Treasurer

Electrical Section

B. F. Webster, M.E.I.C.
Reporter

C.G.E. Engineer is Speaker

On December 2, G. W. Clayton, application engineer for the Apparatus Division, Peterborough, of the Canadian General Electric Company presented a paper on "Switching of Shunt Capacitors and Reactors" to the Electrical Section of the Winnipeg Branch.

Mr. Clayton pointed out that with the longer transmission lines and heavier loads located at the end of transmission lines, electrical utilities were faced with the problem of transmitting power at a very low power factor. Coupled with this was the demand for both leading and lagging kilovars, and it had now been found practical to install either synchronous condensers or shunt capacitors and reactors as close to the load as possible in order to obviate the necessity of transmitting kilovars.

Naturally, there are numerous problems associated with the application of shunt capacitors and reactors to high voltage lines but Mr. Clayton's paper dealt particularly with the problems associated with the switching of this type of equipment.

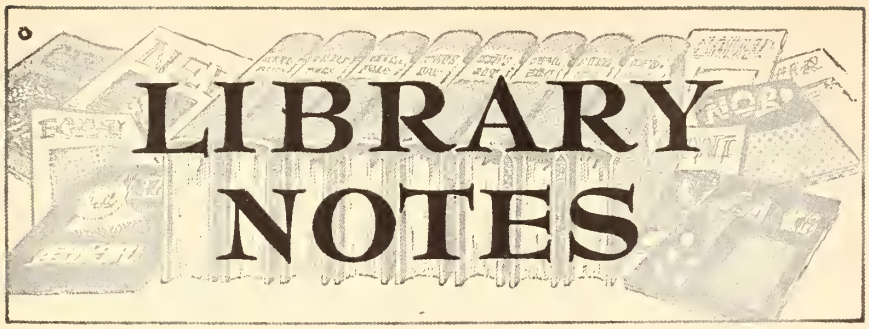
In capacitor switching, there are two main problems. The first concerns high momentary duty imposed on the switching device by the high inrush current produced when the capacitor bank is first energized. The second problem concerns the production of overvoltages due to repetitive restriking in the switching device when a capacitor bank is being de-energized.

Mr. Clayton discussed in detail the mathematical, theoretical and practical aspects of switching either single capacitors or multiple capacitor banks, and then developed a similar argument for the switching of shunt reactors but showed in the latter case that the same switching problems were not as onerous.

Mr. Clayton was able to outline the requirements of a switching device for these duties and presented technical data and performance figures on various switches and oil circuit breakers that had been developed to meet these requirements.

A period of discussion followed and showed the interest that had been developed in this subject as the result of Mr. Clayton's excellent talk.

Col. L. F. Grant, field secretary of the E.I.C., in Yarmouth, N.S., on November 23, visited with a group of engineers: seated, J. K. McKay, J. E. Clarke, president of the Association of Professional Engineers of Nova Scotia, S. W. Kenney, standing, R. B. Killam, D. MacQuarrie, L. F. Grant and H. W. MacKay.



Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Jet; the story of a pioneer. Sir Frank Whittle. Toronto, Saunders, 1953. 320 pp., illus., $3.50.

A BOOK FOR ENGINEERS

Few books will interest engineers as much as Jet, written by Sir Frank Whittle, an Honorary Member of The Engineering Institute of Canada. The sub-title is "The Story of a Pioneer". If ever an engineer's story needed to be written it was that of Sir Frank. He had so many difficulties trying to persuade any person that he had a worthwhile idea in his turbo-jet proposals, and if it had not been for the enterprise of one of his own friends and a friend of his friend who along with him put up a small amount of money (but all they had) to get the thing under way, there is no telling what the story of the jet would have been today as far as the Allies are concerned.

Doubtless when this book appeared on the newsstands it brought red faces to many people in many places. To a great extent the book is an indictment of some government officials and certain sections of industry. As well, it is a vindication of this man who almost single-handed got the jet out of the field of theory and into production.

It is heartbreaking to read of the difficulties Sir Frank encountered in trying to bring the motor into production. With officials in high places refusing to support him, and in fact undermining him behind his back and with certain industries trying to capitalize on his ideas for their own gain, and with mediocrity and stupidity rampant in certain fields, it is a miracle that the man ever produced a jet engine, and that he ever survived the ordeal.

It is well known to everyone acquainted with Sir Frank that in this process he ruined his own health. Not only was he working days and nights almost without cessation in an endeavour to complete the design and get the development work under way, but as well he was struggling with high officials who seemed to have no grasp at all of what he was trying to do or even any grasp of decent business principles.

The reader is impressed from the beginning by Sir Frank's appreciation of the contributions of those within his own company, Power Jets Limited, with whom he was so closely associated. From the preface right through to the last page he gives credit to these indomitable engineers who with him fought the battle both inside their own plant and outside. The following paragraph illustrates this point:

"The writing of this book serves many purposes. Firstly, I hope the act of writing it will serve to free me from the painful emotions which recollection of much of what I now place on record still evokes. Another object is to correct a number of incorrect statements which have appeared in the press and elsewhere from time to time. A third and very important object is to put on record the major contributions to Britain's present lead in the turbo-jet engine field of such men as R. Dudley Williams and J. C. B. Tinling and others whose valuable work has been too much overlooked hitherto."

Later in the preface, Sir Frank says "I have been extremely careful to insure that I can substantiate fully every allegation I make, and where I have made, or implied, criticisms, I have done so confident in the belief that it is in the public interest to do so."

The story is really exciting, and no engineer, or as a matter of fact anyone else who has the opportunity, should fail to read it. Not only does it give the back room story of the development of this great project, but it is the story of the struggle of a group of engineers led by one indomitable spirit to beat a mass of engineering problems, and a mass of stupidity.

Following along the general lines of Nevil Shute's "Slide Rule" and Dornberger's "V-2" this is a personal account of an important aeronautical development. The author has included some biographical material but his book is mainly the history of the jet airplane from its beginnings in Britain in the 1930's to 1948 when Sir Frank retired from active life. He traces the fortunes of his own company, Power Jets Limited, from its formation in 1936 through the war years when engineering problems, financial difficulties and governmental pressure combined forces to make the struggle a long and bitter one.

The text of the book is as non-technical as possible, but retains enough of a scientific flavour to make it interesting to engineers and lay readers alike. Many types of jet planes are described, some developed by Power Jets and others by large companies like Rolls-Royce, or by engineers in the employ of the government. The story of testing these jets is especially interesting.

Sir Frank is an Honorary Member of the Institute, and many members will recall with great pleasure the opportunity of meeting him and hearing him during the Institute's annual meeting in Toronto in 1947. At that time he gave a paper on the jet engine and was the featured speaker at one of the luncheons.

L.A.W.

BOOK NOTES

Prepared by the Library
The Engineering Institute of Canada

*Review provided through the courtesy of the Engineering Societies Library in New York.

Basic naval arehitecture, 2nd ed. K. C. Barnaby. Toronto, McGraw-Hill, 1954. 460 pp., figs., tables, $8.75.

The first edition of this comprehensive volume was published in 1949 and has been out of date for some time. In this

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edition new nomenclature, and additional subject matter bring the text up-to-date. American sources have been used for many of the calculations and formulae connected with new design methods. As in the previous edition the author has written for the practising designer rather than for the university course.

The book begins with the elements of naval architecture: hull form, calculation of areas and moments, transverse stability, hydrostatic curves, the first principles of fluids in motion, etc., and presents the theory underlying the design of ships. Succeeding chapters then describe such matters as the properties of waves, surface friction, residual resistance and form, experimental testing tanks, air resistance and sail propulsion, marine propellers, the powering of ships and the design and powering of planing craft. The sections on motion in a seaway, the strength and vibration of ships, launching calculations and materials of construction complete the sections connected with naval designing. New speed and power curves for launches are found in the appendix.

The value of the book is increased by the author's many years of experience in the design of a wide variety of ships and small vessels.

A bibliography of atomic power and related topics for the non-specialist. Chalk River, Atomic energy of Canada Ltd., 1954. 87 pp. (Publication no. 114).

The references in this bibliography have been largely selected for the non-specialized reader and those which do require some technical training are marked.

The subjects which are covered in the bibliography are mostly scientific, although they also include social, political and ethical implications of atomic energy. References include books films and periodicals. There are references to material on nuclear reactors and fuels, radioactivity, cobalt-60 beam therapy units, Geiger and scintillation counters and other aspects of atomic power.

Under each heading the references are arranged by title and give the author, publication, date and paging, together with a short annotation. Several basic reference books on atomic energy are indicated at the end of the bibliography.

***Calculation design and testing of reinforced concrete,** 2nd ed. K. L. Rao. Toronto, Pitman, 1953. 424 pp., figs., 35/-.

Fundamentals of theory, testing, and design of reinforced concrete are covered in three sections dealing with general theory, experiments, and simple designs of common structures. The book is intended for students preparing for examinations for a first degree or for professional society examinations.

The Empire and Commonwealth year book, 1954-5. R. S. Russell, ed. London, Newman Neame, 1954. 529 pp., 45/-.

Readers of the *Journal* who are interested in imports and exports within the British Commonwealth will find this an especially useful reference tool.

Eighty countries and territories are listed under these general geographic groupings: Europe and the Mediterranean, Asia, Africa, America, Australasia. Facts are given on government, industry, agriculture, trade and communications, and geographical, historical and social backgrounds of the various countries. In addition to this large section there is information given on the Colonial Office, regional and international organizations concerned with Commonwealth affairs, colonial, imperial and commonwealth conferences and treaties which affect trade.

The third part of the year book presents detailed vital statistics concerning the production, import and export of more than ninety important raw materials and commodities.

Engineering dynamics. v. 3. Steam turbines; v. 4. Internal combustion engines. C. B. Biezeno and R. Grammel. London, Blackie, 1954. v. 3, 264 pp., figs., 40/-; v. 4, 282 pp., figs., 50/-.

The other two volumes of this set, on the theory of elasticity and the elastic problems of single machine elements, will be published in 1955. It is a translation of the second German edition.

The material in these volumes is a continuation of the usual textbooks on engineering mechanics and presents the more complicated problems met by the practical designer or research engineer in the fields of statics and kinetics. The problems are given in great detail and the methods of solution are especially stressed.

Volume 3, dealing with steam turbines, is divided into sections on rotating discs, turbine blades, and critical speeds of rotation. These main divisions are subdivided

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By RICHARD F. SHEA, General Electric Co., Syracuse, N.Y., editor of *Principles of Transistor Circuits*, 1953.

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with several pertinent problems presented relating to each sub-section.

The contents of Volume 4 are also in three main parts: inertia forces, power smoothing and torsional vibrations. The arrangement of material is similar to that in the preceding volume.

Engineering units and the Stroud convention. F. W. Thorne and A. C. Walshaw. London, Blackie, 1954. 29 pp., 3/6.

The purpose of this booklet is to present a simple method of overcoming difficulties concerning units and dimensions when developing and using formulae. The Stroud system of using units enables the arithmetical stage of any problem to be carried out consistently and logically, and is applicable to any and every set of units or definitions.

The material is presented in the form of specific examples rather than general principles, and the last section outlines the main advantages of the Stroud convention, which has been used at the Royal Naval College, Greenwich, for nearly fifty years.

FBI register of British manufacturers, 1955, 27th ed. London, Iliffe, for the Federation of British industries, 1954. 1,115 pp., 42/-.

The Federation of British Industries is the largest association of British manufacturers, and its Register contains a great deal of useful information. Added features in the 1955 edition are the French, German and Spanish glossaries giving a translation of every heading used in the Buyer's guide.

The Register includes a buyers' guide and an alphabetical directory of the 6,800 firms listed. Other sections include information on trade associations, proprietary names, and trade marks.

Importers, buyers, trade commissioners, chambers of commerce, reference libraries, all will find the information contained in this directory reliable and useful.

***Handbook of hydraulics,** 4th ed. H. W. King, revised by E. F. Brater. Toronto, McGraw-Hill, 1954. Various paging, figs., tables, $9.75.

Provides in compact form tables and reference data needed for the solution of hydraulic problems. Pipe formulas no longer widely used have been omitted from this edition, and a discussion of viscosity has been added. Among the numerous other changes are new material on flow through orifices and culverts, flow over submerged weirs, and rearrangement of the section on nonuniform flow in open channels.

Hiring practices and labor competition. R. A. Lester. Princeton, Industrial relations section, 1954. 108 pp., $2.50 (U.S.).

This is the first of a series of reports based on a two-year investigation of industrial relations policies and practices in a number of manufacturing firms in the Trenton, N.J. area. It presents a detailed account of recruitment, selection, promotion, wages, and employee welfare activities.

The theory of "total expectancies" associated with a job is expounded and the importance attached to fringe benefits is noted.

While the labor conditions in the area studied may be somewhat specialized, the conclusions reached should be of interest, and possibly of use, to management and labor leaders throughout the country.

Hugh Roy Cullen; a story of American opportunity. Ed. Kilman and Theon Wright. New York, Prentice-Hall, 1954. 376 pp., illus., $4.00 (U.S.).

This is the biography of a Texas millionaire who has shared his wealth with many educational and medical institutions in his state. Some of the most interesting chapters concern Cullen's experiences as a pioneer in oil drilling and producing. There are also a number of references to leading political figures of the day, and the book as a whole is a small chapter in American history.

***Manual on industrial water.** Philadelphia, American society for testing materials, 1954. 420 pp., $5.00 (U.S.).

The general discussion of uses of water, problems of supply, composition, sampling, and analysis, and related subjects is essentially a reprint of the 1953 edition. Material newly incorporated consists of eleven new test methods, a number of revisions of existing methods, a complete table of contents, and a detailed subject index. Several new proposed methods are also included.

***Metals properties.** American society of mechanical engineers, ed. by L. Hoyt. Toronto, McGraw-Hill, 1954. 433 pp., tables, $13.50.

Engineering data on metallurgical, physical, fabrication, and mechanical properties of over 500 typical metals are presented with comments characterizing each metal and indicating its uses. Intended as a convenient reference manual for the mechanical engineer and designer, the book is organized with metals grouped by kinds and individual metals listed in ascending numerical sequence by designations, usually those used by the fabricating industries. There is a separate cross-index to other systems of designation.

National directory of the Canadian pulp and paper industries, 1954. J. N. Stephenson, ed. Gardenvale, P.Q., National business publications, 1954. 490 pp., $4.50.

The statistics and tables in this new edition are for the year 1952, and cover the pulp and paper industry, the paper box and bag industry, the roofing paper industry and the printing trades in Canada. Many comparisons with 1951 figures are given.

The Directory also provides information on forest resources in Canada, water power in the industry, convertors of paper, pulp and paper distributors, foreign commercial representatives, Canadian ministries of lands and forests, and forest protective associations. Pulp and paper mills are located geographically and are also classified by product.

***Nickel in iron and steel.** A. M. Hall. New York, Wiley, published for the Engineering Foundation, 1954. 595 pp., figs., tables, $10.00.

This monograph supplies in a single volume essential information previously scattered in books and journals in many languages. The occurrence and refining of nickel ores is reviewed and there is discussion of melting and working of nickel alloy steels; physical properties; principles and practices of the metallography and heat treatment of wrought nickel steels; and the effect of nickel on engineering properties. Cast irons containing nickel are similarly covered, and there are chapters on corrosion, welding, and fabricating. A bibliography of 784 references is provided.

Non-ferrous foundry metallurgy; the science of melting and casting non-ferrous metals and alloys. A. J. Murphy, ed. Toronto, McGraw-Hill, 1954. 497 pp., illus., $15.50.

The authors, all specialists in a field of foundry metallurgy, and the editor of this important book are attempting to place the non-ferrous foundry industry on a scientific basis so that it will be no longer considered as dependent on purely operative skills. The need for trained metal-

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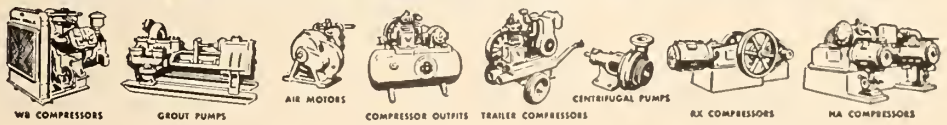

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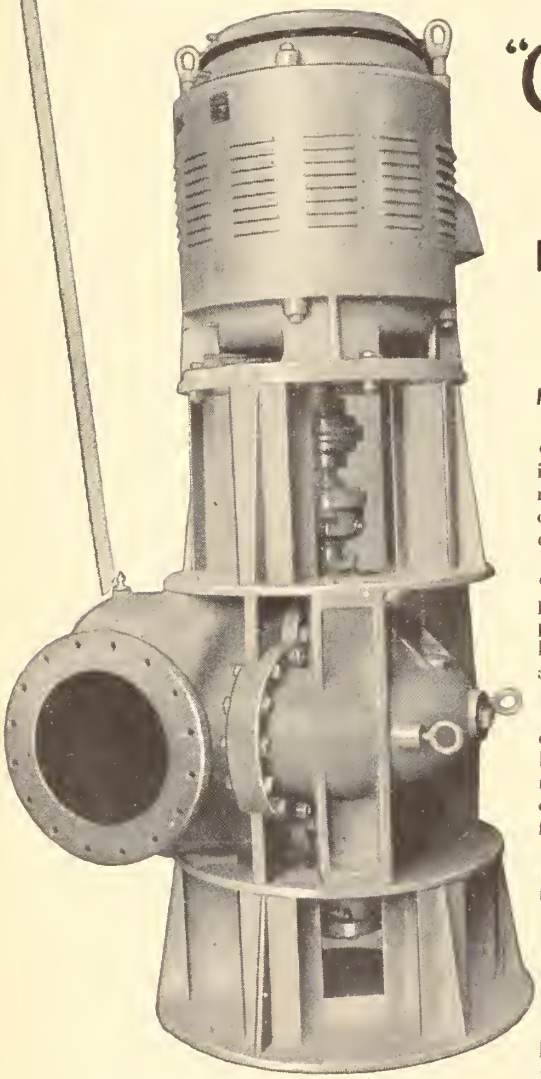

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"By showing that the scientific knowledge now exists for the rational treatment of industrial melting and casting, this book makes a distinct contribution to the commercial and technical welfare of the nonferrous foundry industry."

The physics of particle size analysis. A conference . . . held . . . April. 1954. London, Institute of physics, 1954. 218 pp., illus., 35/-.

This conference was called to study the measurement of particle size, particularly in the sub-sieve range and in these papers are found the results of many experiments and scientific studies.

The papers were presented in eight sessions and are grouped under the following headings: relative motion of particles and fluids: size separation; molecular phenomena; scattering and absorption of light by particles; particle shape factors; visual counting and sizing of microscopic particles; automatized counting and sizing: theory; photoelectronic machines; general subjects.

Descriptions are found in all the contributions of new processes now used in industry, and another feature of the Conference was the discussion of the different approaches to the solutions of many difficulties which have been encountered.

***Practical gear design.** D. W. Dudley. Toronto, McGraw-Hill, 1954. 335 pp., illus., $8.50.

This is a practical manual on the design and manufacture of gears and causes of gear failure written for the general engineer and technician rather than the specialist. There are chapters on materials and tools, and special problems such as high-speed gearing are discussed. References are listed at the end of some chapters.

***Principles of mass and flow production.** F. G. Woollard. London, Iliffe, for Mechanical handling, 1954. 195 pp., illus., 25/-.

According to the author, in flow production a part passes from operation to operation in a direct and uninterrupted sequence; in mass production operations are not necessarily connected. This book discusses the principles and applications of these methods, including the application of the flow system to small-scale production. Some of the topics included are launching a new product, standardization, continuous operation, automatic transfer machines, and the automatic factory. Examples are drawn from British, European, and American industry.

***Quantum mechanics.** F. Mandl. Toronto, Butterworth, 1954. 232 pp., $5.80.

Written as an introduction to the subject, this work presupposes a knowledge of classical physics, calculus, vector analysis, and the qualitative concepts of quantum theory, such as the wave nature of matter. The first five chapters cover underlying

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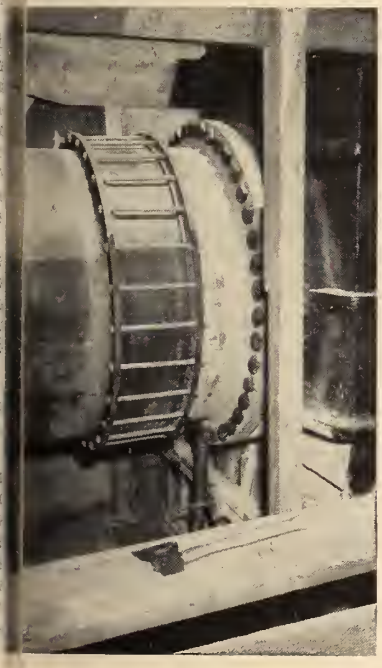

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mathematical methods, wave mechanical concepts, examples of energy eigenfunctions, general principles of quantum mechanics, and matrix mechanics. The last four chapters illustrate the use of the theory in solving specific problems involved in systems of many particles, perturbation theory, scattering, and group theory.

Resistance welding data book; theory and practice, 4th ed. P. R. Mallory and company. Montreal, Johnson, Matthey & Mallory, 1951. 510 pp., illus., $3.25.

Written by the metallurgists and welding engineers connected with the P. R. Mallory company, this fourth edition presents both the basic methods and the new techniques used in resistance welding. Mallory is a leading company in the field of resistance welding electrodes and the great amount of reference material contained in this book will be used by welding engineers, plant operating executives and practical shop men.

The eight sections of the book discuss the fundamentals of resistance welding, resistance welding controls and equipment, materials to be welded, alloys for resistance welding applications, electrodes, dies and holders, the silver brazing of elkonites to Mallory copper base alloys for resistance welding applications, and such miscellaneous data as weight of rods, areas of circles, comparison of gauges and the properties of silver elkonite.

Soil mechanics in road construction. C. F. Armstrong. Toronto, Macmillan, 1950. 215 pp., illus., $5.75.

This is a general survey of the science of soil mechanics, with particular emphasis on its practice and future in Great Britain. The author discusses soil surveys, soil testing, the interpretation of test results and their application to the works under construction, using a practical, rather than theoretical, approach.

The relation of soil mechanics to road construction is considered in detail. Problems such as design of flexible pavements, foundation design, treatment of embankments and cuttings, sub-soil drainage and soil stabilization are presented.

The book is closely related to the British Standards dealing with soil mechanics and they should be read in conjunction with this volume.

Standard metal directory, 14th ed., 1954. New York, Standard metal directory, 1954. 904 pp., $15.00 (U.S.).

The 14th edition of this much used directory contains two new sections: a list of distributors of non-ferrous metal products throughout the United States and Canada, and a list of smelters and refiners of non-ferrous metals throughout Europe.

As in previous editions there are four main sections: iron and steel plants; ferrous and non-ferrous metal foundries; metal rolling mills; smelters of non-ferrous metals. Under these headings the states, cities and plants are listed alphabetically. Data on each plant includes its capitalization, plant equipment, products manufactures, primary and secondary raw material consumed, and names of company officials.

There are also special lists of distributors of pig iron, ores, and new metals; metal stamping plants, storage battery manufacturers; galvanizing plants; dealers in used structural steel, and many other dealers and plants.

Strength of materials, 2nd ed. Joseph Marin and J. A. Sauer. Toronto, Macmillan, 1954. 518 pp., figs., $6.75

A textbook on the science of mechanics of material, and its application to simple problems of design, this second edition includes two new chapters and a revision of many sections. The new chapters are concerned with creep and temperature properties of materials, and with experimental methods of stress analysis. Several additional sections discuss stress concentration, beam columns, and vibrations of beams.

The four general divisions of the book are as follows: simple stresses; statically indeterminate stresses; combined stresses; special topics, e.g. riveted and welded joints, and members subjected to fatigue and impact loads. The new material on experimental stress analysis includes the strain-gage method, strain-rosette, photoelastic, and stress-coat methods, and stress analogies.

Problems on design and on stress analysis are found at the end of the relevant sections.

Titanium and titanium alloys. J. L. Everhart. New York, Reinhold, 1954. 184 pp., $3.00 (U.S.).

The commercial value of titanium is the main point of interest in this little volume. The production and properties of the pure metal have been largely bypassed by the emphasis on the use and technology of titanium.

Rather than being an original work this is a selective review of papers published in scientific, technical and business journals. It contains chapters on the heat treatment, forming and fabricating, joining, machining, grinding, cleaning and finishing of titanium. The last chapter deals with the commercial applications of the metal and its alloys.

***Welding for engineers.** H. Udin, E. R. Funk and J. Wulff. New York, Wiley, 1954. 430 pp., figs., $7.50.

This textbook, based on a course given to juniors at the Massachusetts Institute of Technology, emphasizes principles and adopts, wherever possible, the analytical rather than the empirical approach. All the important unit processes are covered, with the amount of material devoted to a given process dependent on its industrial importance.

World list of abbreviations of scientific, technological and commercial organizations. F. A. Buttress. London, Hill, 1954. 261 pp., 18/-.

These days, the general tendency is to use abbreviations wherever possible, especially in technical and abstracting journals. Very often no clue is given as to the meaning of these series of letters, and the reader is left bewildered. This dictionary will, therefore, be of great value in all libraries, and to those confronted with groups of unknown letters.

The majority of the organizations listed are in the United States, or the British Empire, but enough other countries are represented to justify the description, "world list". Russian abbreviations are not included, owing to transliteration difficulties.

Over two thousand five hundred abbreviations are listed, alphabetically, and in the majority of cases full postal addresses have been given for the professional, scientific and technological institutions and commercial bodies represented.

The list is necessarily incomplete, one notable omission being the Engineering Institute of Canada, but it will be a very useful addition to any library or private bookshelf.

BOOKS RECEIVED

Bases for industrial relations. W. E. Fisher. Pasadena, Calif., Institute of technology, 1954. 26 pp., $1.50 (U.S.). (Bulletin no. 24)

Calcul et exécution des ouvrages en béton armé. t. 4. Ponts, 2e partie, 4e éd. V. Forestier. Paris, Dunod, Montreal, Fomac, 1954. 255 pp., diagrs., $6.35.

Calcul thermique des chaudières et foyers, 12 éd. Friedrich Nuber. Paris, Dunod, Montreal, Fomac, 1954. 302 pp., figs., $8.70.

Cobalt in Canada. R. J. Jones. Ottawa, Canada. Dept. of mines and technical surveys, 1954. 96 pp., loose leaf.

Coffrages métalliques. M.-J. Ricouard. Paris, Eyrolles, 1954. 230 pp., illus., 1950 fr.

Complete plain words. Sir Ernest Gowers. London, H.M.S.O., Ottawa, United Kingdom information office, 1954. 209 pp., $1.25.

Compressed air handbook, 2nd ed. Compressed air and gas institute. Toronto, McGraw-Hill, 1954. Various paging, illus., $9.95.

Conveyors and related equipment, 3rd ed. W. G. Hudson. New York, Wiley, 1954. 524 pp., illus., $9.00.

Electrical elements of power transmission lines. H. B. Dwight. Toronto, Macmillan, 1954. 188 pp., diagrs., $5.25.

Electronic measuring instruments. E. H. W. Banner. Toronto, British Book Service, 1954. 395 pp., illus., $7.75.

Elements of electrical machine design, 3rd ed. Alfred Still and C. S. Siskind. Toronto, McGraw-Hill, 1954. 445 pp., diagrs., $11.00.

Engineering metallurgy. E. M. H. Lips. Eindhoven, Philips, Houston, Elsevier, 1954. 246 pp., illus., $6.25 (U.S.).

Financial Post survey of mines, 1955. Toronto, Financial Post, 1954. 416 pp., $3.00.

Fluid friction coefficients for circular pipes at turbulent flow. J. R. Finniecome. Manchester, Emmott, 1954. 125 pp., figs., tables, 10/-.

For action: the autobiography of a Canadian industrialist. J. E. Hahn. Toronto, Clarke, Irwin, 1954. 305 pp., illus., $3.50.

Formulas for stress and strain, 3rd ed. R. J. Roark Toronto. McGraw-Hill, 1954. 381 pp., figs., $9.50.

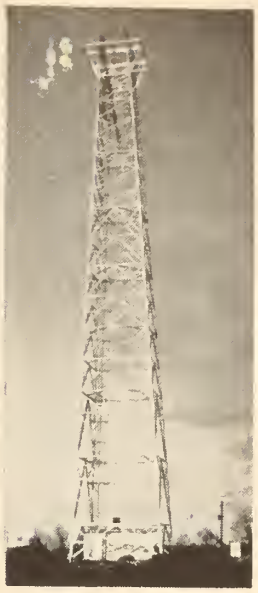
Fresh water from the ocean. C. B. Ellis. New York, Ronald, 1954. 217 pp., diagrs., $5.00 (U.S.).

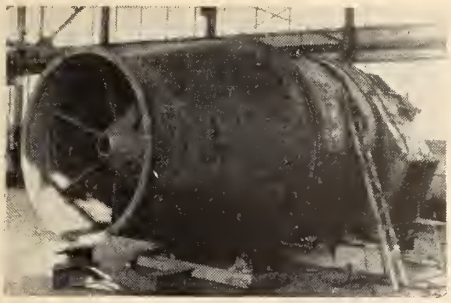
Grinding of steel. E. N. Simons. London, Odhams, Toronto, Nelson, Foster and Scott, 1954. 224 pp., illus., $5.50.

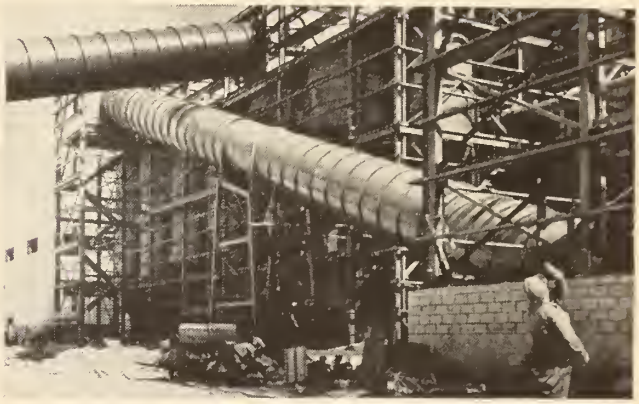
Heat transmission, 3rd ed. W. H. McAdams. Toronto, McGraw-Hill, 1954. 532 pp., figs., $10.50.

Induction and dielectric heating. J. W. Cable. New York, Reinhold, 1954. 576 pp., illus., $12.50 (U.S.).

Light metals handbook. G. A. Pagonis. Toronto, Van Nostrand, 1954. 2 v., tables, $9.25.







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La machine-outil. t. 2, Usinage par tours. A. R. Métral, éd. Paris, Dunod, Montreal, Fomac, 1954. 372 pp., illus., $21.00.

Magnetic control of industrial motors, 2nd ed. G. W. Heumann. New York, Wiley, 1954. 714 pp., illus., $9.50.

Management education for itself and its employees. Part 1—Management education in American business. L. F. Urwick. **Part 2—A survey of management development.** J. M. Trickett. **Part 3—Case studies in management development.** R. G. Simpson. **Part 4—The education of employees: a status report.** New York, American management assoc., 1954. 4 parts, illus., $6.50 (U.S.) a set.

Materials for product development, 1954. New York, Clapp and Poliak, 1954. 160 pp., illus., $7.50 (U.S.).

Materials handling. J. R. Immer. Toronto, McGraw-Hill, 1953. 591 pp., illus., $8.00.

Metallurgy of welding. W. H. Bruckner. Toronto, Pitman, 1954. 290 pp., illus., $6.00.

National conference on industrial hydraulics. v. 7, Proceedings of the ninth meeting, 1953. Chicago, The conference, 1953. 234 pp., illus., $4.50 (U.S.).

Nuclear engineering. Symposium held June 1954. F. J. Van Antwerpen, ed. New York, American institute of chemical engineers, 1954. 3 v., illus., each $4.25 (U.S.). (Chemical engineering progress symposium series, v. 50, nos. 11-13).

Plastics engineering handbook, 2nd ed. Society of the plastics industry. New York, Reinhold, 1954. 813 pp., illus., $15.00 (U.S.).

Résolution pratique des équations différentielles. J. Legras. Paris, Dunod, Montreal, Fomac, 1954. 112 pp., $4.15.

Les soudures; technique-contrôle soudabilité des métaux. D. Séférian. Paris, Dunod, Montreal, Fomac, 1954. 428 pp., illus., $16.25.

Statistical tables on aluminium, lead, copper . . . mercury and silver, 42nd annual issue, 1938, 1946-1953. Frankfurt, Metallgesellschaft A.G., 1954. 199 pp., tables.

STANDARDS REVIEWED

ASTM standards, American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.T.M. Standards on bituminous materials for highway construction, waterproofing, and roofing (with related information), $4.00 (U.S.).

This edition includes 110 standards relating to bituminous waterproofing and roofing materials, materials for roads and pavements, specific gravity, and timber preservatives.

New material includes test methods for asphalt insulating siding surfaced with mineral granules, staining properties of asphalts, Saybolt Furol viscosity of asphaltic materials at high temperatures, and specifications for bituminous saturated woven burlap fabrics. Appendix I covers cooperative studies of a stripping test for bitumen aggregate mixtures.

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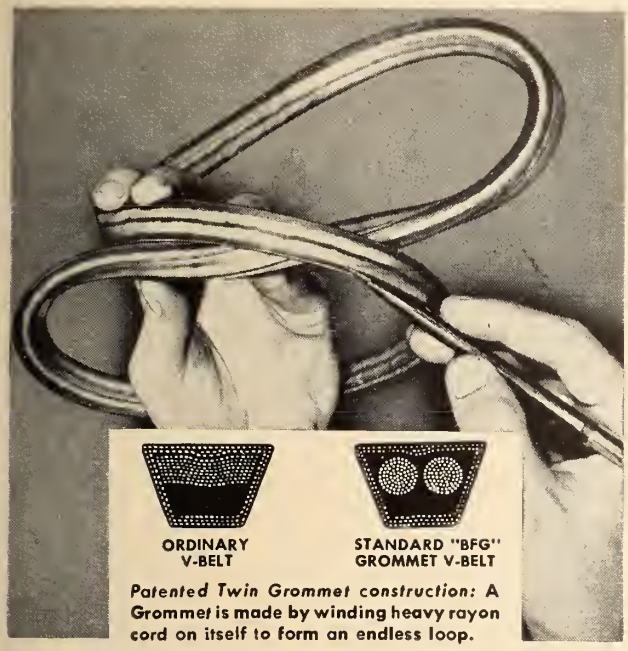

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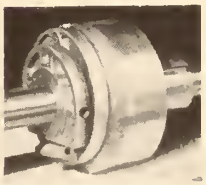

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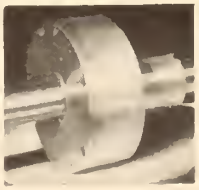

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Business & Industrial Briefs

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The Editor

Appointments and Transfers

Otis appointment.—Leroy A. Petersen, president of Otis Elevator Company, announced from New York City that effective January 1, 1955, W. G. Robson became president of Otis Elevator Company Limited, the Canadian associate of the Otis organization. Mr. Robson, currently vice-president in charge of sales, service and construction in Canada, recently returned to this country after seventeen years of foreign service, latterly as managing director of Australasian operations.

•

The Consolidated Mining and Smelting Company of Canada Limited.—D. F. Rice has been appointed to the newly created position of supervisor of research administration for the Consolidated Mining and Smelting Company. The announcement was made by A. D. Turnbull, manager of the Company's research and development division. Mr. Rice's appointment became effective January 19.

Mr. Rice was born in Thandiani, India, where his father was serving in the Indian Army. He came to Canada in 1920. In 1935, he received his B.A.Sc. in mining engineering at the University of British Columbia. He joined Cominco in that year, starting work on the labour gang. He later served as a smoke tester, assayer and testing engineer, and in 1945, was appointed superintendent of metallurgical research. He joined the administrative controls staff in the next year, and in 1950, became supervisor of projects.

J. D. Hartley has been appointed superintendent of Cominco's zinc department, effective January 1, 1955. The announcement was made by R. D. Perry, general manager of The Consolidated Mining and Smelting Company. The zinc department is one of Cominco's largest departments and is also the largest zinc-producing operation in the world.

Mr. Hartley was born of Canadian parents in San Francisco, California. He was educated in Vancouver and was well known there as an outstanding basketball player. In 1927 he obtained the degree of B.A.Sc. in chemical engineering at the University of British Columbia. He joined Cominco in 1927, becoming an assayer in that year. He was later transferred to the research department. In 1930 Mr. Hartley joined the zinc department staff, becoming superintendent, zinc tank rooms and melting, in 1938. In 1946 he was appointed superintendent of development, zinc department, and, after some smelting department service, in 1951 became special assistant to the superintendent, smelting department. In June 1954 he returned to the zinc department as assistant superintendent.

•

Shawinigan Chemicals Limited.—Louis F. Fitzpatrick, who has been a member of the staff of Shawinigan Chemicals Limited for the past 10 years, has been appointed sales manager of the Company's stainless steel and alloys division, it was announced by Dr. R. S. Jane, executive vice-president of the Company.

A Montrealer by birth, Mr. Fitzpatrick graduated from McGill in chemical engineering in 1943 and went overseas with the Royal Canadian Engineers. On his discharge in 1945 he joined Shawinigan in the chemicals division at Shawinigan Falls, transferring to the stainless steel and alloys division two years later. He was made assistant sales manager of that division in 1953.

•

B. F. Goodrich of Canada.—J. M. Robbins, vice-president of B.F. Goodrich of Canada has been promoted to the parent company's Akron headquarters, it was announced recently by Ira G. Needles, president of B.F. Goodrich of Canada.

Mr. Robbins, formerly vice-president manufacturing, joined B.F. Goodrich in Akron in 1928, and has subsequently held various administrative posts in the B.F. Goodrich divisions in U.S.A., Sweden, and Bogota. A graduate of Rensselaer Polytechnic Institute, Mr. Robbins came to Canada in 1949.

It was also announced that M. G. Morgan has been apppointed general manager of manufacturing. A graduate of Virginia Polytechnic Institute, Mr. Morgan joined the B.F. Goodrich organization at Akron in 1938. A resident of Canada since 1950, he previously held various appointments in Los Angeles, California, and Oklahoma. He succeed J. M. Robbins.

Two other B.F. Goodrich appointments also announced are the promotion of J. V. Brown to district manager for British Columbia, and Gordon L. Callfas as district manager of the Alberta-Saskatchewan territory.

•

G. A. Brace appointed.—Ferranti Electric Limited has announced the appointment of G. A. Brace, formerly assistant general manager, to the position of vice-president and a director.

G. A. Brace

The Garlock Packing Company of Canada, Ltd.—J. B. Stitt of 600 Piccadilly Street, London, Ontario, was retired by The Garlock Packing Company of Canada, Ltd., according to an announcement by Mr. E. W. Reese, vice-president. Retirement became effective January 1, 1955.

Born in Kemptville, Ontario, Mr. Stitt was educated at the University of Toronto. He first engaged in mining and exploration work in South America and then for three years represented Garlock on that continent.

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For the past 20 years Mr. Stitt has been the Garlock representative in Western Ontario.

●

Building up Trans-Canada Pipe Lines Staff.—The appointment of B. E. Lowe as manager of sales for Trans-Canada Pipe Lines Limited was announced by N. E. Tanner, president of the company. Mr. Lowe will be located at Trans-Canada's sales headquarters in Toronto.

Under A. P. Craig, vice-president in charge of sales, Mr. Lowe and J. W. Tomlinson, whose appointment as assistant sales manager was announced last month, will negotiate contracts with natural gas distributors and with large industrial users of natural gas which are located outside the territories served by the distributors. His sales responsibilities will cover the entire Trans-Canada Pipe Lines' natural gas transmission network linking the Alberta gas fields and Montreal.

Mr. Lowe's appointment follows more than 20 years' experience in sales, managerial and engineering positions with gas and electric utilities in the United States and Canada. During the war, he served as an instructor in electronics in the U.S. Navy and was a ground officer with a night fighter squadron.

●

Sheldons Engineering Limited Makes Executive Appointments.—W D. Sheldon, Jr., president, Sheldons Engineering Limited, Galt, Ontario, has nominated the three men shown below to new posts in the organization, as follows:— W. C. Caldwell, special projects manager; A. Nearingburg, general sales manager; T. K. Birss, Toronto Branch manager.

●

The St. Lawrence Seaway Authority.—The Honourable Lionel Chevrier, President, The St. Lawrence Seaway Authority has announced the appointment of two officials to the staff of the Authority. Both appointments were effective February 1.

The two positions filled provide for the supervision of purchases and legal matters. Thomas Oliver Moorse, formerly with Brompton Pulp & Paper Co. Ltd. and The St. Lawrence Corporation Ltd. has been appointed purchasing agent. G. Gilles Gouin, a Montreal lawyer has been named legal officer.

Thomas Oliver Moorse is a native of Montreal. After his high school, he completed business administration, salesmanship and business English courses. The principal firms with which he has been associated include the Ogilvie Flour Mills Co. Ltd., where he started as a detail salesman and advanced to territorial salesman in Northern New Brunswick, the Bathurst Power & Paper Co. Ltd. where he was responsible for both mills and woodlands purchasing and stores from 1939 to 1946. In early 1947, Mr. Moorse was appointed purchasing agent in charge of the Brompton Pulp & Paper Company's East Angus and Bromptonville mills and woodlands purchasing and stores departments. Promoted to general purchasing agent of the Brompton organization in 1948, he was promoted in 1952 to manager mills purchases of the Consolidated Purchasing Department, comprising the mill purchasing departments of Lake St. John Power & Paper Co. Ltd., St. Lawrence Paper Mills Co. Ltd., Brompton Pulp & Paper Company Ltd.

G. Gilles Gouin is also a native of Montreal. Following his studies at St. Stanislas College he received his B.A. degree from the University of Paris. Following his law course at McGill University where he obtained a B.C.L. degree in 1950 he did post-graduate studies at Columbia University where he graduated with a M.B.A. degree. Mr. Gouin has had legal experience with the Canadian National Railways where he was employed from 1952 to 1954. Prior to his appointment he was employed by the firm Hugessen, Macklaier, Chisholm, Smith & Davis.

●

Samuel G. Hibben Retires from Westinghouse Lamp Division.—Dr. Samuel G. Hibben, former director of applied lighting for the lamp division of the Westinghouse Electric Corporation, and a past president of the Illuminating Engineering Society, has retired from Westinghouse after nearly 40 years of service to the lamp and lighting industry.

An internationally-known authority on illumination, and a familiar figure at Canadian lighting gatherings, Dr. Hibben was born in Hillsboro, Ohio, and was graduated from the Case Institute of Technology in Cleveland with a bachelor of science degree in 1910. In 1914, Case awarded him the degree of electrical engineer for his study of light-controlling glassware, and he later took post-graduate work at the Carnegie Institute of Technology, Pittsburgh, Pa., and at the University of Paris, France. In 1952 Case Institute awarded him the honorary degree of doctor of engineering.

After operating an electrical contracting firm and working in Pittsburgh as a consulting engineer, Dr. Hibben joined Westinghouse in 1915 as a meter design engineer. Later he became an arc-lamp specialist at the East Pittsburgh works and later an illuminating engineer at sales headquarters.

Hibben rejoined the Company in 1919 as a supervisor in the Cleveland lamp division office after serving as a captain in the A.E.F. in World War I. He was soon called to Bloomfield, New Jersey, to develop a lighting service bureau that was the forerunner of the Westinghouse lamp division's present commercial engineering department. In 1933 he was named director of applied lighting.

In his active professional career Dr. Hibben has made many contributions to the science and art of illumination. He was the first to design mobile anti-aircraft searchlights (1917); the first to perfect a design for lighthouse lenses of American manufacture (1920); the first to design acceptable semi-indirect lighting fixtures, and a member of a group of scientists that developed the initial "eluster" street lights. He directed the designing of a system of transcontinental airway beacons in 1927, and also the first modern flood-lighting for public monuments and for airports in 1928.

He has championed lighting designs for underwater rescue work and photography, collaborating with other noted scientists in submarine photography. He was a pioneer and an authority in many other lines of lighting development, some of these being the application of radiation to plant growth and insect control, the use of "black light" and fluorescent lighting, and ultraviolet rays.

In World War II, Dr. Hibben served in the Office on Civilian Defense as an authority on defense lighting, blackouts, camouflage, and color signals. He is a member of many professional societies, including the American Institute of Electrical Engineers, the British Illuminating Engineering Society and the Ohio Society of New York, and is a past-president of the Montclair Society of Engineers. He is also a member of the Engineers Club of New York and a Fellow of the Distinguished Service Foundation of Optometry.

He is also recipient of the Westinghouse Order of Merit, the highest award bestowed by the Company.

●

Westinghouse Appointment.—A. H. Sievert has been named sales manager for the Canadian Westinghouse Company's newly-formed tube division in Hamilton. Reorganization of the firm's lamp-tube division into two separate units was recently announced by L. A. McCalpin, who will head up both operations as general manager.

W. C. Caldwell

A. Nearingburg

T. K. Birss

Mr. Sievert has been with Westinghouse for almost 20 years, having joined the Company in 1935 upon graduation from the University of Toronto with a B.A.Sc. degree in electrical engineering. Since then he has been continuously associated with lamp and tube operations in production, engineering and sales capacities. During 1941 Mr. Sievert worked on the design and development of special military tubes at the Westinghouse Electric Corporation's Bloomfield Works. He spent the next four wartime years engaged in similar projects at Hamilton.

For the past year Mr. Sievert has been assistant to the general manager of the lamp-tube division.

•

Taylor Instrument Companies of Canada, Ltd.—H. J. Noble, president, Taylor Instrument Companies of Canada Limited has announced the appointment of E. J. Sheare as managing director. Mr. Sheare has been industrial sales manager and has had many years experience in the application of temperature, pressure, flow and liquid level controls to Canadian industry. Arthur H. Allen, who for many years has been managing director, will continue as active technical consultant.

•

E. Kennard, General Manager, McKinnon Columbus Chain.—Mr. A. L. McKinnon, president, has announced the appointment of Mr. Edward Kennard as General Manager of McKinnon Columbus Chain Limited, St. Catharines, Ontario.

Prior to joining the McKinnon Chain organization two years ago as Assistant General Manager, Mr. Kennard was for some years at Avro, Malton, as Assistant Manager—G. T. Engineering, and later Production Controller—Gas Turbine. He is best known for his work as General Manager of St. Catharines Steel Products Limited during World War II and for overseas industrial missions.

McKinnon Columbus are manufacturers of chain, chain products, hand and power hoists, hardware and specialties.

•

Publications

For copies of the publications mentioned below please apply to the publishers at the addresses given in the items.

Please mention *The Engineering Journal* when writing.

New Dielectric Heater Bulletin.—A new bulletin describing operating advantages of Allis-Chalmers dielectric heaters has been released by the company.

The bulletin tells how Allis-Chalmers dielectric heaters can help cut costs in heating, drying, baking or curing of nonconduction materials.

Units offered range in size from 3 kw for laboratory and research projects, and certain production jobs, such as heating plastic preforms; to 60-kw heaters for setting glue joints, heat forming of parts, or curing, vulcanizing, setting and drying of rubber. The latter can be had without ovens, cages or work handling equipment to fit specific operations.

Also available are 15 to 50-kw heaters for use with a continuous conveyor type oven in handling large quantities of such items as sand cores and cones of yarn.

Copies of "Allis-Chalmers Dielectric Heating," 15B6431B, are available on request from Canadian Allis-Chalmers Limited, Box 37, Montreal, Quebec.

•

Strip Heaters.—A new four-page bulletin describing strip heaters has been

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Stainless Steel KA2MO VALVES

The McAvity line of Stainless Steel KA2MO Valves has been designed to provide outstanding service under severe corrosive conditions. All cast parts are KA2MO Stainless Steel, with bar stock parts of Type 316 Stainless Steel . . . and an important feature from the maintenance standpoint is that McAvity globe, angle, and Y valve parts are interchangeable.

Full details of the complete line available on request from our nearest branch.

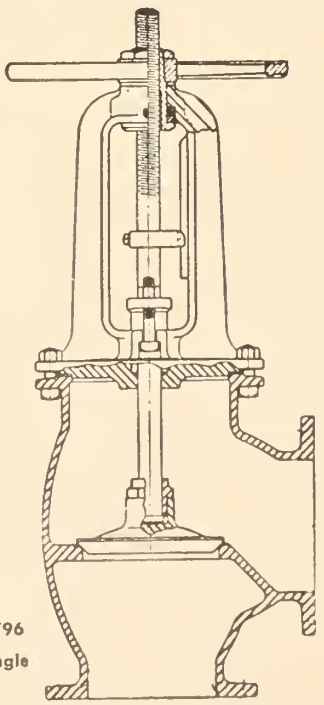

FIGURE 5796
Flanged Angle Valve

McAvity

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announced by Canadian General Electric Company.

Designated CGEA-1157E, the publication contains complete catalogue listings, including specifications of all the available lengths and styles of this product. Detailed diagrams and photographs illustrate the strip heater together with many of its typical installations.

Further information is available from Component Heating Devices, Canadian General Electric Co. Ltd., 212 King St. West, Toronto.

●

Vibrating Equipment. — A 230 page catalogue on Jeffrey-Traylor vibrating equipment has just been published by Jeffrey Manufacturing Company Limited. This catalogue No. 870 is a well illustrated and detailed general catalogue on the complete Jeffrey-Traylor line of electric vibrating feeders, conveyors, coolers, dryers, mixers, constant weight feeders, bin check valves, packers, screens, controls and magnetic separators. Also included are illustrations and information on MV mechanical vibrating conveyors.

This new comprehensive catalogue is available on request through Jeffrey Manufacturing Company Limited offices in Montreal, Toronto, Hamilton, Halifax, Vancouver or Jeffrey distributors across Canada.

●

New Equipment and Developments

New Marconi Premises.—A revolutionary "electronic eye" was demonstrated when the new Research Laboratories of the Canadian Marconi Company were officially opened in Montreal recently by Dr. O. M. Solandt, Chairman of the Defence Research Board. Dr. Solandt opened new premises for Marconi's Aviation, Research and Radio Relay Departments at McEachran Avenue.

The new electronic eye, demonstrated to guests at the opening ceremony is an advanced type of photocell. Its applications include use on TV sets, to adjust the picture automatically to variations in room light, and as a simplified low cost automobile headlight dimmer.

Ceramic crystals were also shown being "grown", which will "remember" electrical voltages for many months. They will also amplify electronic signals.

Great interest was shown in another device which will make the atoms in a material ring like a bell, but at very high frequencies — in the shortwave broadcast bands. The character of the ringing gives a very detailed picture of composition of many substances. It may have important uses in industrial processes in addition to being a valuable research tool.

The hard lot of the surveyor making maps from aerial photographs is going to be much easier in the future as a result of an electronic tape measure which is under development. It is known as a geodimeter. This gadget will measure accurately distances up to 30 miles and is light enough to be carried over rugged country in Canada's bushland.

●

Luria Appoints Canadian Representative.—Taylor, Bishop, MacLean, Ltd., of 3416 Decarie Boulevard, Montreal, has been appointed Canadian dealer representative for the Luria Engineering Company of Bethlehem, Pennsylvania, and New York City, according to an announcement by Grant A. Sattem, vice president in charge of sales for the latter concern.

Robert J. Bishop is president of the newly-incorporated Canadian firm, which also has offices in Toronto. William B. Taylor is vice president and managing director.

●

Multi-zone Air Conditioning.—Sturtevant has recently introduced the new multi-zone air conditioning unit which is a rugged, compact central plant air conditioning unit for supplying air mixtures, blended for simultaneous unequal heat load demands in various zones requiring individual temperature and humidity control. Formerly, heat load variations caused by differences in building construction, changes in occupancy, wind or solar exposure, could be controlled only by separate supply systems for each zone, or by expensive zone reheat arrangements.

Now this problem can be solved with a single Sturtevant Multi-Zone air conditioning unit. Efficient, economical, this versatile unit supplies air conditioning at a central location—for the individual needs of 12 zones.

This complete unit, fans, coils, motors and starters, is designed and manufactured by Sturtevant. With the introduction of this unit, Sturtevant-Westinghouse now manufactures a complete line of air handling units, second to none.

Catalogue 1640 is available on request to B. F. Sturtevant Company of Canada Limited, Advertising Department, Galt, Ontario.

●

American Air Filter. — American Air Filter of Canada, Ltd. has completed plans for the construction of its own Montreal plant, W. G. Hole, vice-president and general manager, revealed. The company now occupies leased space at 7035 Grand Avenue, Montreal.

American Air Filter of Canada, Ltd. has purchased a plant site of 2½ acres on Stinson Blvd. in the Town of St. Laurent, a Montreal suburb. The land was formerly owned by the Canadian National Railway whose tracks adjoin the property. Total plant, land and equipment investment in the plant will be approximately $250,000.00.

●

Employment Service

(Continued from page 176)

cal handling, pressure vessels, tanks, heating, ventilation, industrial wastes, piping, steel and reinforced concrete structures, quarries; surveying; development of new equipment and structures and maintenance engineering. Desires position with manufacturing company or consulting engineers in Toronto area. Available on reasonable notice. File No. 4658-W.

MECHANICAL ENGINEER (Scot), A.M.I., Mech.E., aged 30, arriving in Canada (Toronto) mid-April, 1955, would welcome enquiries from prospective employers with regard to responsible position in design, development, project or plant maintenance work, etc. Available for interview immediately upon arrival. Excellent references. 14 years experience including 5 years apprenticeship with 3 years workshops training. Experience includes design work with regard to water tube boilers and refrigeration plant and design, project handling, estimation, construction supervision, etc., with regard to special purpose apparatus and machinery associated with explosives manufacture. File No. 4659-W.

MECHANICAL ENGINEER, Jr.E.I.C., 51 graduate, N.S.T.C., B.Sc., B.E., married, no children, 3½ years with Canadian Electrical manufacturer, completed graduate training course, 2 years experience on development, assembly and testing of 7.5 to 230 KV circuit breakers, plant layout, tooling and general machine shop practice. Desires responsible position with opportunity for advancement. File No. 4661-W.

YOUNG ENGINEER, 1953 graduate, Ecole Polytechnique, presently completing M.Sc. degree in Industrial management at the School of Industrial Management, Massachusetts Institute of Technology. Good academic and extra-curricular background. Would consider employment with a medium sized manufacturing concern in the areas of production, marketing or industrial engineering; with a management consulting firm; with a municipality. Thoroughly bilingual. Province of Quebec preferred. File No. 4662-W.

MECHANICAL ENGINEER, P.Eng., M.E.I.C., graduate institution of mechanical engineers Great Britain. Age 36, married. 5 years apprentice British Railways Locomotive Works. 6 years engineers office Royal Airforce (squadron leader), 8 years experience Canadian Aluminum Industry in fields of mechanical engineering and production in smelter and fabrication plants. Past 3½ years production engineer in major aluminum forge plant. Seeks position of responsibility with opportunity for advancement. Preferably in Canada, but will consider reasonable location overseas. Apply to File No. 4663-W.

CHEMICAL ENGINEER, P.Eng. (Ontario), Jr.E.I.C., M.A.Sc. (Toronto), 3½ years experience in research and development in plastics, pulp and paper, fluorescent materials, also in laboratory testing and analyses. Working knowledge of biochemistry. Desires research and (or) development position in Toronto area. Available on 2 weeks notice to present employer. File No. 4664-W.

ELECTRICAL ENGINEER, graduate 1949, Melbourne University, Australia. B.E.E., Assoc. A.I.E.E., single, age 26 years, five years electrical engineering experience, graduate G.E. test course, at present in U.S., desires employment commencing March, preferably in Toronto or Montreal. 1½ years design experience with Dept. of Civil Aviation and 2½ years experience as sales engineer with Australian General Electric company handling motor and control gear sales and switchgear and transformer sales. Desires employment as sales engineer. File No. 4665-W.

P.ENG., Jr.E.I.C., age 30, estimating and design, 2 years; instrument man on various types of field surveys—2 years; commercial college—1 year. File No. 4666-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C. Married, 26 years old, bilingual. Supervisory experience in inspection. Quality control and methods work. Supervision and responsibility desired. Prefer Montreal area, will consider Eastern Canada. File No. 4668-W.

MECHANICAL ENGINEER, S.E.I.C., Polytechnique 1955, graduating, married, bilingual. Equivalent of 2 to 3 years experience in plumbing and heating line as an apprentice service man, design, estimate and surveillance of complete plumbing and heating system for a contractor. Desires a position in the heating industry. Also interested in sales. Will consider any offer of situation connected with the heating line, preferably in Montreal. File No. 4669-W.

CIVIL ENGINEER, Jr.E.I.C., graduated 1949. Age 27. Married, 1 child. Two last years with Montreal contractor as job engineer on two large projects including R.C. bridge construction, earthworks, roadwork and tunnelling. Previously employed in Australia by large pulp and paper company in responsible position on civil engineering design and supervision. Also experienced in open cut mining and large scale earthmoving operations. Particularly interested in design and use of precast and prestressed concrete. Desires responsible position with contractor or consultant in Toronto or Western province. File No. 4670-W.

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D. M. STEPHENS, M.E.I.C.
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Editor

H. G. THOMPSON, M.E.I.C.
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236 Avenue Road, Toronto

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55A440

Report on Investigation into the Failure of Two 100-mw. Turbo Generators

by

Sir Claude D. Gibb, C.B.E., D.Sc., M.E., F.R.S.

Chairman and Managing Director
C. A. Parsons and Co. Ltd., England

Sir Claude Gibb gave this paper at a meeting of the Institution of Mechanical Engineers in London, England, on February 15, 1955. He then flew to Toronto to present it to the Toronto Branch of the Engineering Institute of Canada on February 18. The paper is being published in collaboration with the I.Mech.E. and discussions contributed to each organization will be published eventually by both.

Sir Claude Gibb was born in Adelaide, Australia, in 1898 and was a pilot in World War One in the Australian Flying Corps. He is a graduate of Adelaide University and has doctor of science degrees from London and Durham Universities. As director general of Armoured Fighting Vehicles and chairman of the British Tank Board, he led the team that designed and developed the Centurion Tank. Previous to that he developed and forced into production the 17 pounder gun and was responsible for all British weapon production. He was knighted in 1945 for outstanding war work and was president in 1951 of the Engineering Section of the British Association. He was elected a Fellow of the Royal Society for original research and design and new methods of manufacturing steam turbines, and for his armament work. Starting as a fitter in 1924, he is now chairman and managing director of the largest turbine firm in the British Empire and chairman of the world's largest switchgear firm.

It has often been said of engineering that "progress is made by solving the problems resulting from the making of progress".

The paper describes the investigations made following the failure of two generators each of 100-mw. capacity installed in the Richard L. Hearn Generating Station at Toronto of the Hydro-Electric Power Commission of Ontario. The author details some general considerations affecting the design of alternator rotors, the selection of materials used, past troubles which had to be avoided, reasons for certain features incorporated in the original design and modified as the result of the failures, and safeguards introduced into current practice to avoid the possibility of a repetition of the failures.

The designers of large output turbo-type generators have long accepted the fact that the dimensions of the revolving field or rotor primarily determine the basic design of the generator and that there are many more problems arising from rotor design than from stator design.

One of the first and fundamental questions arising is the material to be used for the rotor end bells (or end caps or retaining rings as they are variously called). Figure 1 shows the original design of the rotors concerned in this investigation. The end bells are shown shaded. For mechanical strength, the designer would prefer to use a relatively low alloy steel which would provide the desired physical properties after hot forging and simple heat treatment. Such end bells would, however, be magnetic and introduce difficulties in both rotor and stator because the leakage fluxes at the ends of the stator core would be intensified, thus augmenting the core end section and core end plate heating and also causing eddy current surface heating in the end bells. In addition, the leakage of flux from the rotor into the end bells would increase the main flux densities in the rotor body and thus increase the current in the rotor windings required for magnetization.

Considerations of desirable magnetic paths call for end bells to be of non-magnetic material; this demand has led to intensive metallurgical research in many countries seeking the most suitable material. Scores of alternative alloys and materials have been considered, among them being titanium and various nickel-copper (monel) alloys.

The material which has been most widely used is an austenitic steel of the following approximate composition:

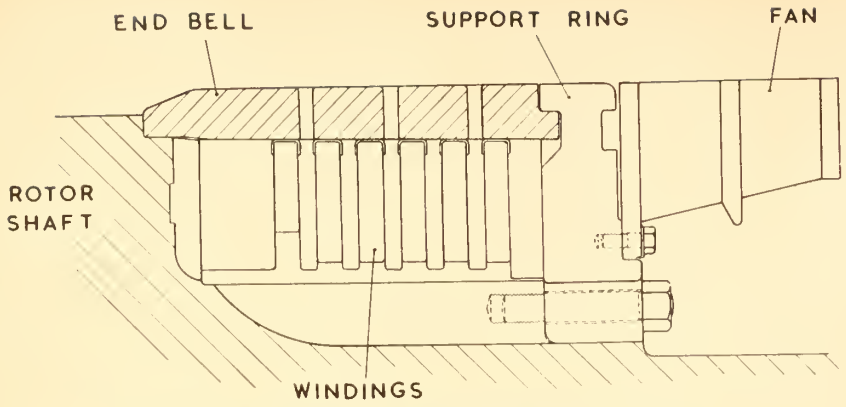


Fig. 1. Section showing original arrangement of rotor end winding supports.

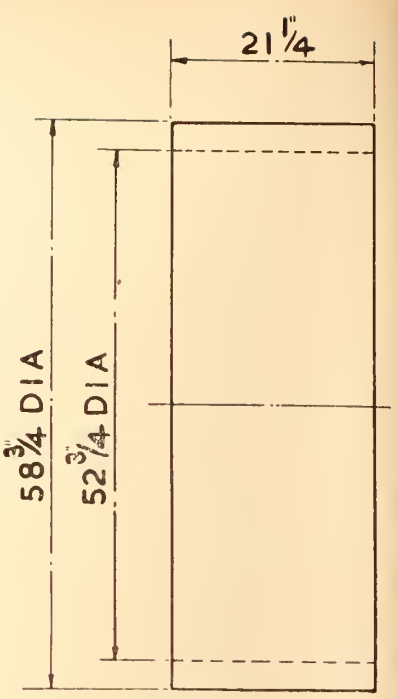


Fig. 3. Dimensions of rotor end bell forging.

Carbon, 0.64% — 0.70%.
Silicon, 0.37 — 0.45%.
Manganese, 7.23% — 8.18%.
Sulphur, 0.006% — 0.014%.
Phosphorus, 0.020% — 0.032%.
Chromium, 3.80% — 4.09%.
Nickel, 8.40% — 8.83%.

The analysis of the material from which the end bells of the rotors in question were made lay between the limits given above. Such a material gives considerable advantages to the electrical designer, but provides major problems for the metallurgist, the forgemaster and the machinist.

Figures 2A and 2B illustrate the way in which the more important component of leakage flux at the ends of the rotor and stator core is affected by the rotor end bell material. The intensity of the leakage field is indicated by the spacing of the lines depicting the flux path; this spacing clearly demonstrates the effect of the longer flux path with non-magnetic end bells in reducing the field intensity.

For the sake of clearness the leakage field is drawn only for the airpath. It will be understood that the flux path is completed in the iron portions of the magnetic circuit in a direction normal to the plane of the paper.

A flux distribution as shown in Figure 2B has so many advantages in large generators that the designer seeks them vigorously and presses the metallurgist continuously for better and better physical properties from non-magnetic materials.

In the smaller output generators

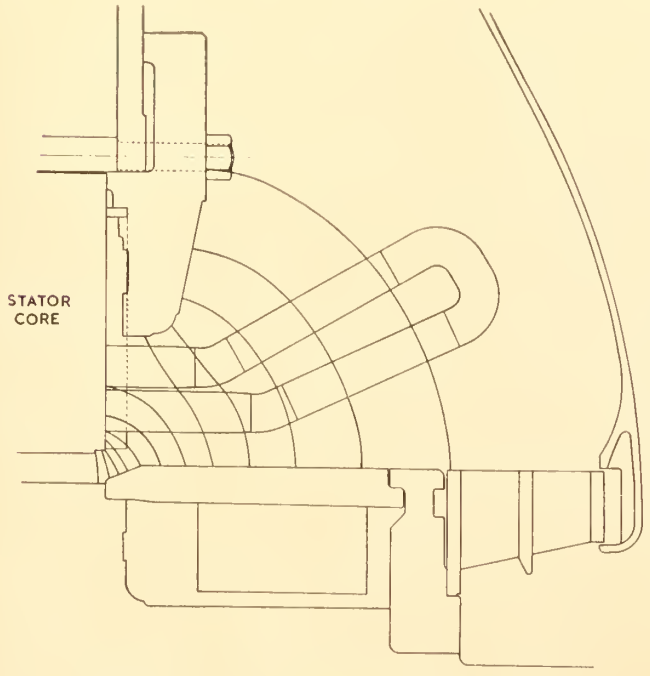


Fig. 2a. Stator end leakage flux paths with magnetic end bell.

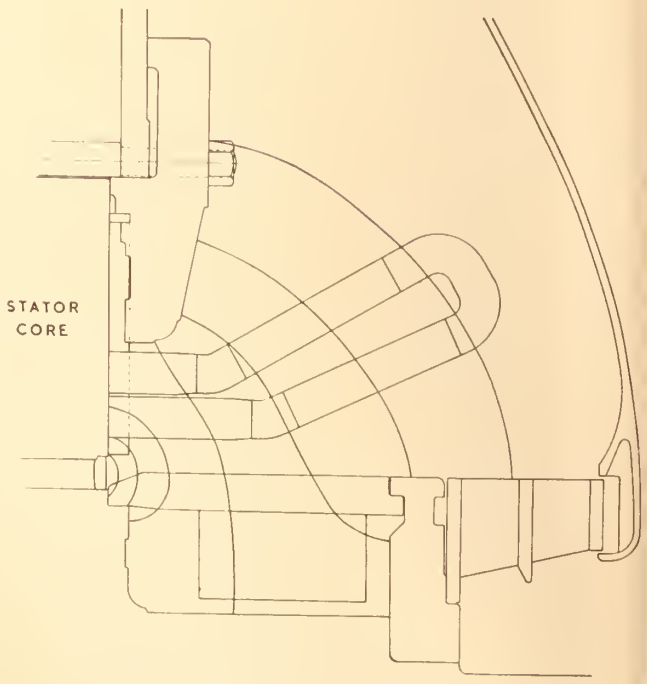


Fig. 2b. Stator end leakage flux paths with non-magnetic end bell.

Table I

Machine No.	Serial No.	Cast No.	Yield point tons/sq. in.	U.T.S. tons/sq. in.	Elongation, per cent	Reduction of area per cent
1	FB. 1333	64139 A2	50.6	57.0	38.0	44
1	FB. 1345	64139 A3	48.8	56.2	42.0	49
2	FB. 1346	64139 A4	49.8	56.8	38.0	51
2	FB. 1377	65699 A1	56.2	61.0	29.5	42
3	FB. 1476	67137 A	63.2	64.0	6.0	19
			53.0	57.8	20.0	28
			55.8	60.0	18.5	30
3	FB. 1648	71269 A3	49.6	56.2	39.0	43
4	FB. 1505	65699 A	55.4	60.6	23.0	32
4	FB. 1378	65699 A2	59.0	63.2	23.5	38

built prior to about 1930, magnetic end bells were generally used, and at the time non-magnetic bells became available, a yield point of only 35 tons per square inch was adequate to meet the operating stresses then applied. With the rapid growth in size of generators came the need for improved physical properties, and the commonly demanded yield point was stepped up to 40, 45 and finally to 50 tons per square inch. The specification to which the Toronto end bells were ordered was as follows:

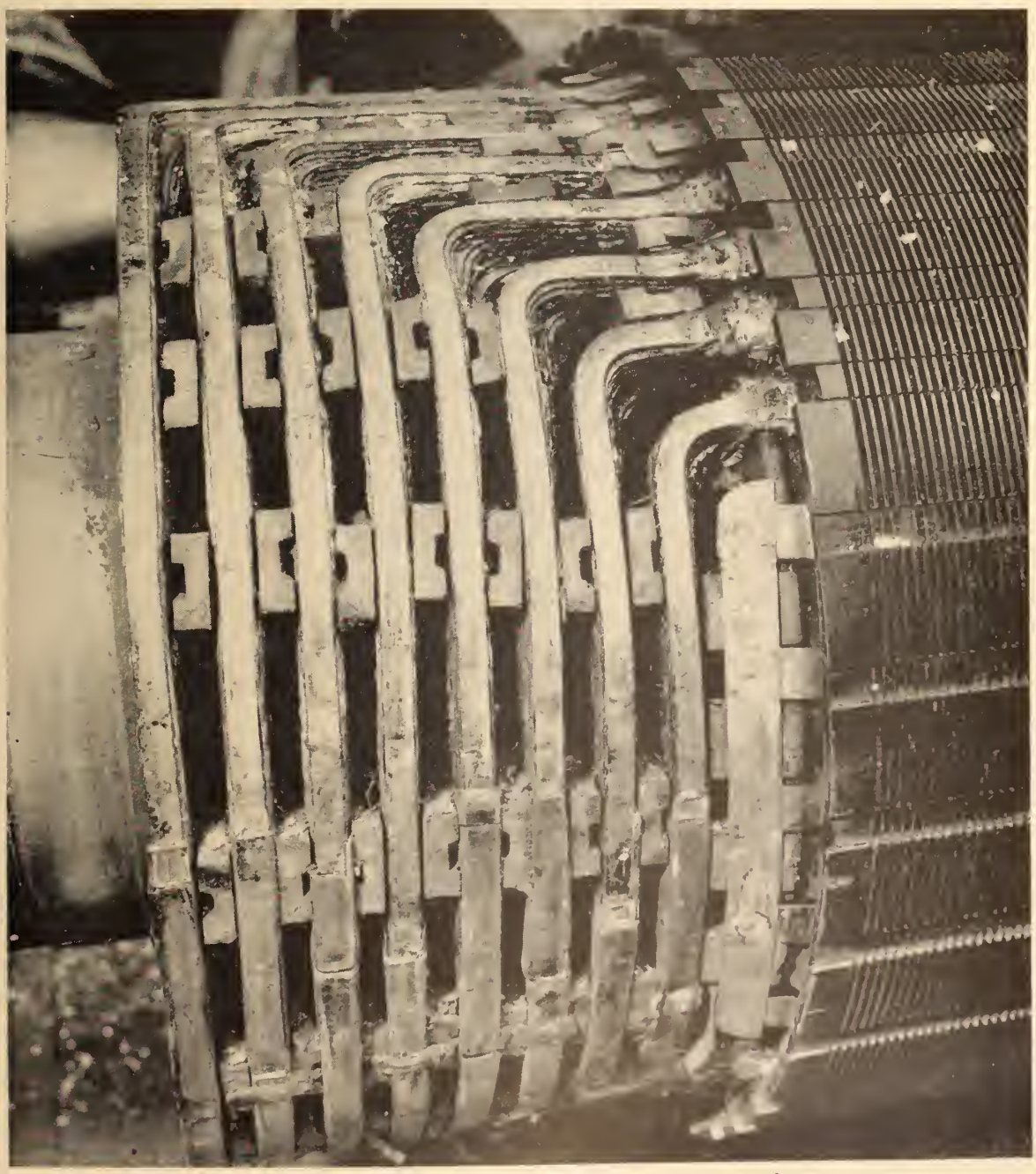


Fig. 4. Typical view showing effect of rotor coil distortion.

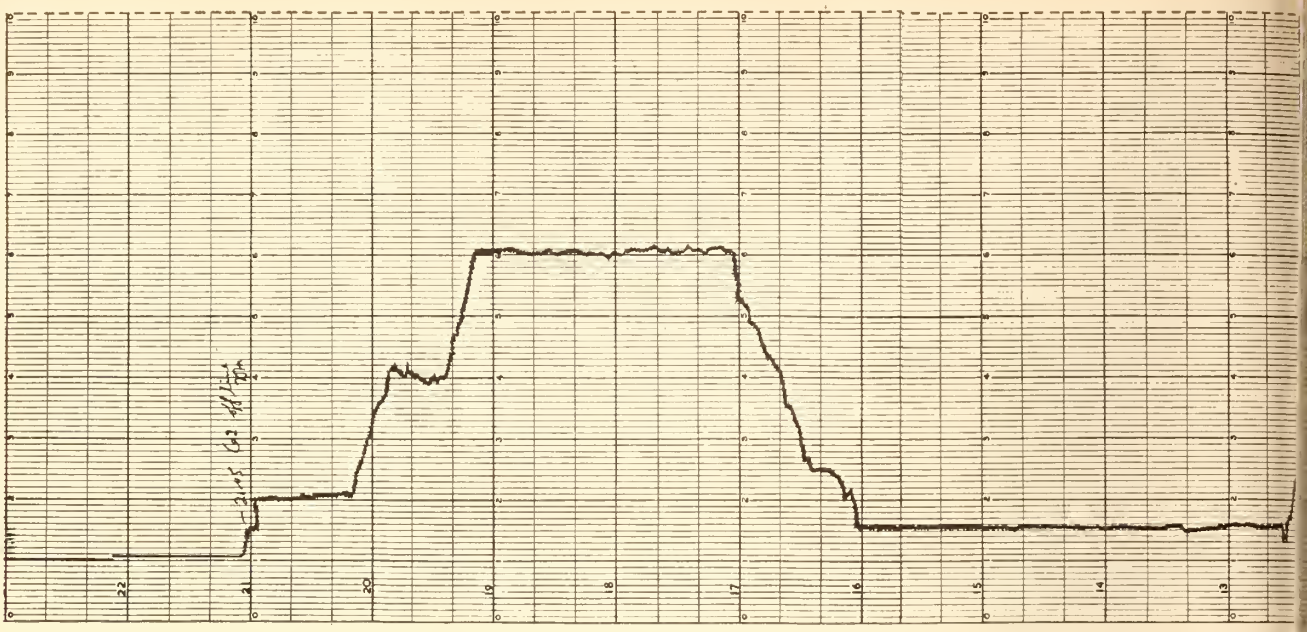


Fig. 5. T

Yield point, Tons per sq. in. minimum	Ultimate tensile strength, Tons per sq. in. minimum
50	57
Elongation in 2 in.length. per cent, minimum	Reduction of area per cent, minimum
20	30

Acceptance test results on the Toronto end bell material are given in Table I.

The disadvantage of non-magnetic bell material is that being an austenitic, the physical properties required can be obtained only by cold working, actually warm working, and not by heat treatment. This cold working inevitably produces residual stresses in the finished ring, because improvements in physical properties are a consequence of grain structure distortion. Depending upon the technique of manufacture adopted, the residual stresses resulting from cold working almost certainly will vary considerably from end bell to end bell and from forgemaster to forgemaster. This is a feature which neither metallurgist nor designer likes. It has led to investigations into alternative methods of manufacture, including forging on a mandrel under a more powerful press, expanding on tapered mandrels of various sizes and rolling on a special type of tyre mill.

The method of manufacture adopted depends upon existing facilities, upon the forgemaster's experience and upon his opinions on the quality of the final product. Expanding on tapered mandrels may lead to greater residual stresses than forging under a hydraulic press while on a mandrel, but there is room for further and more definite information on this point, which is being obtained by continued research. Rolling is a preferred method always provided that the rolls are capable of exerting a load sufficient for the cold work to penetrate through the full thickness of the end bell, since otherwise the inner and outer surfaces would be stretched, placing the centre of the thickness in severe tension which would remain as residual stress, the worst possible condition for resisting the hoop stress due to the mass of the bell and the stress produced by the end turns of the rotor windings.

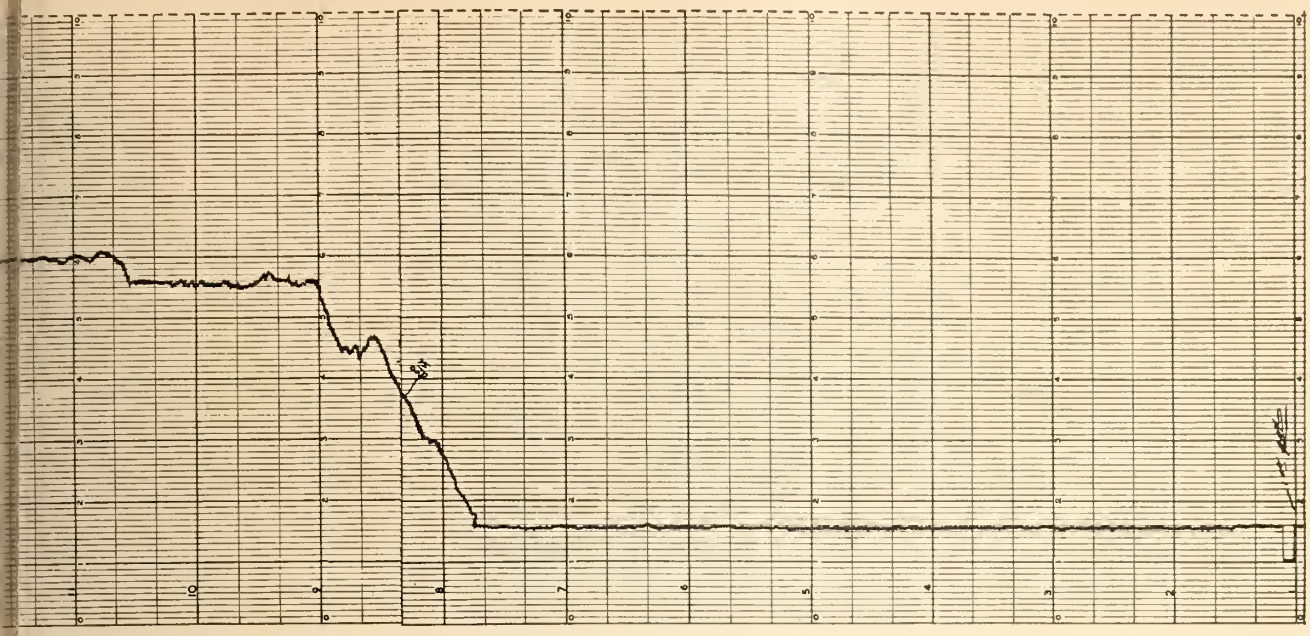
To produce end bells of the dimensions required for the Toronto rotors (Figure 3) a 4,000-ton press was not powerful enough to forge over the full axial length after partial cold work; thus the forging tool was restricted in working to approximately one-third of the length of the end bell by tilting the mandrel. For satisfactory rolling the force exerted between the rolls for Toronto size end bells would have to approach 12,000 tons; such a rolling mill would involve fantastic bearing loading problems which have not, as yet, been solved. A design of a suitable rolling mill is, however, under active consideration.

The Toronto end bells were forged under a 4,000 ton press by the following method:

1. The ingot is cogged into a billet in a number of heats, forging being carried out between 1,100°C. and 900°C.
2. The billet is cut into blocks under the press.
3. The blocks are flattened (upset) and the central hole punched and drifted under the press. The shape is trued by flattening and edging.
4. Hot expanding is carried out on a mandrel in two stages.
5. The forgings are cooled and rough machined.

Table II — Service History of Nos. 1 and 2 units

		No. 1	No. 2
No. of hours in service	25 cycles	6,916	
	60 "	4,427	10,739
	Total	11,343	
Total kwh. generated x 10^6	25 cycles	197,390	
	60 "	370,129	685,199
	Total	567,519	
No. of Starts, 25 cycles		75	
" " 60 "		25	77
	Total	100	
No. of overspeed trip tests, 1695 r.p.m. 26 cycles		10	
1980 r.p.m. 60 "		7	17



ad chart.

6. Expanding by forging under the press on a mandrel is carried out after heating to 1,050°C. and allowing to cool to 480°C., when forging commences.

7. Stress-relieving prior to machining by heating for five hours at 400°C. and cooling in the furnace.

When producing the end bells for Nos. 1 and 2 generators, Item 5 above was not current practice, but this step was carried out on the end bells for Nos. 3 and 4 generators.

Late in 1952, the machining allowances in the bore after cold working were increased to remove the material having the highest residual stress, tests having shown that the high internal stresses present in the bore decreased rapidly below the surface.

Another problem which has been prominently in the designer's mind for many years is whether or not to drill ventilating holes through the end bells. Such holes, shown in Figure 1, appreciably lower the temperature rise in service, but weaken the bell and are potential stress raisers, particularly in a work hardening non-magnetic material. The designer must make his choice between two evils and his decision will be influenced by previous experience.

It is almost certainly true to say that every manufacturer of large turbogenerators has experienced the phenomenon known as "rotor coil distortion" where, after varying periods of service, the bottom turns of the rotor coils shrink and eventually cause a breakdown, either between coils or to earth. Figure 4 shows a rotor with such a development.

When first experienced, rotor coil distortion was something of a mystery, but the causes are now clearly established and it is known that one direct manner of avoiding the trouble is to reduce the rotor temperature rise either by putting more copper or aluminium into the windings, which may well be limited by stress considerations, or by improving ventilation. Having added as much active material as possible, the designer endeavours to aid the air or hydrogen flow across or through the windings. Ventilating holes in end bells is one of the outstandingly helpful ways of reducing temperature rise and may give a reduction ranging from 7° to 15°C. or even greater, according to other design features.

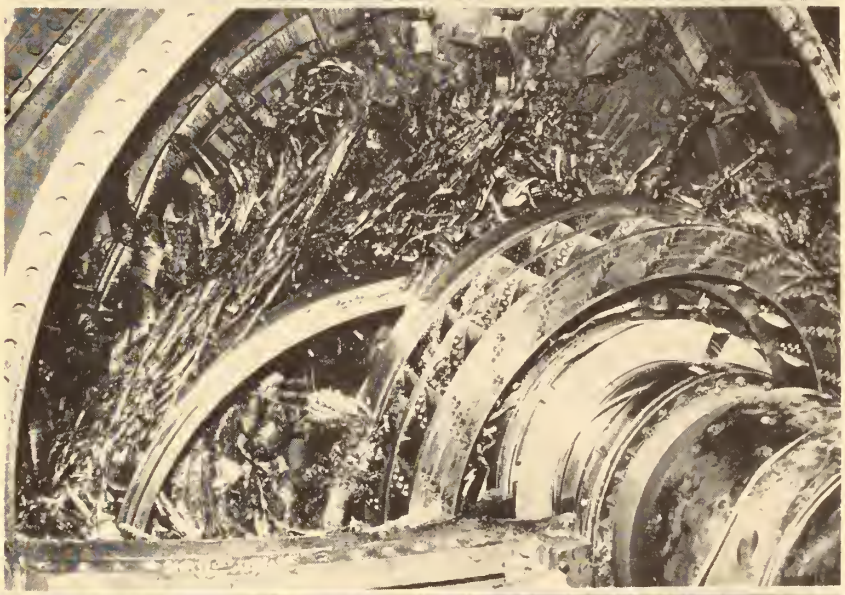
Rotor coil distortion is a direct function of the number of heating and cooling cycles to which the generator is subjected, and this generally is the number of times the unit is started up and put on load. Hence a turbogenerator which is operated on a one- or two-shift basis, i.e., is shut down each night, is much more likely to develop coil distortion than one kept almost continuously in service.

It was known when designing the Toronto generators that they were to be used to take the peak loads on a system predominently supplied by hydro-driven generators, and that the load was likely to vary from 10 to 100 per cent of maximum rating two or three times each day and to go off completely each night. Conditions more likely to produce coil distortion could hardly be visualised and much thought was devoted to limiting rotor temperature rise.

The final decision was to provide ventilating holes, since rotors of similar design, although of smaller capacity but higher rotational speeds and similar stresses, had been in service for many years, all completely without any form of trouble. The potential danger of ventilating holes was fully appreciated and allowed for in design and in manufacturing technique. Carefully sharpened drills were used and great care taken to radius the holes at the inside and outside surfaces of the bell.

Table III

Unit	Date 1954	Length of shut down	Time to run up from rolling gear
No. 1	March 19	6 hr. 35 min.	1 hr. 5 min.
	March 26	7 " 43 "	42 "
	March 30	7 " 27 "	52 "
	April 1	8 " 4 "	22 "
No. 2	March 23	8 " 4 "	38 "



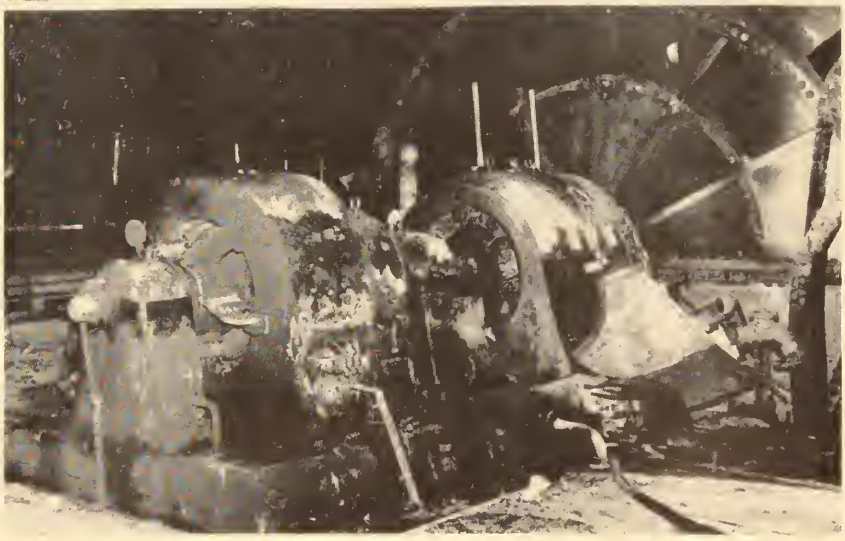


Fig. 6a. Damage to No. 1 unit.

Fig. 6b. Damage to No. 2 unit.

Fig. 6c. Damage to No. 1 unit.

Description of Units Concerned

The Hydro-Electric Power Commission of Ontario ordered four units each of 100 mw. similar in most details except that Nos. 1 and 3 sets were to be dual frequency units, i.e., originally to operate at 25 cycles and then as conversion of the Hydro system to 60 cycle proceeded, to be converted to generate 60 cycle current.

	Date of Order	Date on Load
No. 1 Machine,	Feb. 1, 1949	Oct. 28, 1951
No. 2 "	Feb. 19, 1949	Feb. 4, 1952
No. 3 "	Nov. 14, 1950	Nov. 24, 1952
No. 4 "	Nov. 7, 1950	June 10, 1953

The two dual frequency sets ran at 1,500 r.p.m. with two-pole rotors to give 25 cycles and were converted to 60 cycles by changing the stator connections and providing new four-pole rotors running at 1,800 r.p.m. No. 1 unit was converted and recommissioned as a 60 cycle set on August 31, 1953, and ran until failure on April 1, 1954.

Particulars of the service history of Nos. 1 and 2 sets are given in Table II:

During the latter part of March, 1954, tests were made to determine the effect of shutting down for short periods at night, and some details are given in Table III.

No abnormal vibration was experienced during these tests.

The number of rms under these conditions is comparatively few and the cycles of stress and temperature to which the end bells were subjected are not likely to have had any significant effect.

These sets operated under peak load conditions. A typical daily load chart (from No. 2 set, dated December 19, 1952), is reproduced in Figure 5. During the night the load was steady at about 10 mw., rising to 90 mw. between 7.45 and 9 a.m. and to 100 mw. between 10.30 and 12 a.m. The load dropped to 10 mw. from 12.30 to 4 p.m., when it was again increased to over 100 mw. at 5 p.m. which load was maintained until 7 p.m. The load was reduced to 20 mw. at 8 p.m. and the set taken off the bars for the weekend at 9 p.m. During the week the load was normally maintained at 10 mw. during the night.

The temperature of the rotor body and of the end bells is dependent upon the losses in the rotor windings. The rotor body has much the greater heat capacity and therefore could follow only slowly the load changes, whereas the end bells would respond rapidly, as they are cooled directly by the cold inlet gas. The co-efficient of expansion of the end bell austenitic steel is 65 per

ent greater than that of the rotor steel and the variations in temperature would cause a corresponding change in the shrink of the end bells on the body and in the stress in the bells due to this shrink. Superimposed upon the main stress in the end bells, this fluctuation could be a minor contributory factor to the failures.

Occurrence of Breakdowns

No. 1 Set

The first failure occurred on No. 1 set at 6.14 a.m. on April 1, 1954. The machine had been shut down during the night of March 31 to April 1 and was run to speed in 22 minutes in the early morning. The generator was synchronised at 5.55 a.m. and the load built up to 10 mw., when at 6.14 a.m. an apparent explosion occurred. Flames immediately appeared at the exciter end of the generator, which rapidly developed into a major fire around the generator and the foundation block. It was thought at first that a hydrogen explosion had taken place inside the generator, but from subsequent examination it was clearly evident that the original cause was a mechanical failure in the rotor at the exciter end. The immediate result of the severe mechanical forces caused by the disintegration of the rotor fractured the bearings, supports and housings, gas seals and oil pipes at both ends of the rotor, releasing cooling gas and lubricating oil which flowed freely around the generator and the foundation block. A major oil fire developed and was fed from the auxiliary oil pump, which was automatically brought into operation when the main oil pressure dropped as the turbine speed fell, because the set was automatically tripped by the protection gear. Figures 6A, 6B and 6C convey some idea of the damage.

Damage external to the generator, caused by the fracture and breakage of bearing housing, pedestals, main driving coupling and other parts, was relatively minor. Practically all the damage to auxiliaries, bus bars and cables, structural work and building was caused by the fire in which approximately 3,000 gallons of oil were consumed. Excellent efforts by the station operating personnel, despite extremely difficult conditions and hazards, limited the effects of the fire mainly to the area of No. 1 set. At the same time, the remaining turbogenerators, Nos. 2 and 4 sets, were shut down without harm to turbogenerators, boilers or auxiliary equipment.

No. 2 Set

After the fire on No. 1 set was finally controlled with the assistance of the city fire department, service was restored to No. 4 set. As the station service supply is common to Nos. 1 and 2 sets, temporary connections had to be made to No. 2 set auxiliaries from No. 3 unit. No. 2 set was put back into service during the early morning of April 2. Both these units were operated to meet system load requirements and running conditions were normal. The sets were shut down for a period during the weekend and both were restarted during the early morning of Monday, April 5. No. 2 set was synchronised at 5.18 a.m. and, as the mechanical and electrical performance was normal, the load was built up to the full output of 100 mw. by 8 a.m. This load was maintained until 10.58 a.m., when, without warning, a heavy thud was felt, followed immediately by excessive vibration and a similar sequence of events as had occurred with No. 1 set. The mechanical damage to the bearing housing was not as extensive as on No. 1 set, but oil feed and drain pipes were loosened and shaken off by the excessive vibration, allowing oil to be discharged over the area around and beneath the generator. The auxiliary pump was shut down at an early stage and the oil fire was not as prolonged. The amount of oil consumed was about 1,800 gallons and the damage to auxiliary equipment was considerable. It is likely that hydrogen gas escaping from the damaged seal at the exciter end was first ignited and in turn set fire to the escaping oil. It was quite clear from the examination of the generator later that there had been no hydrogen explosion nor fire inside the stator casings. It was afterwards found that some hydrogen gas was still retained in the casing of No. 2 generator, which had to to be scavenged with CO_2 gas before it was opened for examination. No. 4 set was taken out of commission pending the result of the investigation and a decision on the modifications to be made to the rotors of Nos. 3 and 4 sets.

Investigations

The examination of No. 1 set was proceeding at the time of the failure of No. 2 set, though progress was retarded as the crane had been put out of commission by the fire. The top half steel end covers at the exciter end had been removed and it was found that the rotor end bell and about 75 per cent of the teeth at that end of the rotor forgings had fractured. The rotor and stator end windings had disintegrated and the stator frame was severely damaged.

The end bell support ring and fan, though damaged and displaced, were intact and the end bell itself was lying in the debris in the bottom of the stator casing. The bell was removed without great difficulty and was found to have fractured in one place radially and axially through a line of three ventilating holes on a pole centre line. Details of the fracture are shown in Figures 7, 8 and 9.

From the appearance of the fracture surface, it was deduced that fracture had started at the ventilation hole nearest to the rotor, that is hole No. 38 in Figure 11A, or the hole on the left of Figure 8 and at mid-thickness. From that hole the crack had spread in each direction. There was evidence, too, that when the fracture reached the other two holes it started again in each instance at the mid-thickness.

The examination of No. 2 set after the failure showed it to be in a similar condition, although the extent of the damage was not so great. The end bell at the exciter end had fractured in an identical manner, but the number of fractured rotor teeth was much smaller and did not extend so far along the rotor. The condition of the stators and rotors at the turbine ends was found to be normal and did not provide any clue as to the cause of the failures. The condition of both windings at this end was excellent, confirming that there had been no hydrogen explosion nor fire inside the casings.

A superficial examination of the fractures in the end bells did not reveal any flaws or abnormal features which could be regarded as important. The bells had failed in an identical manner, which also seemed to eliminate the possibility of a local fault in the material. The appearance of the surfaces of each fracture indicated that a crack had started near the centre at a ventilation hole and was propagated normally to the plane of the principal stress to the edge, where the bell is shrunk on to the rotor body. The remaining portion nearest to the balancing ring appeared to have the nature of a shock fracture and to have parted more rapidly. This end of the bell is spigotted into the support or balancing ring, which initially would carry some of the loading. The sequence of events as described above would appear logical.

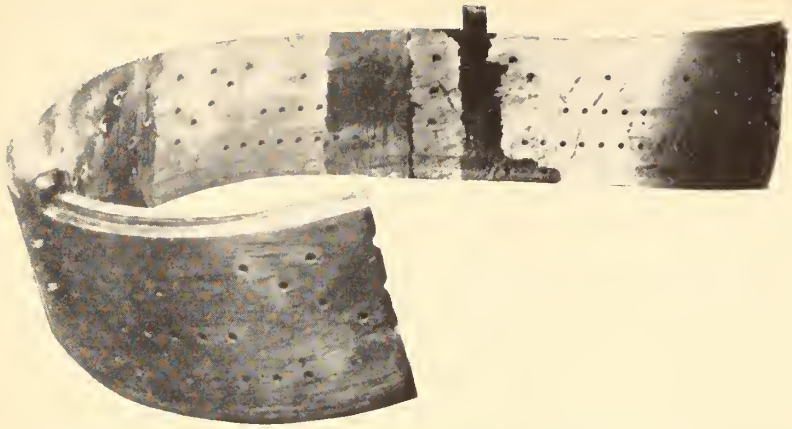


Fig. 7. Fractured end bell from No. 1 machine on arrival for examination.

Fig. 8. View of fracture on end bell from No. 1 machine.

Fig. 9. View of fracture on end bell from No. 1 machine.

The damage was so extensive that it could not immediately be determined whether the initial failure had been in the end bell, or in the rotor slot wedges, or in the rotor body at the roots of the slot teeth.

When the first cabled report of the failure of No. 1 machine was received by the makers of the units, consideration was given to possible causes, assessing these in the light of all known experience.

A relatively new phenomenon was the subject of investigation at the time of the Toronto failure. This was the cracking of nonmagnetic end bells after being stored for a considerable period under damp conditions and was known as "stress-corrosion." Such cracking was always distinctive in that the cracks were transgranular and jagged. Since No. 1 60-cycle rotor had been in store for almost two years, the possibility of stress corrosion being the cause was seriously considered, but as will be seen later, it was subsequently proved beyond question not to be.

The end bell which failed on No. 1 unit was flown back to England by charter plane for examination and testing.

A typical stress corrosion crack is shown in Figure 12A, while one of the cracks in the end bell of machine No. 1 is shown in Figure 12B. There was no similarity in the two fractures, nor was there any sign of corrosion at any area of the end bell which failed in service.

Two nonmagnetic end bells which had cracked seriously while stored on an overseas power station site under damp conditions, had been the subject of investigation in 1953 and early 1954. Both end bells were of composition, manufacture and design similar to the Toronto bells, and from examples commonly observed in steel structures exposed to damp atmospheric conditions, would not have been regarded as badly corroded. A penetrant dye method of crack detection on the areas adjacent to the cracks showed a network of cracks of varying depth, some over 0.06 in. deep and of a nature which might have led to immediate or early failure had these rotors been put into service. In neither of these bells did the crack commence at or extend to a ventilating hole, nor were there any corrosion or cracks in ventilating holes.

Although No. 1 60 cycle rotor had been stored for almost two years the rotor of No. 2 unit had not been stored and at no time had been damp nor in any way exposed to conditions likely to lead to corrosion. All the holes in the two Toronto end bells which failed in service were examined with a small boroscope and some of the holes were cut through and examined under the microscope. No signs of the typical stress-corrosion network were found.

Every hole in the end bells from the turbine end of units Nos. 1 and 2 and in the four end bells from units Nos. 3 and 4 was examined by the penetrant dye method before and after the hydraulic testing later described. In no case was any trace of cracking or surface crazing typical of stress corrosion found.

In nonmagnetic austenitic steel of the type under investigation stress corrosion cracks are always transgranular, while the cracks in the end bells, which either failed in service or were failed by hydraulic testing, were invariably intergranular. At first glance it might be thought that the crack in Fig. 13 commences transgranular through the first grain and then becomes intercrystalline. A close study of that and of a large number of similar micrographs shows clearly that in every case the cracks arising from overstress are intergranular. The cracks arising from normal fatigue testing of nonmagnetic material are

generally transgranular, but distinctively different from transgranular stress-corrosion cracks.

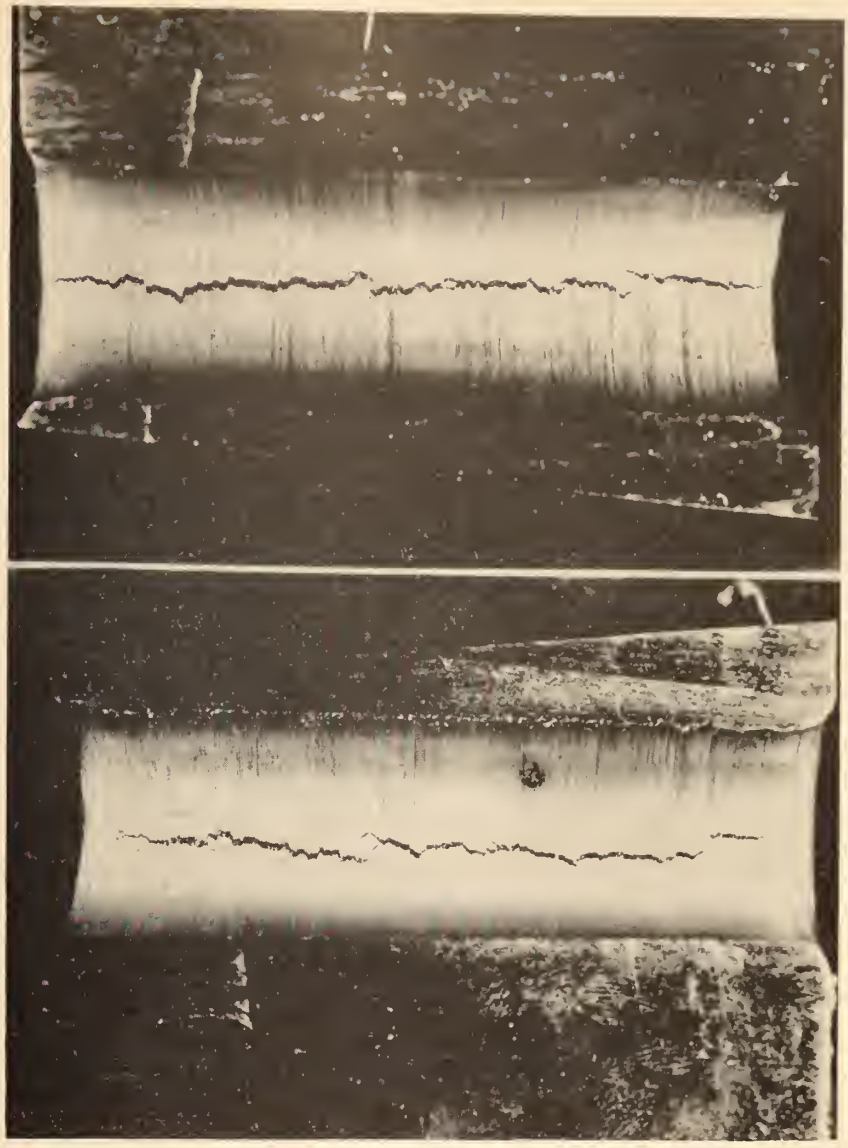
The rotors from both Nos. 1 and 2 sets were returned to England and the slot wedges carefully removed, examined and tested. No information justifying any suspicion of them could be found. Their physical properties and microstructure were normal and in accordance with specifications.

When removing rotor copper from slots and when examining fractured rotor teeth, a careful study was made of copper marks on the teeth. These appeared to show that the sequence of failure had been end bell first, then rotor winding end turns flying out and fouling stator bore, thus wrenching out slot wedges and allowing copper in the slots to rise and foul stator bore which, in turn, wrenched off rotor teeth. Test pieces were cut from the rotor and these appeared to clear the rotor from any suspicion.

Investigations into the end bell material, stresses, design and manufacture had been proceeding during this time, but it was not until after many weeks of examination that it could, with any certainty, be decided that the cause lay with the end bells.

One possible cause of the failures, explored at an early stage, was severe unbalance between phases, possibly due to a single-phase closing of a circuit breaker on a feeder carrying a considerable proportion of the generator output. Such an occurrence has been known on air-cooled machines and has given rise to such overheating of rotor slot wedges and of arcing between end bell and rotor as to be dangerous. In an air-cooled machine, the presence of severe negative phase sequence generally becomes evident by smoke from the rotor escaping from the stator casing covers. It was realised that in a hydrogen-cooled generator smoke would never become evident and serious unbalance in phase current could be all the more serious in consequence. No evidence of such unbalance could be obtained, nor was there any sign of arcing between end bell and rotor body, nor of overheating of slot wedges. That possible contributory cause was therefore eliminated, but the absence of warning of severe electrical unbalance in a hydrogen-cooled generator should be noted and thought given to the desirability of providing some suitable warning system.

Hydraulic testing gear was made and a series of end bells from the Toronto and other generators (37 in.-diameter bells) were tested to destruction. Figure 14 shows the heavy nature of the equipment required to carry out such tests. Figure 15 shows details of the equipment. Some of the results are given in Table IV.



Figs. 10a and b. Turbine end rotor end bell, No. 1 unit. (Inner surface, at left of pictures, outer surface at right). Failed by 76 repeated applications of hydraulic pressure of mean hoop stress 27.6 tons per sq. in.

10a. (Top) Side of hole nearer rotor body end.

10b. (Bottom) Side of hole nearer balancing ring end.

Because of the danger arising if identification numbers are stamped on end bells, the identification symbols painted on the Toronto bells were removed in the final machining, hence it was not possible to be certain to which end of a rotor a particular bell was fitted, so both acceptance tests are quoted.

With the exception of the end bell from Toronto No. 4 exciter end and one of the 37-in. bells, all bells which failed under hydraulic test did so by cracking quietly without the crack's spreading. The hydraulic pressures to produce a crack at a drilled hole were of the order of 10,000 p.s.i. and, small capacity pumps were deliberately used, so that if a crack developed, a very small leakage of oil reduced the pressure and prevented damage to the test equipment. No. 4 Toronto exciter end bell, however, failed with explosive force, indicating a remarkably rapid rate of crack propagation, and produced a fracture almost identical with the two failures which occurred in service. The bell at the moment of failure opened out with sufficient force to damage the test equipment. The gap at the fracture must have measured over three inches momentarily and then closed as shown in Figure 16.

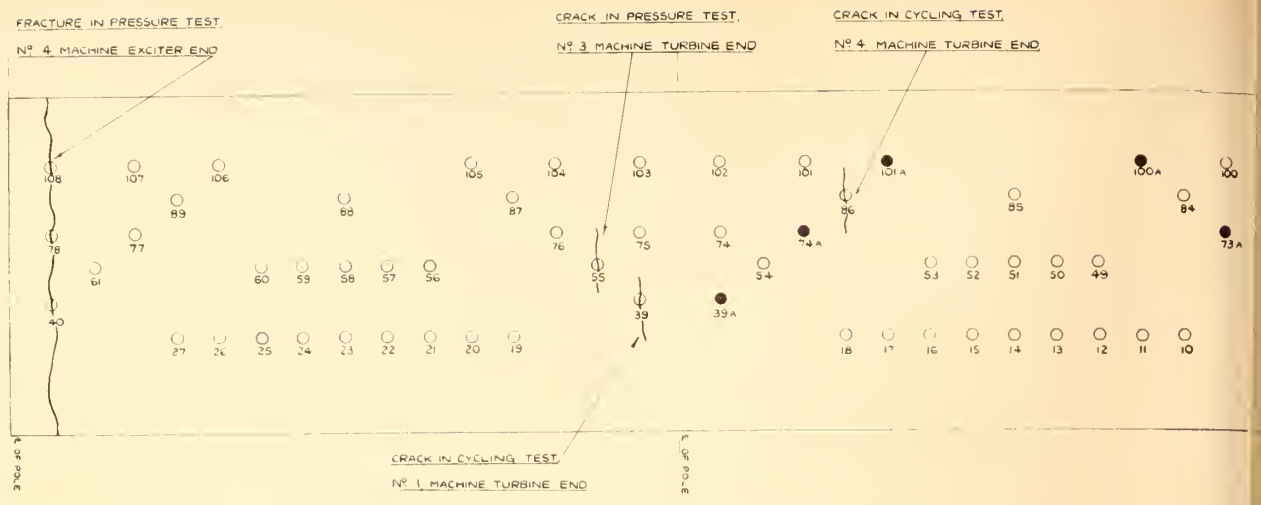


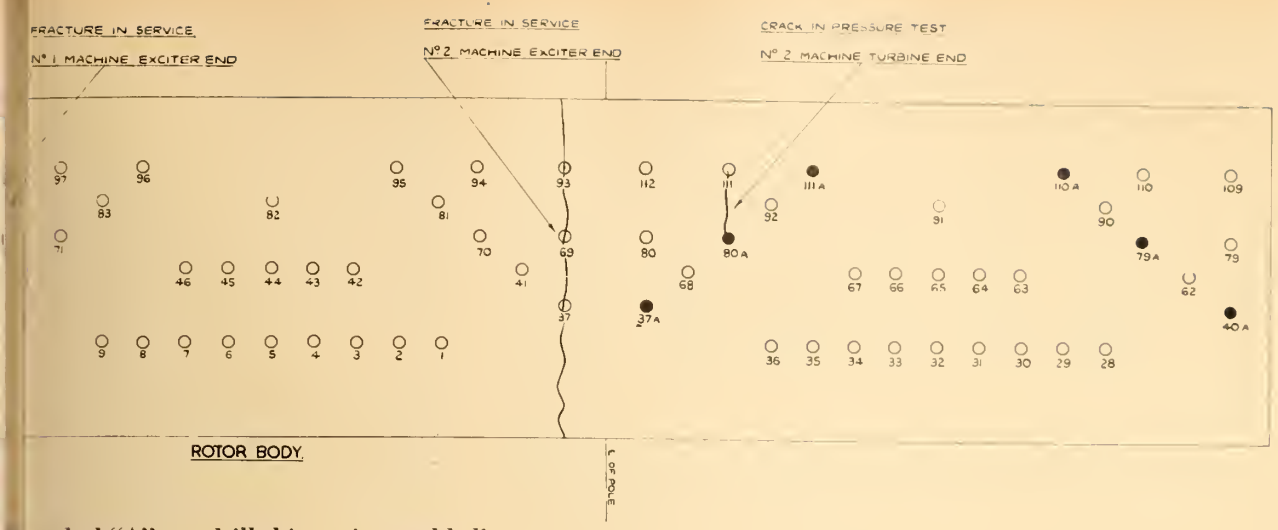
Fig. 11a. Expanded plan of inner surface of rotor end

It seemed important to ascertain why No. 4 exciter end bell failed similarly to Nos. 1 and 2 exciter end bells, while Nos. 2 and 3 turbine end bells cracked without the crack's spreading, as had now occurred on three exciter end bells.

A critical examination of the two end bells which failed in service, had revealed that after the failure 24 holes of No. 1 set exciter end bell showed minute surface cracks, while No. 2 exciter end bell had 68 holes with cracks. The most searching examination by boroscope and by the penetrant dye method failed to find any crack in any hole in the turbine end bells of Nos. 1 or 2 units or in either end bell of Nos. 3 or 4 units before hydraulic testing. After failure by hydraulic pressure however, No. 2 turbine end bell had 12 holes with minute surface cracks; No. 3 turbine end bell had cracks in

Table IV — Results of Hydraulic Tests

End Bell	Acceptance Tests				Maximum Applied Hoop Stress-Tons/Sq. in.					Result
					Rotor body end		Balancing ring end		Mean hoop stress	
	Yield point, tons/sq. in.	U.T.S., tons/sq. in.	Elongated on 2 in. per cent	Reduction in area per cent	Inside	Outside	Inside	Outside		
Toronto No. 2 turbine end,	49 8	56 8	38	51	36 62	33 27	34 18	30 83	35.69	Cracked through two holes
drilled	56 2	61 0	29.5	42						
Toronto No. 3 turbine end.	49 6	56 2	39 0	43	40.28	36 6	37 6	33 91	39.26	Cracked a one hole
drilled	55 8	60 0	18 5	30						
Toronto No. 4, exciter end	55 4	60 6	23.0	32	42 73	38 82	39 87	35 97	41 64	Fractured through three holes
drilled	59 0	63 2	23 5	38						
37-in bell, 60 mw. rotor drilled					43 20	37 4	41 72	35.98	42.92	Cracked a one hole
37-in bell, new, drilled	51 8	57 4	35	49	41 30	35 83	39 50	34 03	40.70	Cracked a one hole
37-in. bell, new drilled	56 4	60 4	34	33	42 13	36 53	40.51	34 91	41.69	Fractured through two holes
37-in bell, new undrilled	52 8	57 8	34	40	50 82	44 12	48 57	41 88	49 85	Expanded without cracking
37-in. bell, new, undrilled	57 2	60 4	32	45	50 57	43 92	48 24	41 59	49 50	Expanded without cracking
Torongo magnetic replace bell,	47 2	54 0	24	61	43 85	39 26	43 85	39 26	43 21	Expanded without cracking
undrilled	49 4	56 2	25 5	65						



emarked "A" not drilled in exciter end bell.

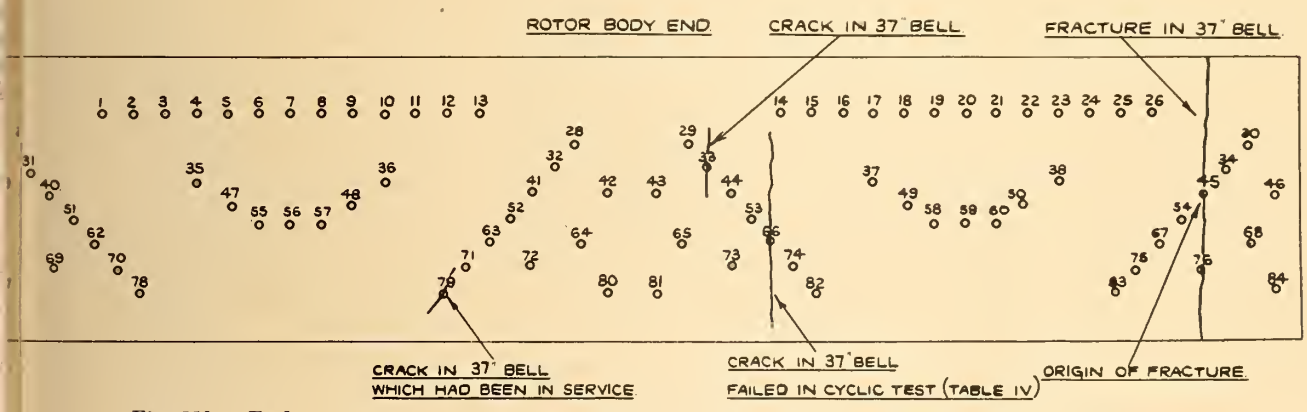


Fig. 11b. Failures under hydraulic test. Expanded plan of inner surface of rotor end bell.

Fig. 12a. Typical stress corrosion fracture.

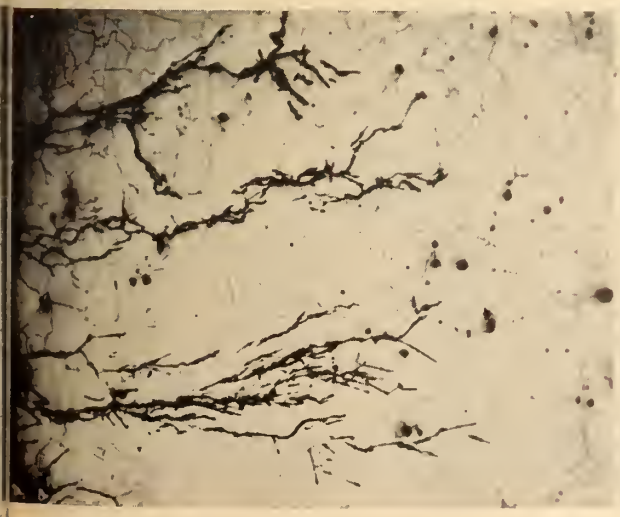


Fig. 12b. Typical crack in exciter end bell from No. 1 unit after failure in service.

Table V — Results of Cyclic Pressure Tests

End Bell	Maximum applied hoop stress, tons/sq. in. Rotor body end Inside	Rotor body end Outside	Balancing ring end Inside	Balancing ring end Outside	Mean hoop stress tons/sq. in	Number of cycles
Toronto No. 1, turbine end	28.35	25.72	26.42	23.83	27.6	76-failed
Toronto No. 4 turbine end	18.95	17.20	18.27	16.48	18.5	500
"	23.75	21.50	22.60	20.60	23.5	500
"	27.78	25.19	26.68	24.09	27.6	464-failed
Toronto magnetic bell, undrilled					30.0	924-not cracked
37-in. end bell	28.07	24.32	27.13	23.38	25.59	174-failed

9 holes and No. 4 exciter end bell had 26 holes showing cracks. After the cyclic testing to failure of the turbine end bell of No. 1 set, described later, three holes were found cracked, one crack extending from bore to outside, the other two cracks not extending to either inside or outside surface and obviously commencing at approximately mid-thickness of the bell, which is the area of maximum stress. A large number of the cracks in each bell were sectioned and microphotographed; in every case the crack was intergranular and in no case was there any sign of stress corrosion.

Figures 12B and 13A, 13B and 13C, show typical cracks from the exciter end bell of No. 1 unit; exciter end bell of No. 2 unit; turbine end bell of No. 2 unit and the exciter end bell of No. 4 unit. The striking similarity of these cracks will be noted; all are intergranular. Of the cracks found in the holes of the end bells which failed in service, it is not possible to say what proportion developed due to the straightening out of the end bells which followed the failure. Some of them certainly conveyed the impression that they were due to the ovality of the holes produced by the straightening. They all, however, were typical of cracks produced by overstress.

Of the five 37-in. end bells tested hydraulically, the one failing at a mean hoop stress of 42.92 tons per sq. in. was from a 60-mw. rotor which had been in service, while the two new drilled 37-in. bells were specially prepared under control conditions and tested hydraulically at once before any corrosion could possibly take place. These two bells failed quietly at a mean hoop stress of 40.70 and 41.69 tons per square inch.

Two new 37-in. bells were also prepared without drilling ventilating holes and tested hydraulically. These began yielding at mean hoop stresses of 49.85 and 49.50 tons per sq. in., when the oil seals failed. Repeated attempts to maintain an oil-tight seal at the pressure producing appreciable yield were unsuccessful. The amount of yield (expansion) at a mean stress approaching 50 tons per sq. in. was more than sufficient to have released the shrink on to the rotor body.

Several hundred hardness tests were made on the internal surfaces of holes, using a 10-kg. load with a Vickers diamond pyramid hardness tester. These showed variations from 351 to 657, while the parent metal away from the holes ranged from 280 to 340. Thus, despite every care in drilling ventilating holes, there was considerable work hardening on the surface of the holes. This hardening appeared to have no relation to depth of hole, i.e., hardening was not progressive with depth. In many

Fig. 13a. Typical crack in exciter end bell from No. 2 unit after failure in service.

Fig. 13b. Typical crack in turbine end bell from No. 2 unit after hydraulic testing.

Fig. 13c. Typical crack in exciter end bell from No. 4 unit after failure in service

holes, the hardness was lower at the bottom of the hole than at the top; in general, hardness was a maximum at or about the middle depth of the hole. The work hardened skin of the hole was extremely thin and possible explanations are that the drill cuttings or swarf rubbed the surface, sometimes causing surface polishing and at other times causing scratches, or that radial pressure of the drill was responsible.

An attempt was made to correlate hole surface hardness and polish with the area of incipient failure, but the results were contradictory. In the case of No. 2 exciter end bell, failure started from a hole with an exceptionally smooth and soft surface.

The stress applied in service to the Toronto end bells is 19¼ tons per sq. in. from centrifugal loading of the copper and from its own hoop stress. At the nose of the bell where it is shrunk to the rotor body, the stress is 26 tons per sq. in. when both rotor and bell are cold, but is appreciably less under normal operating temperatures, when body and bell are warm, because of the greater expansion coefficient of the austenitic bell material. The shrink stress could, however, be increased were the rotor body to be hot after coming off a high load and the end bell cold, or appreciably cooler, because of low temperature cooling water left on at full quantity to hydrogen coolers. In such a case the greater expansion coefficient of the end bells would increase the shrink and hence the stress.

The shrink stress of 26 tons per sq. in. is that resulting from the design ruling that the end bell shrink shall just loosen at 10 per cent above normal speed with rotor end bell at operating temperature. This ruling had been standard for many years and was a reasonable one, occasioned by the desire to have no possible chance of end bell movement when the unit was taken to overspeed to test the emergency governor. As a result of the reconsideration of all design factors, a change has been made, and the shrink stress reduced to 23 tons per sq. in. by reducing the speed at which the shrink loosens to 5 per cent above normal.

At this stage of the investigation, it had been demonstrated that holes were undesirable but did not explain the failures. Numerous test pieces cut from alongside the service failures merely confirmed the accuracy of the original acceptance tests and gave no clue to the cause of failure.

It was decided to put in hand repeated stress cycles by the hydraulic method to see what part fatigue played in the failures and also to make fatigue tests by the Wohler method on samples of the end bell material. Izod tests at subnormal, normal and above normal temperatures were also made.

Table VI — Results of Wohler Fatigue Tests on Specimens from No. 2 Machine Turbine End Bell and No. 4 Machine Exciter End Bell which failed in Hydraulic Pressure Test

No. 2 TURBINE END			No. 4 EXCITER END		
Stress range, tons/sq. in.	No. of reversals	Results	Stress range tons/sq. in.	No. of reversals	Result
± 21	10,480,300	Unbroken	± 19	10,000,000	Unbroken
± 23	10,000,000	Unbroken	± 20	9,891,100	Broken
± 24	4,359,900	Broken	± 21	3,879,000	Broken
± 25	1,884,000	Broken	± 23	2,773,000	Broken
± 27	651,900	Broken	± 25	2,680,900	Broken

The cyclic pressure tests were carried out in the same apparatus as that used for the single loading pressure tests. The hydraulic pressure was built up to a specified level, maintained for five minutes and then released. The cycle of loading and unloading was continued until the bell cracked or until the test was stopped for some other reason. The results obtained in this test are given in Table V.

The turbine end bell from No. 1 Toronto machine failed by cracking after it had been subjected to 76 cycles of stress over the range of 0 to 27.6 tons per sq. in. The crack occurred at a hole at the end of a row of three (Hole No. 39 in Figure 11A) which is in a position similar to that of the holes at which the fractures began in the two bells that failed in service and in the exciter end bell from Toronto No. 4 machine that fractured completely in the single loading pressure test. Two views of this crack are shown in Figures 10A and 10B. Two other holes in this bell were found to be cracked, these being Nos. 39A and 37 in Figure 11. It will be noted that all the cracks in this end bell occurred in holes that were similarly disposed to those in which the fractures began in the two bells that failed in service and the exciter end bell from Toronto No. 4 machine that was fractured in the hydraulic test.

In view of the result obtained in the cyclic test on the turbine end bell from No. 1 Toronto machine, it was decided to try to produce a crack in the turbine end bell from No. 4 Toronto machine by repeated applications of cycles of stress with a lower maximum. In the first instance, this bell was subjected to cycles of stress arranged to give a maximum mean hoop stress of 18.5 tons per sq. in. After 500 cycles the test was stopped and the bell examined for cracks in the holes. No cracks were found and the test was resumed, but the maximum mean hoop stress of the cycle was raised to 23.5 tons per sq. in. After 500 cycles of this range of stress the bell was again examined and as no cracks were found in the holes, the test was again resumed, but the maximum mean hoop stress was raised to 27.6 tons per sq. in. After 464 cycles of this range of stress the bell was cracked at Hole No. 86 in Figure 11A.

The test on the undrilled magnetic bell was carried out in order to confirm that the resistance of the replacement bells on the Toronto machines to repeated cycles of stress was better than that of the original bells. As this bell contained no holes and was made from a material dif-

Table VII — Results of Izod Tests on End Bells

The numbers are values in ft.-lb.

End Bell	−78°C		Room temp. +15°C.			+100°C.	
Toronto No. 1, exciter end failed in service	9	11	39	37	35	54	89
Toronto No. 2, exciter end failed in service	8	7	29	26	26	55	44
Toronto No. 2, turbine end failed pressure test	9	11	26	32	28	45	44
Toronto No. 4, exciter end failed pressure test	6	6	21	21	21	54	42

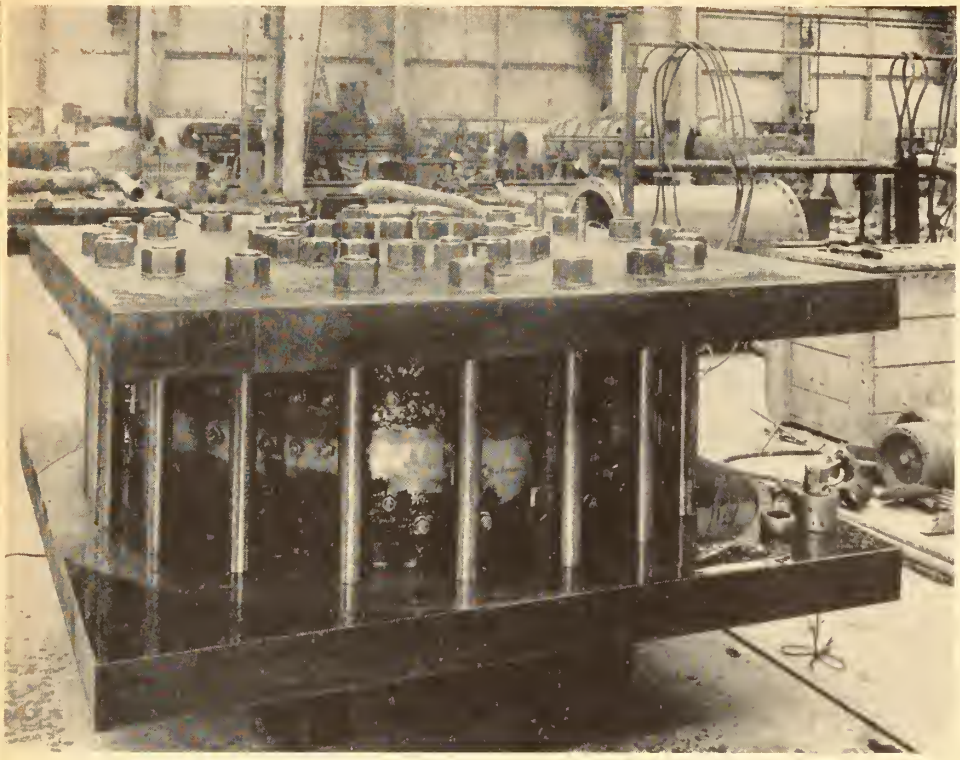


Fig. 14. Hydraulic testing equipment.

ferent from the other bells subjected to the cyclic test, it cannot be compared with them either from the point of view of showing the effect of holes, or from that of showing the effect of the material.

The cracks produced in the cyclic tests were similar to those produced in the single loading pressure tests. There was no deformation of the material near the holes, but as the cracks extended away from the holes the material deformed in front of them. It seems clear that the failures were produced because cracks can be started at the surface of the holes under repeated applications of a lower stress than that required to start them in one application.

It will be seen that the turbine end bell from No. 4 machine gave a better performance in the cyclic test than that from No. 1 machine. It appears, however, that this difference is not substantial. There was an appreciable difference in the mean hoop stresses at failure of the three Toronto bells in the single loading pressure tests; it does not seem that the difference in perform

Table VIII — Residual Stresses in Bells

Material	Treatment	Dimensions, Ins.			Circumferential Stress, Tons/Sq. In.				Maximum Longitudinal Stress Tons/Sq. In.	
		Outside diameter	Inner diameter	Length	Bore before machining	Bore after machining	Outer diam., before machining	Outer diam after machining	Before Machining	After Machining
A Non-magnetic, yield point 50 tons/sq. in. ultimate strength 55.6 tons/sq. in.	Cold worked, 22%	59 3	50 5	24 75	+40 to −50	+15 to + 6	+ 8 to − 16	+ 2 to − 10	−17	−12
B. Non-magnetic.	Cold worked	39 48	32 81	24	> −15	− 7	+ 7	+ 4	+ 7	− 7
C. Non-magnetic, yield point 55 tons/sq. in. Ultimate 63 tons/sq. in.	Cold worked	55 03	47 75	33	−16	+10	− 5	− 7	> −20	+ 8
D. Non-magnetic	Stretched by hydraulic pressure	37 34	32 375	16 4	−	+ 4 to + 8	−	−10	−	±4
E. Non-magnetic, Toronto No. 3, exciter end.	Cold worked	58 44	53 19	20	−	+10	−	+10	−	−10

−Indicates tension. +Indicates compression.

ance of the two bells in the cyclic test was any more significant than this. No two end bells are exactly alike and it is not to be expected that two bells selected at random would give identical results in a cyclic test. It is conceivable that one reason for the difference between No. 4 and No. 1 end bells may be at least partly due to the fact that the better results on the one end bell were associated with the prestressing given by the cyclic test at the lower stresses. Furthermore, in addition to the differences between the two bells as produced, they were in service for different lengths of time on different machines before they were tested, and this might have influenced their behaviour.

The results of the cyclic tests were so significant in relation to the Toronto failure that it was decided to carry out some cyclic tests on freshly machined and drilled 37-in. bells. (Table V). The disposition of the holes in these bells is shown in Figure 11B, which shows the position of the holes where failure occurred in both static and cyclic tests.

In both the static and cyclic tests on the 37-in. bells a number of holes in the diagonal groups of seven were found to be cracked and no cracks were found in holes outside of these groups. In all cases the cracks originated at the centre of the thickness.

The results of some Wohler-type fatigue tests on specimens from two Toronto end bells are given in Table VI.

In addition, to these results, there were available the results of some similar tests on other specimens of end bell steel. These results agree quite well with the results in Table VI; on the basis of all the results it may be estimated that the fatigue limit of end bell steel under alternating stress (i.e., mean stress = zero) is about ±21 tons per sq. in. This figure is not relevant to the conditions realised in the cyclic tests, in which cycles of repeated stress (i.e. mean stress equal to half the range of stress) were applied, but it does show that for end bell steel the ratio of the fatigue limit to the ultimate tensile strength is about 0.35 as compared with 0.46 for heat treated steels.

There are, however, the following results of Haigh fatigue tests on end bell steel in which cycles of repeated and fluctuating stress were applied:

Mean stress tons/sq. in.	Range of stress tons/sq. in.	Cycles to fracture
17	±16.7	94,000
17	±12.1	1,618,000
17	±10.5	67,829,000
		(unbroken)
17	± 9.5	33,334,000
		(unbroken)

The drilled non-magnetic steel end bells were subjected to cycles of repeated stress with a range of ±14 tons per sq., and a mean stress of 14 tons per sq. in. This range of stress is much less severe than the range that the Haigh specimen withstood for 94,000 cycles and should probably be compared with the range that the Haigh specimen withstood for 1,618,000 cycles. From this it appears that the performance of the end bells in the cyclic tests was very far below what would be expected from the available information on the fatigue properties of end bell steel under cycles of repeated stress. The fatigue tests were, of course, carried out on plain specimens without notches.

The general result of the cyclic tests on the two end bells from the Toronto machines was to show that under a relatively small number of cycles of stress of about the same order of magnitude as that applied in service, failure could be brought about.

It was evident that more information was required and further thought was given to one of the earliest suggestions made as to a possible cause. This was the effect of rapidly chilling the end bell while the rotor was at speed, with rotor body and windings still relatively hot. Such a condition had occurred frequently in service. But it was also desired to ascertain if the end windings and their packings arched, bound and resisted being forced to a smaller diameter, thus increasing end bell stress, when the end bell was hot (and therefore expanded more than the rotor body, with rotor end winding copper hard underneath the bell) and was then suddenly cooled and contracted.

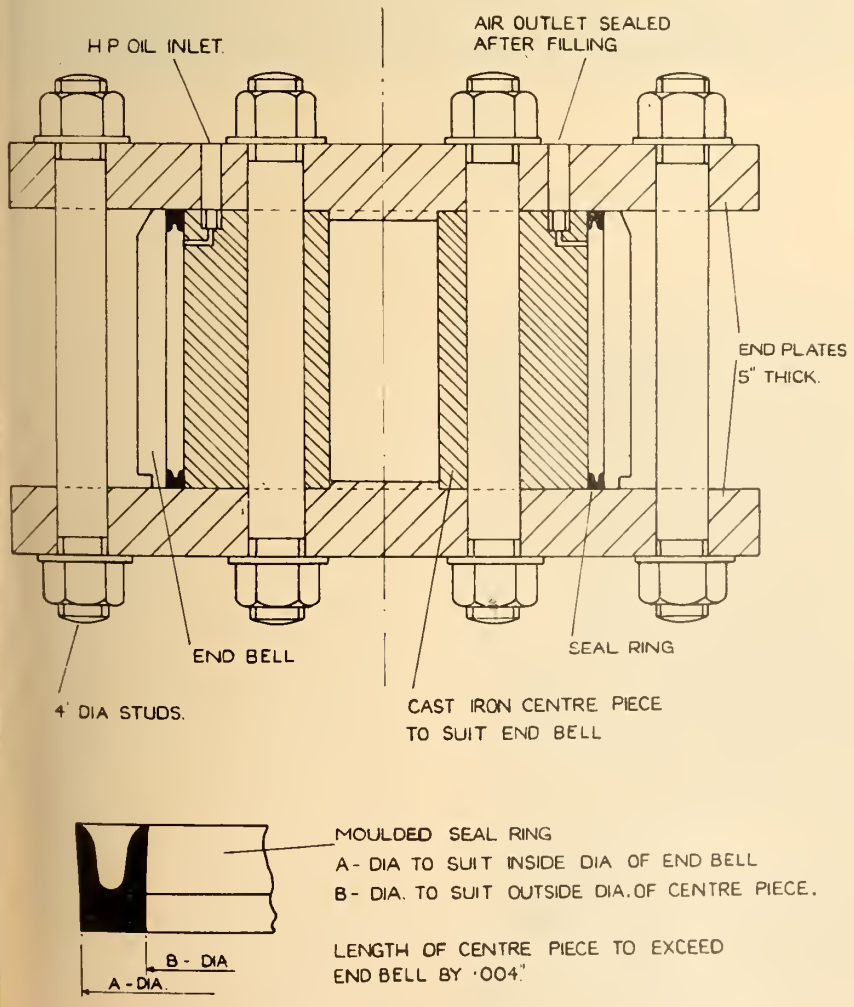


Fig. 15. Rotor end bell test gear.

Fig. 16. End bell, showing fracture, under hydraulic test.

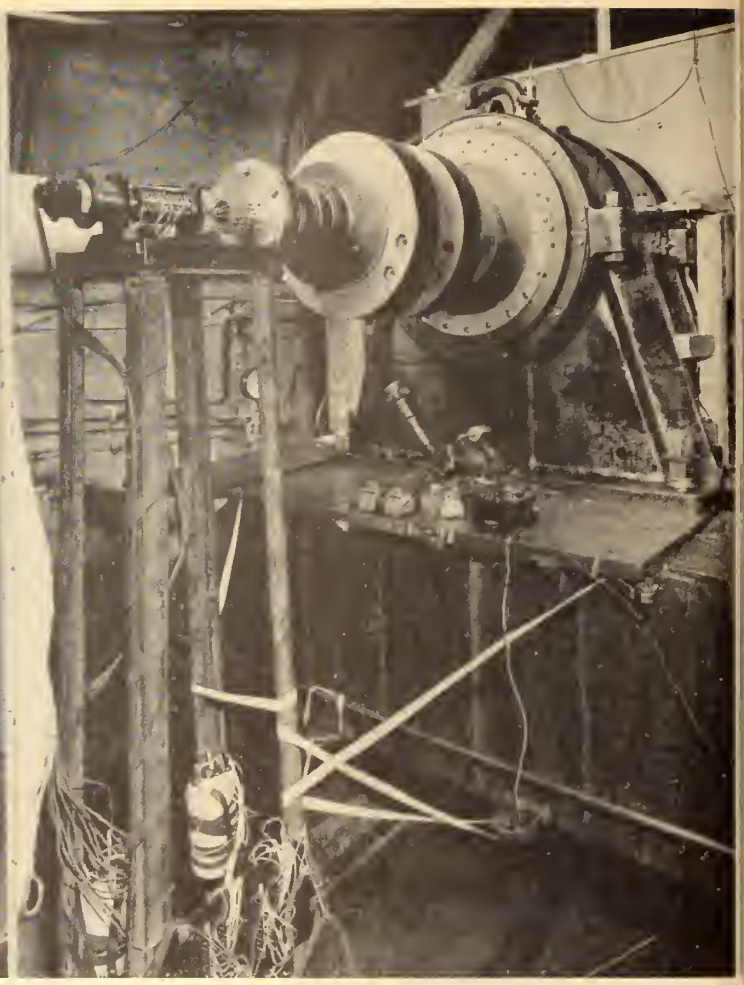
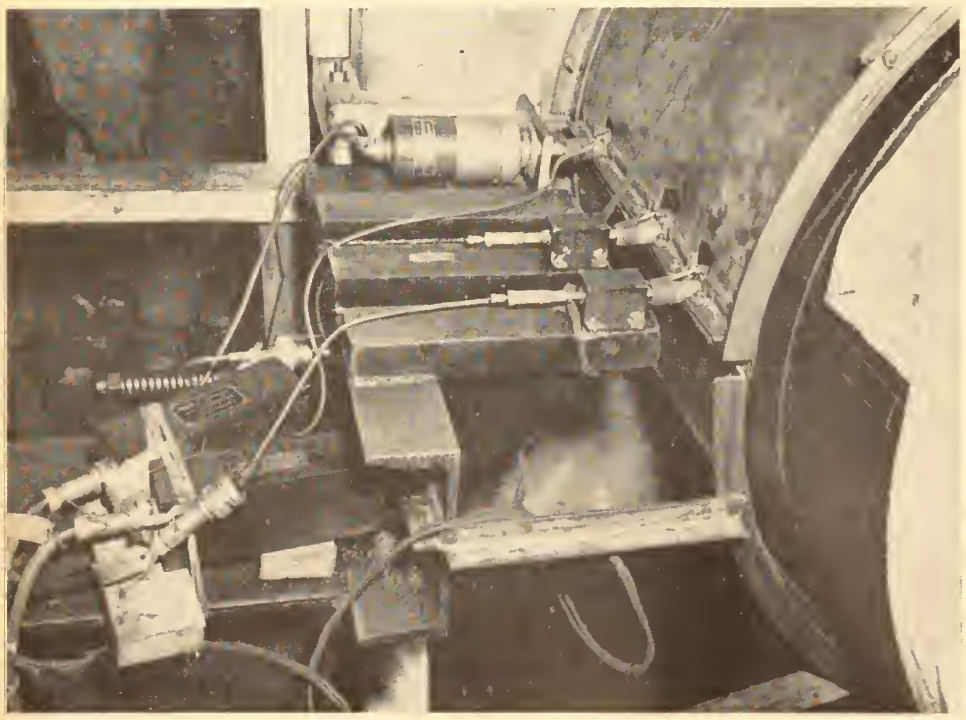
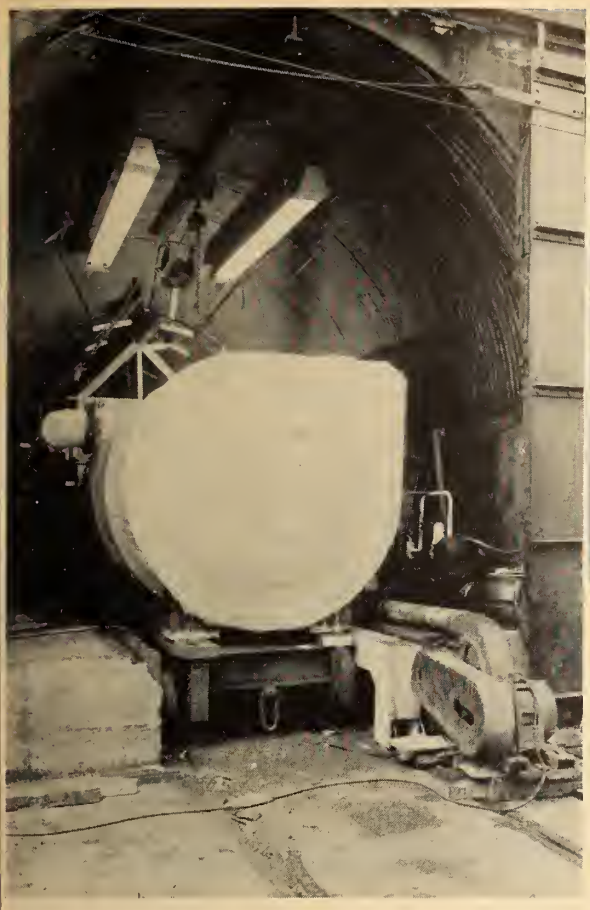


Fig. 17. Slipring arrangement for rotor temperature measurement on 50-mw generator.

Fig. 18. Capacitance electrodes mounted in position for measuring expansions on 50-mw rotor end bell.



As a further means of resisting rotor coil distortion, rotor end windings are frequently packed solidly with a hard insulating material and the Toronto rotors had been so packed. Only by actual tests could arch binding be detected. A rotor from a 50-mw. generator was erected in an overspeed chamber with provision for heating the rotor body and subsequently cooling the end bell. Thermocouples were attached to the rotor body, to the rotor windings and to the end bell. These were brought out through the rotor bore to sliprings outside the bearing. Figure 17 shows the assembly. Capacity heads were mounted close to the end bell as shown in Figure 18 and were shown by calibration to be able to measure changes in bell diameter as small as one-thousandth of an inch. Cooling was by air drawn through a condenser in which refrigerated brine had been circulated for 24 hours before commencing the test. Figure 19 shows the condenser and refrigerator unit and Figure 20 shows the instrumentation. It was



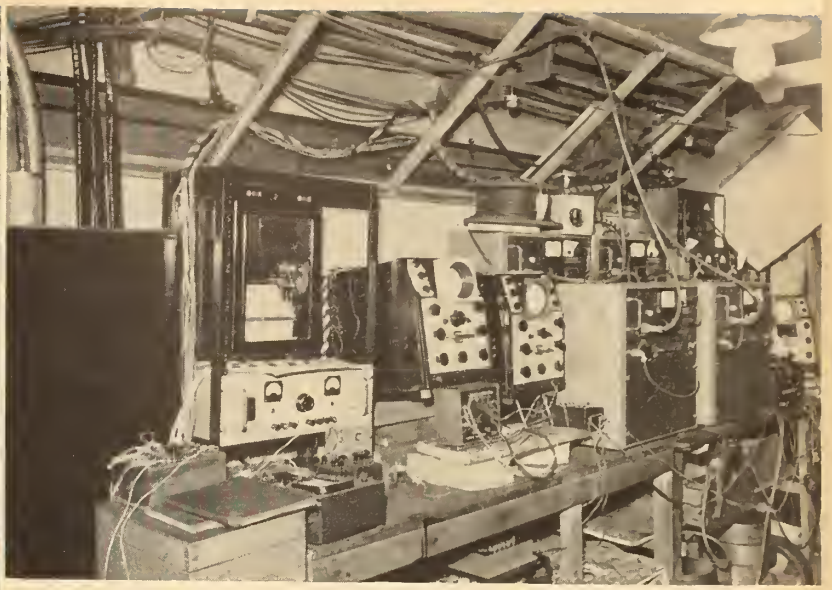


Fig. 19. Refrigeration plant for cooling end bell on 50-mw. rotor.

Fig. 20. Electronic measurement equipment used on 50-mw. rotor end bell measurements.

realised that the cooling effect of chilled air was far less than that of cold hydrogen at 10 to 15 pounds pressure, but the danger in using hydrogen was far too great.

Measurements of the end bell dimensions were taken at various speeds, both increasing and decreasing, and found to agree with calculation. The amount of cooling of the end bell which could be achieved was relatively small and probably insufficient, or too slowly achieved to produce arch binding, if that could occur. The measurements taken did not indicate any lag in the end bell diameter returning to that which calculation and temperature indicated to be normal. Although this difficult experiment gave only negative results, it was decided to ease the tightness of the packings in the replace rotors and in the modified rotors of Nos. 3 and 4 units.

Results of Izod tests on end bells at varying temperatures are given in Table VII.

Although these tests show a marked fall in impact value with temperature, within the range of service operating temperatures the reduction cannot be considered important or relevant to the investigation.

The second matter on which some concern had been felt related to the residual stresses in the bells. Some information was available relating to residual stresses in these rings prior to the Toronto failures, and the matter had been given some attention by the manufacturers. Two types of tests to determine residual stresses in end bells were carried out:

1. *Destructive Tests*, in which successive layers of material were machined from the bore until 75 per cent of the cross sectional area was removed and Sach's method used to obtain the stress distribution over the section removed.
2. *Non-destructive Tests*, in which thin layers are machined from the bell up to 5 per cent of the cross section at either the inner or outer surface or both. This gives an estimate of the stresses near the machined surface.

In all the tests, electric resistance strain gauges were used to measure the deformation as the layers were removed. Deformation was measured in the axial and circumferential direction at mid-length of the ring. Gauges were arranged in three, four or five groups equally spaced around the circumference. The calculation of stresses was based on the mean values of gauge readings and where large variation in the recorded strains of corresponding gauges occurred, the mean of the more consistent strains was used.

Five end bells were tested by the destructive method and the calculated surface stresses in each are given in Table VIII.

End bells A, B and C in Table VIII were tested initially in the rough forged state. The results show high tensile stresses ranging from 15 to 50 tons per sq. in. at the original bore. These stresses are reduced when the bore is machined to the finished diameter to about 10 tons per sq. in. compression in two bells and to 7 tons per sq. in. tension in the third.

End bells D and E were already machined to final dimensions when tested. Compressive stresses of about 10 tons per sq. in. existed at the bores of both bells, with tensile stresses of 10 tons per sq. in. at the outer surface. The strain readings in these two bells showed increasing spread as successive layers were removed and only the bore stresses

may be considered as approximately correct, i.e., within ±3 tons per sq. in.

Non-destructive tests were carried out on 13 end bells. Rejecting the results of the tests on one bell, which gave two very high and therefore suspect tensile readings, the range nevertheless is from 19 tons per sq. in. compression to 39 tons per sq. in. tensile circumferentially and from 18 tons per sq. in. compressive to 27.6 tons per sq. in. tensile longitudinally. All these figures relate to stresses in the material which was removed. No relation between the known amount of cold work applied on the residual stresses produced could be traced. Similar amounts of cold work gave either compressive or tensile bore stresses apparently quite fortuitously, nor did there appear to be any regular difference in residual stresses with yield points varying from 50 to 55.6 tons per sq. in.

The calculations of residual stress are based upon a number of assumptions which, at least, can be stated to be of doubtful validity. The destructive testing method almost certainly is more accurate than the non-destructive method, and it is obvious that much more development of the non-destructive test method is necessary before any reliance can be placed upon it.

While the numerical accuracy of the tests may be subject to doubt, they do nevertheless serve to warn the designer that with the residual stresses likely to be either compressive or tensile in two apparently similar end bells, and of a magnitude likely to encroach seriously upon the estimated margin between calculated stress and safe working stress as determined from material acceptance tests, it is essential to reduce working stresses if that is possible, or to eliminate every form of stress raiser or to change materials, preferably using one free from residual stresses.

Reducing working stresses in end bells is difficult, since approximately one-half of the total stress is that arising from its own mass, with an almost equal amount due to the performance of the real function of an end bell, which is to contain the rotor end windings. Thus increasing the cross section of the end bell quite appreciably only relatively slowly reduces the stress, since the mean diameter of the bell, and therefore the radius of gyration, increase with increase of thickness as well as does the mass.

To eliminate every form of stress raiser would preclude the use of ventilating holes and thus increase the rotor temperature rise and bring the rotor nearer to the point at which rotor coil distortion becomes a possible danger. If ventilating holes are retained they must be carefully ground after drilling, increasing their diameter by at least 0.04 in. and then subsequently honing the holes to a very fine finish.

Design Changes

Shortly after the late war, it was realised that with the rapid growth in turbogenerator size, stress considerations would preclude the use of ventilating holes in end bells, and an improvement in rotor ventilation was essential to allow their elimination. A form of ventilation with cooling air in direct contact with rotor copper had been considered and rejected because of the danger of dust, carbon or oil vapour being drawn in and by reduction of leakage path lead to insulation breakdown. With hydrogen cooling, such potential dangers do not exist and development of that design was pursued vigorously and first put into commercial service in 1952 on a 60-mw., 3000-r.p.m. unit. Direct hydrogen cooling is a great success and has reduced rotor temperature rise far more than would be the increase due to the elimination of end bell ventilating holes. The 60 cycle, 4 pole rotor for No. 3 Toronto unit had already been completed with the new design of direct cooled windings and was ready for shipment when the failure occurred on No. 1 unit. Despatch was delayed until some detailed information was received from the site, but it was necessary to make an early decision as to action to be taken, so that both No. 3 and No. 4 units, which had been kept out of service after the failure of No. 2 set, could be recommissioned with absolute safety at the earliest possible date.

At that time, it was not by any means certain that it was the end bells which had failed first, but they were the obvious suspects, since they were the most highly stressed components. If it were end bells, then material or the effect of ventilating holes were the most likely causes of the failure.

It was decided, therefore, to replace the end bells with new ones made of a well known chrome molybdenum alloy which would give the required physical properties by simple heat treatment, but would be magnetic. Since direct-cooling already existed on No. 3 rotor, ventilating holes were not required and would not be used. No. 4 rotor was returned to England, re-machined for the direct-cooling subslots and then rewound and fitted with magnetic end bells without ventilating holes. No. 3 unit returned to service on August 31, 1954 and No. 4 unit on September 15, 1954.

A complete new 100-mw. generator for No. 2 set was built and tested in less than seven months and is expected to be in service in ten months from the date of failure.

In the light of subsequent investigations, the decision taken to change end bell material for the Toronto generators and to omit ventilating holes was a sound one. Changes which had been made in nonmagnetic end bell forging technique prior to the failures in April, 1954, have, however, been demonstrated by the investigations to lead to a reduction in residual stresses, and no hesitation would now be felt in fitting nonmagnetic end bells to machines similar to those in Toronto, provided direct-cooling of the rotor were adopted with the elimination of ventilating holes.

Every end bell, after machining, is now hydraulically tested to a mean hoop stress of 35 tons per sq. in. and then is radiographed, supersonically tested and tested for cracks by the penetrant dye method. It is important to note that had these additional tests been current practice at the time of manufacturing the Toronto end bells, without doubt, they would all have been passed.

Metallurgical and Mechanical Properties

Metallurgical and mechanical tests carried out on the two Toronto end bells that failed in service and others that were cracked or fractured in pressure tests, gave little indication that as regards composition or grain size they differed substantially from acceptable standards based on previous experience. It is to be noted, however, (Table IX, Figures 21, 22 and 23 Appendix A) that the relations between the elongation and reduction in area on the one hand and the yield point on the other, shown by the tests carried out on bells after failure, are not as good as those (particularly on No. 1 exciter end bell) in general obtained in acceptance tests. As these are the only end bells for which numbers of tests have been carried out on the body, we cannot say whether this feature is peculiar to these bells or common to all bells. It is probably common to all bells.

In the following table an attempt is made to compare the various bells on the basis of the ratio of the elongation and reduction in area to the yield point.

End Bell	Relationship of elongation to yield point	Relationship of reduction in area to yield point
No. 1, exciter end	Low	Low
No. 2, exciter end	Medium	Low
No. 2, turbine end	High	Medium
No. 4, exciter end	Medium	Low

Possible Effects of Operating Conditions

After an all-night shut down, it seems possible that at start-up with cold hydrogen, a temperature difference of 20-25°C. between the rotor body and the end bell may prevail due to the rapid cooling of the bell. Under such conditions the shrink stress and the effective hoop stress (algebraic sum of the hoop stress and the circumferential bending stress) will increase at running speed, as is shown in comparing Figs. 24 and 25 in Appendix B.

At the same time, the Izod value for the material which appears from Table VII to fall more or less proportionately with decrease in temperature, will decrease, although not to a disturbingly low level.

The chief interest in this assumed condition springs from the cyclic behaviour of the end bell where failure was induced at the relatively low mean hoop stress of 27.6 tons per sq. in. in relatively few reversals.

One cannot, therefore, lightly discount the possible effects of the particular circumstances of operation for the bells under consideration.

Effect of Holes

From all the evidence at our disposal it seems clear that failure of all the bells that have failed in service or under test springs from the holes. These are undoubtedly severely work hardened and give rise to stress concentrations of a high order. The inability of the metal immediately adjacent to the holes to spread the high stress by deformation is clearly shown by the increasing ductility apparent as the crack proceeds away from the hole. The holes vary in surface finish, but without question the high hardness gives rise to increased notch sensitivity. The fact that, in all the bells fractured in service or in tests, varying numbers of holes other than those through which the fracture took place were cracked indicates a general, rather than a local, onset of the failure condition. Without doubt, therefore, in the light of the evidence, holes have a substantial effect in weakening the end bell. The fact that surface hardness often is a maximum at the mid-depth of the hole, and that stress also is a maximum at mid-thickness is important, since then at the area of maximum stress there can be the minimum of plastic flow and therefore a maximum of stress concentration. It is clear that cracks can then be initiated at the mid-depth surface of holes under relatively few repetitions of a range of stress, the upper limit of which does not greatly exceed that to which they might well be subjected in service, although the range under the conditions of the tests was considerably greater than that obtaining under operating conditions. That they are not under all conditions a predominant cause of failure can perhaps best be indicated by the behaviour of a 7,500-kw., 3,600-r.p.m. turbogenerator in Venezuela which, in September, 1949, ran to an excessive overspeed; while both of the rotor fans burst, completely wrecking the stator end windings, no mechanical distortion could be detected in either the rotor forging nor in the rotor end bells. The rotor end windings were ventilated by means of holes in the end bells. The overspeed was caused by continuous operation with the governor set at its top limit; boiler deposits formed on the neck of the gland of the relay valve, which jammed open, and the runaway valve failed to close by about ¼ in. The stator and rotor were sent to England for repair and examination and were returned to the site and recommissioned early in the following December.

Unfortunately, the exact speed attained was not observed, but since, in addition to the bursting of two fans, subsequent examination of the rotor showed that the bronze slot wedges were slightly deformed in shear, it became possible to estimate the speed attained.

The rotor fans were of the centrifugal type and the most highly stressed part was the front shroud in which the normal running stress was 11.45 tons per sq. in. The U.T.S. of the material used was 40/45 tons per sq. in., so that the speed corresponding to the lower figure would be 6,730 r.p.m. Both of the rotor fans had burst and it is not known, of course, how much the speed continued to rise after this point.

The wedges closing the rotor slot were of bronze having a nominal yield point of 16 tons per sq. in. and a normal running shear stress of 2.58 tons per sq. in. Tests on this material indicated that yield might be expected to commence at a figure as low as 9 tons per sq. in., so that, on this basis, the maximum speed attained would be expected to be 6,700 r.p.m.

The end bells were of non-magnetic steel and the tensile test figures for the yield and ultimate were 57 and 63.6 tons per sq. in., respectively. The hoop stress in the end bell at 3,600 r.p.m. was 16 tons per sq. in., so that at an overspeed of 6,700 r.p.m., the bell stress must have been 56.5 tons per sq. in., which is very close to the yield point of 57 tons per sq. in. The holes in the end bell did not appear to exercise any appreciable weakening effect and it is probable that with a bell of this thickness the amount of locked up stress was small.

Disposition of Holes

The disposition of the holes has evidently an important effect in determining the behaviour of end bells subjected to stress. In the three exciter end bells that fractured either in service or in test, the fracture passed through three similarly disposed holes and all the cracks found in the 37 in. bells were in similar diagonal rows of holes. It is quite probable that bells of the Toronto type and of the 37 in. type may behave differently in service, simply because of the different disposition of the holes.

Residual Stress

Sufficient evidence is available to show the variability and unpredictability of locked-up stress in non-magnetic end bells. The effect of holes on its magnitude and distribution is likewise unpredictable.

It is clear (Table IV) that almost irrespective of size or yield point, the effect of holes is to limit the mean applied hoop stress at failure to the order of some 40 tons per sq. in. There is one exception; No. 2 Toronto turbine end bell which failed at an applied hoop stress of some 35 tons per sq. in. It is obviously difficult to assess the extent to which locked-up stress might be responsible for this, but it may be of some significance that, as mentioned previously, the end bells for Nos. 1 and 2 machines were not made in a manner similar to those for Nos. 3 and 4 machines, or for the 37 in. end bells used for comparative tests.

Little relief of residual stress could be expected in the neighbourhood of the holes at any reasonable applied stress level, having regard to the hardness obtaining there and, owing to the stress concentration factor associated with the holes, any appreciable residual stress could have a pronounced effect on behaviour.

Shock

It must always be a matter of conjecture as to what extent the failure of the first machine was directly responsible for the failure of the second. In general, the properties of the end bell material for the latter were better than those of the former, and the possibility of inertia shock initiating a crack in the second set cannot be discounted.

Brittle Fracture

The failures that occurred in the exciter end bells of Nos. 1 and 2 units, that is, those that failed completely in service, and also the failure that occurred under hydraulic pressure test on No. 4 exciter end bell, had a close resemblance to the "brittle fractures" that have occurred from time to time in welded ships, high pressure gas mains, fluid storage reservoirs and other welded steel structures. These cases of failure have been characterised by high general stress and the presence of a welding fault or other defect, e.g., a surface crack or a constructional feature which introduced a concentration of stress, especially if aided by a localised deficiency of ductility that may start a local or restricted crack, which, entering the region under general stress, sets off therein an extensive crack of great suddenness and probably with catastrophic consequences. In the welded ship case, the breaking in two of the ship, or, in the cylindrical storage reservoir, the cracking through of the shell over the greater part of its height perhaps with the complete destruction of the reservoir, may result. The conditions of a high general stress, the presence of a stress concentration feature and local deficiency in ductility are those which apply to the end bells. The failures would thus begin at points of stress concentration, which might be cracks formed at the surface of holes, and the cracks propagate rapidly, as is known to have occurred in the end bell of No. 4 exciter end that failed under hydraulic pressure, and is assumed to have been the case in the bells that failed in service. Furthermore, the surface of these fractures showed chevron-like markings which enabled the point at which the failure began to be identified. The only respect in which the failures in the end bells differed from the characteristic mild steel brittle fractures was that they were intercrystalline and not transcrystalline or cleavage. This may be accounted for by the fact that in the end bells the material was an austenitic steel in which fracture normally is intercrystalline, whereas in mild steel fracture is normally transcrystalline.

A large number of investigations have been carried out on brittle fracture in order to ascertain the conditions under which it occurs and many factors have been suggested as contributing to it. Of these, the main ones seem to be the presence of a multiaxial stress system, insofar as the stress system may limit ductility and thereby promote cracking, a notch of some kind, or low temperature and low notch toughness in the steel. These factors apply particularly where a brittle crack is initiated. After initiation, a brittle crack may spread extensively where the general stress system may be only simple tension—for example, the circumferential tension at the shell of a cylindrical storage reservoir—the spreading crack itself carrying with it as it travels its own stress concentration feature and system of complex stresses.

Various combinations of these factors may cause brittle fracture. For example, if the notch is very sharp and the temperature very low, it may not be necessary for the steel to have a low impact toughness to fail. Whereas if the notch is sharp and the steel has a low impact toughness, it may not be necessary for the temperature to be low for failure.

It is clear that in addition to the fact that the fractures of the end bells had most of the characteristics of brittle fractures, the conditions of service conformed with the circumstances under which brittle fracture may occur. The hoop stress, shrink stress, thermal stress and residual stress in the bells could, in combination, give a resultant stress high enough to support the propagation of a brittle fracture in a material susceptible to this mode of failure, if initiated by a feature of sufficient intensity. This is the significant and important fact of a brittle fracture, because usually working and design stresses exceed those able to support propagation. The steel has a relatively low impact toughness; at times the temperature of the bells was low and the holes and small cracks formed in them by repeated cycles of stress would provide the notches required to start brittle fracture.

In the case of No. 4 exciter end bell, the fracture under hydraulic pressure test was to all intents and purposes the same as those that occurred in service. In this test, the stress system would be simpler than in service and the question of low temperature did not arise. This suggests that it is the notch effect and the properties of the steel that are the controlling factors.

In the case of No. 1 unit, which failed shortly after going on to a light load following an overnight shutdown, at the time of failure chilling of the end bells would have occurred while the rotor remained hot. In consequence, the stress due to shrink at the rotor body had increased and the lower temperature of the end bell, together with the increase in shrink stress, may have produced the combination of conditions which triggered off a brittle fracture. No. 2 unit, however, failed after several hours on full load, when end bell temperatures would be reasonably high and shrink stress would be a minimum. Hence, although the conditions generally considered to be associated with brittle fractures could be regarded as having been present in the case of the failure of No. 1 unit, that does not appear to be the case with No. 2 unit. On the other hand, the hydraulic testing of No. 4 exciter end bell was carried out during warm weather in an atmospheric

Discussion

Discussions of the foregoing paper by Sir Claude Gibb are invited by *The Engineering Journal* and, if acceptable, will be presented in the *Journal* along with the discussion which took place at the corresponding meeting of the Institution of Mechanical Engineers. Arrangements have been made as well for the publication of discussion from Canadian engineers by the British society along with that of their own members.

Readers are requested to forward discussions (typewritten copy in triplicate, double spaced) to The Editor, *The Engineering Journal*, 2050 Mansfield St., Montreal 2, Que.

temperature of approximately 65°F. and failure occurred in a manner which legitimately could be termed a brittle fracture.

There is evidence that brittle fracture is more likely to occur in thick material than in thin, and at a low temperature. This may well account for the difference in behaviour between the Venezuela end bells, which were much thinner than those in Toronto and certainly were at a much higher temperature when the serious overspeed occurred without affecting the end bells. Further, the Venezuela end bells being thinner, almost certainly would have lower residual stresses than those in Toronto.

The three Toronto end bells which failed with explosive violence were each from the exciter end. No metallurgical reason could be found why in each case it was the exciter end which failed, while the turbine end was quite unaffected and in perfect condition. There was, however, a minor difference between turbine and exciter end bells. At the exciter end, the crossover connections between coils would have blanked certain ventilating holes which therefore were not drilled. Thus there were twelve holes fewer in the exciter end bells than at the turbine end. The effect of the omission of these holes, which are shaded in Figure 11A and have the letter "A" after their numbers, was to induce a possible increase of stress not exceeding one ton per sq. in. at the hole where failure was initiated in the exciter end bells of Nos. 1, 2 and 4 units. This small increase of stress may well have been significant in locating the actual plane of fracture.

General

When the investigation of the relations between the properties of components and the service conditions under which they operate shows that the margin of safety is less than experience up to the time of failure would indicate, it is generally difficult—lacking a glaring reason for the failure—to ascribe it to a particular cause. Many variables, each in themselves not decisively significant, may combine to cause failure.

Previous experience and design by the same maker using end bells of similar material, drilled with ventilation holes, had been completely free from failure of the kind described by this paper. This circumstance, taken into account with the greater margin of safety which would be conferred by not drilling holes, will convey an idea of the greatly increased margin of safety introduced by the changes made as a consequence of the failures and referred to in the paper.

Conclusion

The broad picture of the analysis has been drawn from a mass of intimate detail. The inclusion of detail in the body of the paper would rather cloud than clarify the picture, but in the hands of those competent to judge, it may serve to throw some fresh light on the subject and so a representative cross-section has been included in the appendices.

In matters of such widespread importance as the Toronto failures it is clearly the duty of all concerned to sift every tittle of evidence with meticulous care and to undertake, and to make public the results of, every practicable investigation as to the cause of failure.

This paper is an endeavour to make the best possible use of the available material and to present the full results of the investigations and conclusions in a form readily understood by engineers.

The author wishes to make it clear that he is merely reporting the work of many metallurgists, engineers and applied mathematicians. In particular, reference should be made to the investigations of Dr. Charles Sykes, F.R.S., and his colleagues and staff in the Brown-Firth Research Laboratories, and to the many at Heaton Works who worked such long hours over a long period, endeavouring to obtain a definite conclusion to a very worrying disaster.

Finally, but by no means least, tribute must be paid to Dr. Richard L. Hearn, M.E.I.C., then chief engineer and general manager of Ontario Hydro who, with his colleagues and staff, at all times showed sympathy and understanding and provided invaluable assistance to those making the investigations.

Appendix A

A number of tangential tensile tests were carried out on specimens cut from four of the end bells dealt with in this report, i.e. from the two bells that failed in service, from the Toronto bell that fractured completely in the hydraulic pressure test and from one of the Toronto bells that cracked in the hydraulic pressure test. To obtain the test pieces a cut was made along the bell at a distance of about 2 in. from the fracture (or from the line of the crack in the case of the bell that did not fracture completely) and another cut was made 7 in. away from this. From the strip thus obtained tangential test pieces were machined and the results of the tests and the positions of the test pieces are given in Table IX.

It will be seen from the results relating to No. 1 machine exciter end bell in Table IX that although the yield point (0.5 per cent proof stress) and the ultimate tensile stress were uniform throughout the bell and in accordance with specification requirements, the elongations and reductions in area were variable and in half the tests below the specification requirements. The values of elongation and reduction in area obtained in the tests would be associated with the fact that all the specimens broke outside the middle half of the gauge length, but this in itself is an indication of nonuniformity in the material. Some significance might have been attached to the results of these tests in relation to the failure of this end bell, except for the fact that much more satisfactory values of elongation and reduction in area were obtained in the tests on the exciter end bell from No. 2 machine, which also failed in service.

The tangential tensile tests were carried out on specimens from the exciter end bell from No. 4 machine and the turbine end bell from No. 2 machine to ascertain whether the fact that the former fractured completely in the hydraulic pressure test, while the latter simply cracked, was associated with any difference in their mechanical properties. It will be seen from Table IX that the average values of the yield point, ultimate tensile stress, elongation and reduction in area were about the same for both bells, so that the difference in behaviour in the hydraulic test does not appear to be associated with any general difference in mechanical properties.

In Figures 21 to 23 yield point is plotted against ultimate tensile stress (Figure 21), elongation (Figure 22) and reduction in area (Figure 23). The areas marked out in those figures enclose most of the points obtained when the results of recent acceptance tests are plotted.

It will be seen from Figures 21 to 23 that when the yield points obtained in the acceptance tests on

the Toronto end bells are plotted against ultimate tensile strength, elongation and reduetion in area the results are in aeeordance with the standards. Furthermore, it will be seen in Figure 21 that most of the points representing the ratio between yield point and ultimate tensile stress in the tests earried out on end bells after failure in serviee, or in the pressure tests, are in aeeordanee with standard. In Figures 22 and 23, however, it will be seen that the relations between the elongation and reduetion in area on the one hand and the yield point on the other shown by the tests earried out on end bells after failure, are not as good as those obtained in acceptanee tests. As these are the only results available for numbers of tests earried out on the body of end bells, it eannot be said whether this feature is peculiar to those bells or common to all bells. It is probably eommon to all bells.

Appendix B

The Calculation of the Stresses in an End Bell.

The well-known equation for the inward displaeement (w) of a eylinder of mean radius (a) and wall thickness (h) is

$$\frac{d4w}{dx^4} + 4\beta^4 w = 0 \quad \ldots\ldots (1) \text{ (Ref. 1*)}$$

where

$$\beta = \sqrt[4]{\frac{3(1-v^2)}{a^2h^2}},$$

(v is Poisson's ratio)

Using a Maclaurin's series for w, i.e.

$$w = w_o + \left(\frac{dw}{dx}\right)_o x + \left(\frac{d^2w}{dx^2}\right)_o \frac{x^2}{\lfloor 2} + \left(\frac{d^3w}{dx^3}\right)_o \frac{x^3}{\lfloor 3} + \ldots$$

Equation (1) was solved and expressions in a suitable form were obtained, giving the displacement and bending moments along the cylinder for given end conditions. The mean hoop stress and the axial and eircumferential bending stresses were then calculated from the relations

$$\text{Hoop stress } (f_h) = \frac{-Ew}{a} \text{ (*Ref. 1)}$$

Bending stress at the bore in an axial direetion,

$$f_b = \frac{6M_x}{h^2},$$

where $M_x = -\frac{Eh^3}{12(1-v^2)} \cdot \frac{d^2w}{dx^2}$

Bending stress at the bore in a circumferential direetion,

$$f'_b = v f_b$$

To obtain the stress in a rotating

*Reference (1) Timoshenko, S. 1940. "Theory of Plates and Shells", Chap. 11, (McGraw-Hill Book Co., New York.)

Table IX — Results of tensile tests on specimens from end bells

	Near apparent origin of fracture			Balancing ring end		Rotor body end	
	Inside	Middle	Outside	Inside	Outside	Inside	Outside
No. 1 Machine—Exciter end							
L.P. tons/sq. in.	40.4	38.4	38.0	39.2	38.0	37.0	34.0
0.05% proof stress, tons/sq. in.	48.8	46.8	46.0	47.5	46.8	48.0	45.2
0.1% " " "	50.4	48.8	48.4	49.8	49.2	50.2	48.0
0.2% " " "	51.8	50.0	50.0	50.8	51.0	51.6	50.0
0.5% " " "	52.4	51.0	51.0	51.3	51.2	53.0	51.0
Maximum stress, tons/sq. in.	56.2	56.6	56.8	58.4	58.4	55.0	57.6
Elongation, per cent	12	18½	24	18	29½	17½	30½
Reduction of area, per cent.	22	27	23	32½	36	21½	32½
	OMH	OMH	OMH	OMH	OMH	OMH	OMH
No. 2 Machine—Exciter end							
L.P. tons/sq. in.	36.0	38.0	35.0	34.0	34.0	34.0	29.0
0.05% proof stress, tons/sq. in.	48.0	48.8	48.0	48.0	47.6	47.7	45.0
0.1% " " "	50.4	50.4	49.8	51.2	50.4	50.0	48.2
0.5% " " "	54.0	53.0	52.8	56.0	54.0	54.0	53.0
Maximum stress, tons/sq. in.	60.4	59.2	59.2	62.4	61.2	60.5	59.2
Elongation, per cent	21.5	20.5	27	23.5	26	21.5	26.5
Reduction of area, per cent.	26	26	28	29	31	28.5	31
No. 4 Machine—Exciter end							
L.P. tons/sq. in.	36.1	37.0	38.4	42.3	44.2	38.2	41.3
0.05% proof stress, tons/sq. in.	46.4	45.6	48.7	52.0	53.5	46.4	49.7
0.1% " " "	47.5	47.0	50.5	53.2	55.4	47.0	50.4
0.5% " " "	49.2	49.2	52.7	55.1	58.3	47.2	50.6
Maximum stress, tons/sq. in.	57.5	56.3	58.2	62.6	62.3	57.0	58.3
Elongation, per cent	30	28	28	25	15	31	31
Reduction of area, per cent.	31.5	31	27.5	29	23.5	36	33½
No. 2 Machine—Turbine end							
L.P. tons/sq. in.	38.6		39.6	36.2	38.0	32.5	37.0
0.05% proof stress, tons/sq. in.	49.3		50.3	51.2	51.6	47.0	48.6
0.1% " " "	51.1		51.9	52.1	53.1	49.3	50.7
0.5% " " "	52.8		53.5	53.0	55.0	52.0	53.0
Maximum stress, tons/sq.in	61.2		60.2	62.0	62.0	60.6	60.4
Elongation, per cent	23		26	25.5	31	26	33.5
Reduction of area, per cent.	28		31.5	28	34	29	38

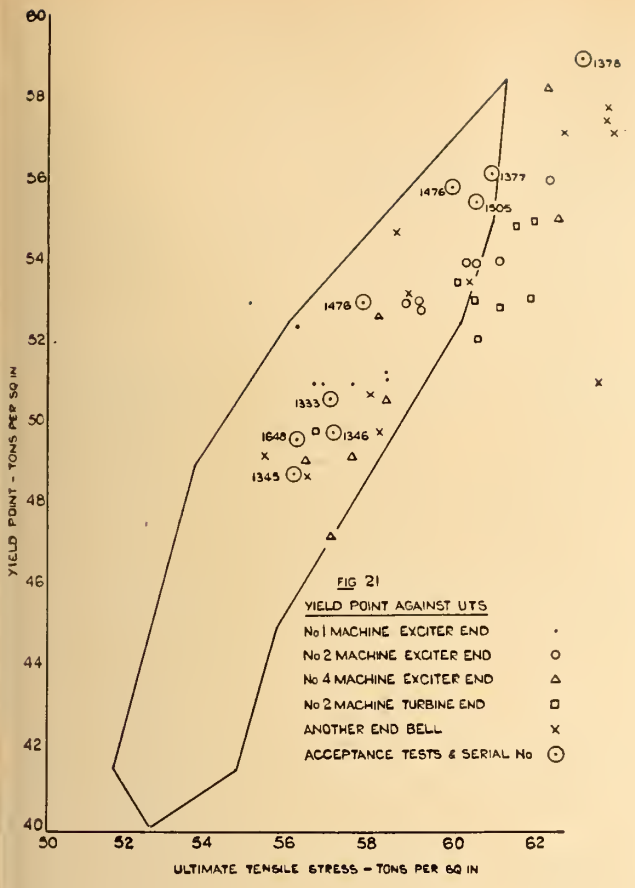
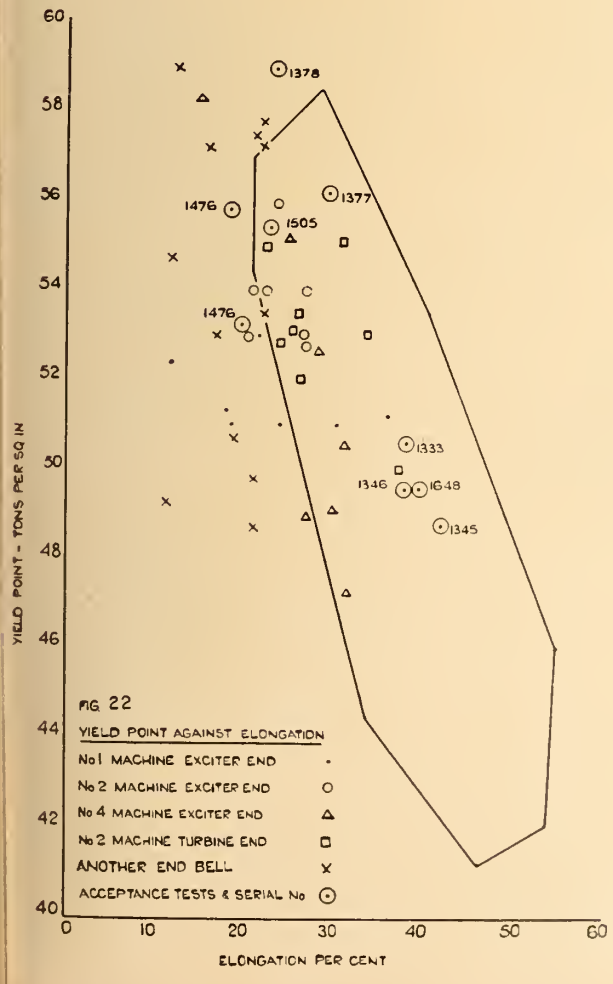
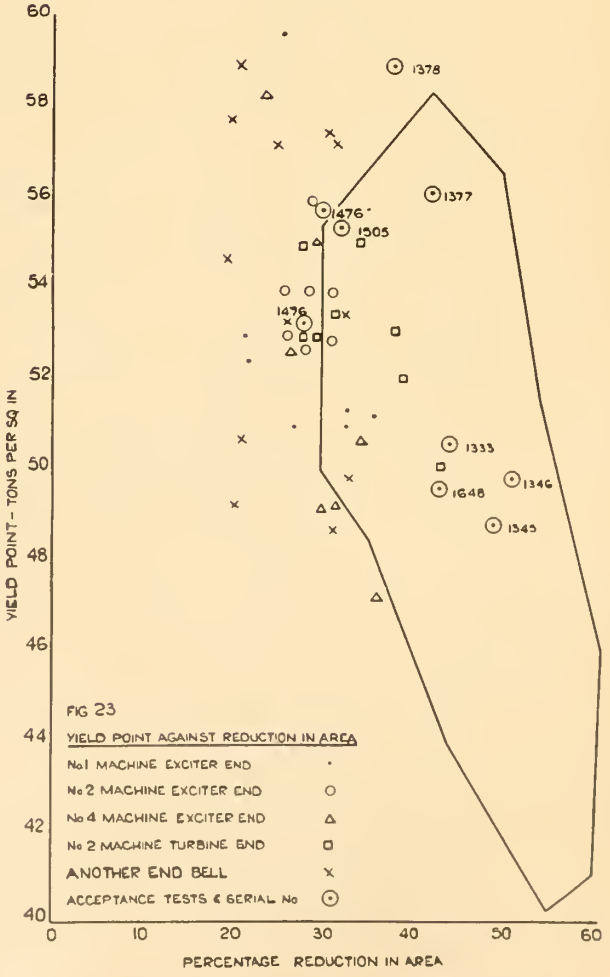


Fig. 21. Yield point vs. ultimate tensile stress.

Fig. 22. Yield point vs. per cent elongation.

Fig. 23. Yield point vs. per cent reduction in area.





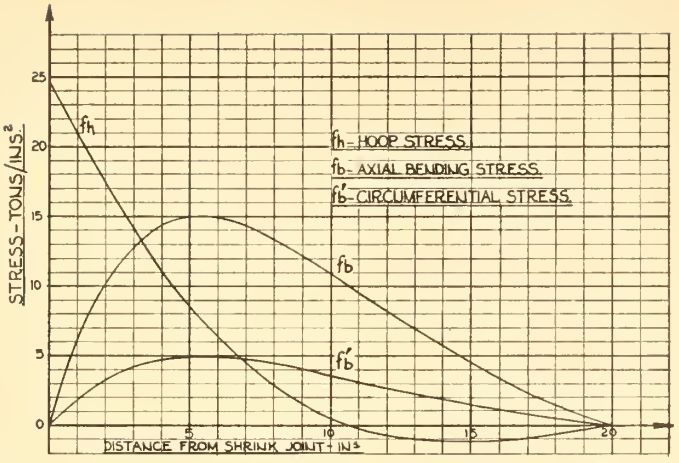


Fig. 24. Calculated stresses in end bell when stationary — elastic case.

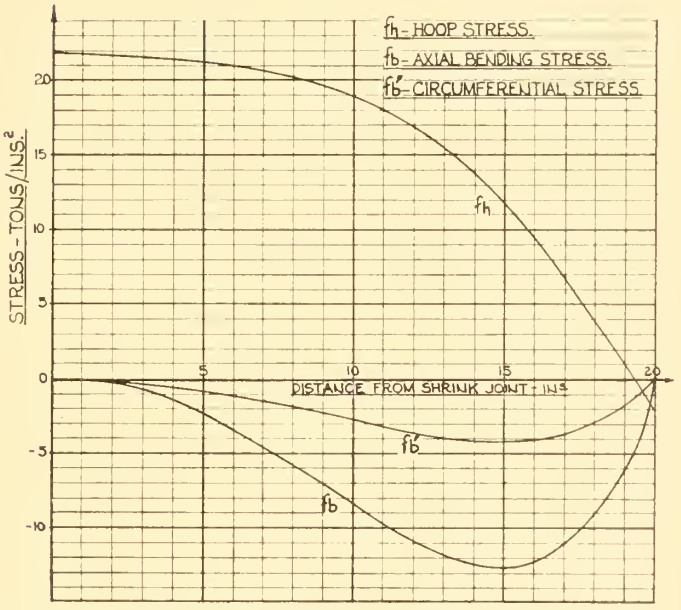


Fig. 25. Calculated stresses in end bell under normal running conditions — elastic case.

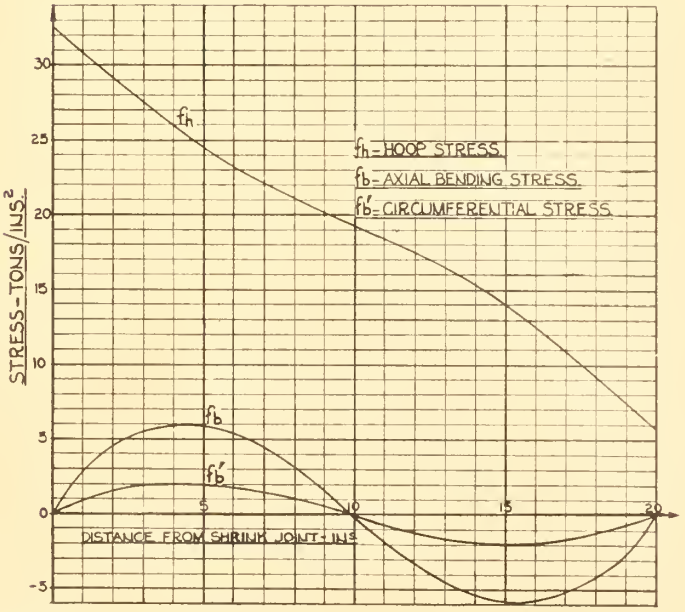


Fig. 26. Calculated stresses in end bell under running conditions; rotor temperature, 35°C; end bell temperature 10°C — elastic case.

eylinder, the basie equation (1) was modified to:—

$$\frac{d^4w}{dx^4} + 4\beta^4 w = -\frac{p}{D}$$

or

$$\frac{d^4}{dx^4}\left(w + \frac{p}{4\beta^4 D}\right) + 4\beta^4\left(w + \frac{p}{4\beta^4 D}\right) = 0 \quad \ldots\ldots (2)$$

Equation (2) is of the same form as (1) and the term p represents an equivalent uniform radial pressure assumed to act over the whole internal surface, giving the same hoop stress as that whieh is eaused by the inertia of the end-bell itself and the pressure of the end windings and packing. Equation (2) was solved conveniently by the same method as Equation (1) and similar expressions were derived to give the hoop and bending stresses.

The solutions in all cases were obtained by applying end eonditions in whieh ealculated allowanees were made for the radial movement of the end supports, i.e., the rotor spigot and the balancing ring recess, under the pressure of the end-bell and from ehanges in temperature.

The assumptions made in the ealculation of the stresses shown in Figures 24, 25 and 26 were:

1. The temperature was 15°C. throughout when stationary.
2. The difference in diameters of the end-bell and rotor spigot was 0.110 in. at 15°C. before the joint was made.
3. No interference occurred between the balancing ring and the end bell when stationary at 15°C.
4. The loading due to the copper windings and paeking was uniformly distributed over the end bell.
5. At normal running the temperature rise was 60°C. throughout.
6. At running condition with a temperature difference, the rotor temperature rose to 35°C. and the end bell and balaneing ring temperatures fell to 16°C. at some time after reaching normal running speed.

The stresses in the end bell under,

(a) Stationary conditions.
(b) Normal running eonditions.
(e) Running condition with a temperature difference between rotor and end-bell

are shown in Figures 24, 25 and 26, respectively. √

THE ENGINEER

AND

NUCLEAR DEVELOPMENTS

A series of four papers presented before the Montreal Branch of the Engineering Institute of Canada on March 23, 1954, followed by a discussion. The panel members were: moderator, Dr. L. Thiesmeyer, Pulp and Paper Research Institute of Canada, J. L. Gray, Atomic Energy of Canada Ltd., Dr. A. J. Mooradian, Atomic Energy of Canada Ltd., Dr. D. C. Brunton, Isotope Products Ltd. and Dr. Leo Yaffe, McGill University.

The Effect of Nuclear Science on Engineers

by

J. L. Gray, M.E.I.C.

Vice-President, Atomic Energy of Canada Ltd., Chalk River, Ont.

The next phase of Canada's participation in the atomic program must be in the application of nuclear energy to power production. It can be demonstrated that the present Canadian 10,000,000 kw. of installed electric energy will rise to around 40,000,000 kw. by 1980.

Of this amount 30,000,000 kw. will probably be supplied by hydro power, leaving 10,000,000 kw. from thermal sources. We are predicting that the standard thermal sources of coal, gas, and oil will increase 10-fold in this period and would supply about 3,000,000 kw. This leaves 7,000,000 kw. to nuclear power sources, which seems to be a reasonable goal and quite attainable.

We are, of course, assuming that nuclear power will be competitive economically with other thermal sources, and are using as a yardstick coal at $8.00 per ton. The fact that Southern Ontario is highly industrialized and that there are no coal resources in the Province adds considerable immediate impetus to the studies of evaluating reactor economics. It is predicted that early in the "sixties" Ontario will have developed and utilized all readily available hydro resources in the Province, including the St. Lawrence, and will have an ever-expanding requirement for power from thermal sources.

The Effect on Engineering Consultants

In attempting to estimate the probable requirement of engineering design for nuclear power we have made some calculations which, though based on assumptions, appear to be within normal long-term forecast predictions. Assuming that economical production of nuclear power is started in the early 1960's with two units of 100,000 kw., and continues until 7,000,000 kw. are installed by 1980, we can estimate the design staff needed.

The cost of design and development of an initial small prototype would probably be 25 per cent of the construction cost; the first 100,000 kw. units would require perhaps 15 per cent of the cost for design and development. Following this stage if the basic reactor type did not alter too much the design costs would be approximately 10 per cent of cost.

Knowing the cost figures of the reactors to compete with $8.00 coal and allowing $9,000 per year per man as the design office cost, it is possible to predict the design staff necessary to meet this probable program. At present there are about 150 persons working on reactor design. This number should increase to about 200 by 1958 and remain fairly steady to nearly 1970, at which time it will start a rapid increase to near 700 by 1972 and double this number by 1980.

It seems fairly evident, however, that the reactor designs for nuclear power application will not generally affect the consulting engineer. The major reactor design effort for the next decade must be confined to one or two closely associated organizations.

This may include a consulting engineering firm and if so such a firm will feel an "impact of nuclear science". The requirements of security and the necessity of training design staffs in handling the effects of radiation and the limitations of a reactor system make sub-contracting parts of the design to other groups extremely difficult.

Relating to the design experience of the NRU reactor, the early stages of design indicate a requirement of nearly 4 engineers to 1 draughtsman —however, this soon evens out to near one to one. This means that with a staff of 200 perhaps 100 would be engineers and, based on the cost of the work, this group breaks down to 47 mechanical, 32 civil and architectural, 13 chemical and 8 electrical and instrument engineers.

The requirements for chemical process plants is one place where a consulting engineer may well find a fertile field. This again is such a specialized requirement due to the nature of the chemical problem and effects of radiation that it is likely to be undertaken by one organization. The training period of design staff—which is probably of the order of one year before design re-

sults are of value—precludes the general use of consultants.

The only place where the normal consulting firm might find an immediate effect of nuclear science is in the design of radiation laboratories that are becoming a requirement at many locations. Universities, hospitals, and research laboratories are all finding that isotopes and particle accelerators are of value in their work, and that they require very specialized techniques in handling. This, of course, is a very small part of a normal building—but the consultant should be aware of the latest developments.

We at Chalk River have had by far the most experience in actual installations dealing with radiation shielding, ventilation, air filtration, etc. in Canada. We feel we are now approaching reasonable solutions to most of these design requirements. We are only too pleased to discuss the results of our experience with anyone who may be faced with these special problems in this relatively new field.

The Effect on the Engineer in Industry

The design engineer of fabricators of heavy and light equipment and electronic components may well find that he is drawn into a new field rather quickly. The fabrication of the parts of our NRU reactor now under construction has posed many new manufacturing problems. We are asking for closer tolerances than are normal on very large pieces. We are giving industry new metals and new alloys to work with that will require experience and ingenuity.

The design and fabrication of large vessels to operate with at least 1,000 lbs. per sq. in. pressure seems to be a requirement for the first power reactors. This is the type of problem the industrial engineer can tackle, and is well within our design and fabrication talents.

The necessity of eliminating even minute leaks of a variety of fluids poses design specifications on pumps, shaft seals and valves in excess of anything on the market today. Since the fluids being circulated will in most cases be radioactive, the materials presently used in seals and bearings are not acceptable. Pump and valve manufacturers are involved in the first stage of this work now at low temperatures and normal pressures, but when they are faced with the temperatures and pressures necessary to produce economic power, some aspects will be complicated many fold.

The extremely high cost of some materials, such as heavy water, changes the concept of heat exchanger design and general configuration of the plant layout. The designer is limited in the hold-up of this expensive material and must cut pipe runs to a minimum, and ¾ in. heat exchanger tubes are just not acceptable.

There are many examples of this type of problem that can be solved by the design and production staff of the manufacturers. We would expect the reactor design staff to make early and extensive use of the industrial engineers, which will ultimately result in the industry becoming involved in mock-up design and fabrication and even testing. The research and development facilities of Canadian industry, at present virtually non-existent, should receive considerable impetus to expand.

The Effect on the Engineer in Management

The only effect nuclear science may have on the engineer in management is to ensure that he will be required in the management team a little more than in any industry to date. Certainly for the next 15 or 20 years it is difficult to visualize the operation of nuclear power plants without several well qualified professional engineers on the job. Ultimately, of course, they may well operate as simply and efficiently as a normal steam plant, but until some are built and run for a few years they will be handled with great respect and care.

The general type of management problems, however, will not alter much from those found in any proc-

The authors. Left to right, Mr. J. L. Gray, Dr. L. Yaffe, Dr. L. R. Theismeyer, Dr. D. C. Brunton, and Dr. A. J. Mooradian.

ess industry. The number of engineers required on the management team should be considerably higher than average, not only in the reactor operations but in the chemical processing plants, the plant service organizations and the design and development staffs.

Conclusions

To sum up, we do not see nuclear science causing an effect on consultants that could be described as an impact. The requirement for engineering design and development will increase slowly, probably approaching an exponential curve. The major design effort for the next few years will be concentrated in one or two organizations.

The engineer in industry, particularly the larger organizations where design and possibly development staffs are available, is quite likely to find himself faced with problems foreign to his experience and requiring some further training. A considerable development effort will be needed, and industry can take an active part if it so desires. Opportunities for engineers in management will be similar to those in a process industry but relatively more abundant.

How Are Engineers Fitted Into Atomic Energy Work

by

Dr. A. J. Mooradian,

Atomic Energy of Canada Ltd., Chalk River, Ont.

The principal aim of Canada's atomic program is clear and simple. We are after commercial atomic power as soon as possible. At the present time we are in the middle of a race for the economic atomic unit. How Canada finishes in this race will depend, in large measure, on the performance of her engineers.

At Chalk River, there are, in all, about 76 graduate engineers whose work is peculiar to the atomic field. One fourth of them are operational engineers who concern themselves with the economic operation of existing units. Another 26 per cent are development engineers who concern themselves with "trouble shooting", research and the development of new units and processes. The remaining half is distributed among the design and service departments.

Operational Engineers

Let us consider now the operational engineers. Under this heading we find the reactors staff. These are the men responsible for the day to day operation of Chalk River's reactors. To three of the superintendents of the reactors I posed the following question,—"What type of engineer do you find best fulfils the qualifications you would like to see in your junior engineering staff ?"

The first replied, "The pile is operated almost entirely on the principles of physics. It is honeycombed with ion chambers, neutron counters and all manner of instruments. The neutron balance must be computed for every change. Experiments must be planned with the research departments. The pile has to have engineering physicists."

The second replied, "Metallurgical engineers have by far the broadest background; they fit into the organization very well." The third replied, "The pile is nothing more than a unit process; you put things into a pile, you pump fluids through a pile and you are continually plagued with piping and heat exchange. The chemical engineer is my choice."

I had been talking to an engineering physicist, a metallurgist and a chemical engineer. It became clear that there was no real answer to my question. The fact is, it takes all kinds of engineers to run a pile—especially at this stage in the development of atomic power. These engineers are the men whose voice will carry the greatest weight in design until reactors become as much a part of our every day lives as our present power stations.

One of the major cost considerations in any atomic plant will be that of fuel processing. At Chalk River this function falls to the Chemical Extraction Branch. The professional staff of this branch are almost entirely chemical engineers. These men must meet and solve the day to day problems of a production plant, but the hazard of radioactivity is superimposed on the normal problems of chemical processing. It is not uncommon to handle materials radiating the equivalent of 10,000 curies of radium.

These high levels of radioactivity convert most of the simple operations into major problems. Proper sampling becomes very difficult. Pumps and valves can only be used when the utmost foresight has been shown as to their future maintenance. The high degree of reliability demanded of process equipment in general imposes a severe limitation on the use of most conventional installations.

The experience of these process engineers is the only sound foundation on which to develop economic radiochemical processing. The full cooperation of these men with the designers of new plants will be required before the cost of operation and maintenance on any future installation can be made to fall within the acceptable limits.

Research and Development

Now let us consider the research and development men. I will group all of our development departments together. Few of our research departments get far into a given field before they find themselves giving birth to embryo chemical engineering groups. It is becoming apparent that the chemical engineer must play an increasingly important role in the evolution of atomic energy. Most of the urgent problems are of a "trouble shooting" nature in the processing facilities.

There are three main factors which characterize problems associated with the processing of irradiated uranium. These factors are common to both existing processes and new processes under development:

First—We are dealing with a portion of the periodic table which has hitherto received little or no attention. Pu, Am, Cm, Np, Rare Earths, Zr, Nb, Ru and the rest of the fission products are indiscriminately produced in the pile. Some of these have never before been produced either by nature or man. A knowledge of their chemistry is vital.

Second—We are concerned with the isolation of microscopic concentrations of chemicals in the presence of macro quantities of impurities. Many of the substances which must be separated and concentrated by factors which exceed 1 in 100,000 are not even spectrographically detectable in their original concentration.

Third—The high radiation levels usually involved require that most operations be carried out by remote control through thick shielding.

To meet these problems of chemical treatment there is an active and continuing program of development, aimed at evolving the simplest process which will give acceptable products. This requires not only a

sound technical background but also a certain ingenuity in circumventing the knotty problems of future maintenance. Pilot plant work must be done in close cooperation with operating, research and design personnel.

Waste Problem

As in any other industry, chemical processing inevitably gives rise to a waste problem. However, the disposal of radioactive wastes poses a problem considerably more serious than that from any other industry. Radiation from these wastes is a potential health hazard for many hundred of years. There is no way of destroying the radioactivity. The disposal problem ranges from almost inactive solutions to those containing in the order of curies per litre.

At Chalk River the only acceptable dispersal method is disposal to the river. A stringent limitation is placed on the allowable daily pollution. All of the chemical operating areas are only allowed to dispose of 1 milligram of plutonium per day to the river. One problem then becomes, how can you economically treat thousands of gallons of relatively inactive waste prior to river disposal. What are we going to do with the multicurie wastes from the present and future reactors? The problem is one which will command the attention of development groups until some acceptable solution is found.

Reactor Technology

A more fundamental approach to the problems of chemical processing and economic power lies in the field of reactor technology. The total capital outlay of a reactor is the largest single factor which contributes to the cost of power. A major portion of this capital outlay is tied up in fuel and moderator inventories. It is no secret that Chalk River is interested in the heavy water moderated pile. Some published figures place the cost of heavy water at over $80.00 per lb. It is of the greatest importanee that this figure be brought down to as low a value as possible. The development of a cheap source of heavy water is fundamentally a chemical engineering problem which is being aetively considered at Chalk River.

Fuel

With regard to the fuel, one of the important unanswered questions is whether or not it is practical to operate as a breeder reactor in which the spent uranium whose U-235/U-238 ratio is lower than that of natural uranium is returned to the pile. There is a feeling that the present generation should make every attempt to conserve uranium recources by going to the full breeding reactor, in which not only the U-235 is used up, but also the much more abundant U-238. The full breeder will always be a sufficiently attractive possibility to command a good deal of attention. One of the fundamental requirements of this type of reactor is a cheap method of processing and recirculating partially spent uranium to the pile.

Thus far, I have assumed that the successful power reactor will be of the heterogeneous type, that is, metallic uranium in slug or rod form suspended in moderator much like the NRX reactor. There are, however, multiple types of reactors which are possible, some of which promise to overcome many of the limitations inherent in the heterogeneous type. One of the most attractive of these alternatives is the slurry reactor, in which a slurry of uranium oxides is suspended in the moderator and is circulated through the reactor.

As well as promising low fuel processing costs, this type allows the continuous removal of some of the serious nuclear poisons which build up in the form of fission products. Its feasability is being investigated by a combined group of chemists, physicists and chemical engineers at A.E.C.L.

The fact is, there are far more problems than there are chemical engineers. To make a mark in the atomic energy field, Canada will have to exercise a maximum of sound technical intuition in order not to spread her limited effort too thin over the most pressing problems, for the sake of dabbling in them all.

Current and Potential Applications of Radioactive Isotopes

by

Dr. D. C. Brunton,

President, Isotope Products Ltd., Oakville, Ont.

Possible applications of radioactive isotopes fall into two main groups, as follows:

A. Bulk Radiation Uses
   1. Radiation beam Therapy units —"Cobalt Bomb"
   2. Pasteurization and sterilization
   3. Insect control in grain and other vegetable products
   4. Polymerization

B. Individual Isotope Applications
   1. Medical uses as tracer and therapeutic doses.
   2. Tracers in research
   3. Tracers in industrial application
   4. As a measurement tool in industrial applications

This list is not comprehensive but includes the most widely discussed applications. Among the bulk uses only the radiation beam therapy units are an established successful application. The value of radioactive isotopes and Cobalt 60, in particular, is now widely accepted and in increasing demand in our hospitals. Until recently Canada's N.R.X. reactor at Chalk River was the only practical source of Cobalt 60 for such units.

Pasteurization and sterilization have received considerable attention and study. A number of major difficulties have arisen:—the size of the sources, one or more million curies for practical industrial food product irradiation; the resultant handling problem and indeed even their availability and the deteriorating effect of radiation on taste, colour and vitamin content in many cases. Such radiation sterilization may be practical in the near future for certain low volume high cost items as pharmaceuticals, but considerable further development will be required before commercial application in the food industry is attained.

Insect control in grain appears to be a considerably more practical proposition, since only about 1 per cent of the radiation dose is required here as in the case of food sterilization. Even so the large quantities of grain handled demand enormous sources for large scale operations.

As in the case of sterilization, very large radioactive sources are required for polymerization processes on a commercial scale. However the different action of radioactive polymerization and heat polymerization allows the production of new products hitherto impossible and this application may prove successful in the case of certain high cost, low volume products.

In the list of individual isotope applications the medical uses, particularly the treatment of thyroid conditions, are well established. The

uses of tracer isotopes in a wide variety of research laboratories is likewise an accomplished fact. Tracers in industrial process applications, however, have found very limited use. In general the radiation hazard of contamination in the product, the high cost of pilot trials and frequently simpler alternatives have resulted in restricted use in these cases. By far the largest application of radioactive isotopes outside the medical field is their use as a measurement tool in industrial processes.

For the most part current applications may be placed in two general categories, and as such they are playing a partial role in two major industrial objectives. The first of these is the "push-button plant", the complete automatic control of the continuous process industries. The second is the elimination of *design* waste in construction and fabrication.

The Push-Button Factory

The push-button factory is no longer a myth. It is now approached closely in certain industries and in other cases great strides are being made to convert batch processes to continuous operation. It is virtually impossible to operate a continuous process without control over the significant variables on the operation. The central problem of control is measurement. The present state of instrumentation is such that any variable that can be continuously measured can be automatically controlled—the real difficulty is making the measurement. It is here that radioactivity is making an important contribution.

In paper making, for example, three basic process variables are basis weight, stock consistency and stock freeness. The most important of these, the basis weight, has defied continuous on-the-machine measurement until the development of the beta-ray gauge. This gauge measures weight or thickness by the absorption of beta rays from a radioactive isotope. By its application, paper machines have been put on automatic control for the first time in paper-making history.

The measurement of basis weight made by the beta gauge is fed back to control the pulp stock flow into the paper machine. The result is a marked improvement in product quality, variously estimated as reducing weight fluctuations by a factor of two to four. Improved uniformity can, of course, result in substantial savings, in the paper industry. However, the improvement in quality is at least equally important. The printers and converters (eg. punch card makers) continue to run their machines at higher speeds and closer tolerances, and demand a more uniform product from the paper maker.

Besides its function as a control mechanism, the beta gauge is playing a valuable role in the paper industry in improvement of quality. This application is carried out both by the usual Betameter machine installation and by a new form of beta gauge which we call a Profiler. With this equipment several mills have made a thorough study of variations in weight across the web which have resulted in modifications of head box and slice design to produce a more uniform sheet.

The improved uniformity resulting may well have far-reaching effects on the paper industry. It is my belief that with the reduction of weight variation in the paper the news press man will find he can operate just as satisfactorily on a 30 lb. sheet as he now does on a 32 lb. sheet. The newsprint manufacturer would, of course, require a higher price for the improved quality, but substantial savings could still be made and such a change would immediately increase our national wealth in forest reserves by 6 to 7 per cent!

The same instrument is being used in the rubber, steel, copper, aluminum, plastics, in fact, in virtually all sheet-making industries. Rubber, for example, is a difficult material to measure by any contact means because of its compressibility in its uncured state. The measurement of thickness, and consequently control of uniformity, will vary from operator to operator and even with the same operator applying varying pressure to a micrometer gauge.

The beta gauge, measuring without contact with the sheet, avoids this difficulty and one user, for example, has reduced his thickness variations to ⅓ by changing to beta gauge measurement. A particularly interesting problem in the rubber industry, now being solved by these same techniques, is the measurement of the contour of tire tread extrusion as it comes out of the tuber machine. Precision in following the designed tire shape is most important for both quality control and elimination of waste.

Again it is high speed, in this case high speed automobile driving, which demands a more uniform product—a better balanced tire. The measurement is carried out by a Gammagage, employing a fine pencil gamma ray beam in place of the usual beta radiation. As the gauge traverses the sheet, a pen recorder makes an accurate drawing of the tire tread shape.

Again let me stress the importance of such measurement to the industry. Measurement difficulties are such with rubber that a 10 per cent error is not too uncommon. Assuming an average error of 5 per cent and a raw material cost of 50 per cent, the potential savings are 2½ per cent on the annual income, which may amount to half of the year's profit before taxes.

In the steel industry, the problem is just the opposite to the rubber industry. The sheet is too hard rather than too soft. A flying micrometer will give an excellent measurement on a relatively slow moving sheet, but frequently chatters and bounces on a high speed mill. Our betameters have been used extensively on shearing lines for tin plate, we have recently installed a special type gauge on a cold reduction mill and are currently building a Gammagage for measurement on a hot strip mill.

Measuring a fast moving strip at a temperature of 1,100° or more presents some pretty difficult problems but radioactive isotopes which are indestructible, completely free of maintenance problems and measure without contact provide an unequalled tool. In all cases the goal is more uniform production and successful results are being obtained.

Beta gauges on sheet processes are by far the most developed of industrial radioactive instrumentation. The same principles, however, are now being applied to the measurement of density of liquids and pulps. Highly accurate and trouble free measurement of density will lead to a great extension in automatic control. The Density Gauge is still in its infancy but extensive application will be made not only in the chemical, petro-chemical and oil industries but in a variety of jobs from per cent solids in ore concentration processes to density of soap chips.

Elimination of Design Waste

Turning now to our second basic objective, the elimination of *design* waste, we have an entirely different application. By *design* waste, I mean that waste in engineering of structures which is built in as a safety factor or a factor of ignorance. To use a low safety factor in design, the engineer must have confidence that his specifications will be met, and to ensure this there is an expanding field of industrial inspection.

Such inspection may cover every phase of construction and by no means the least of these is the inspection of welded joints. The isotopes Cobalt 60 and Iridium 192 have invaded this inspection field to offer formidable competition to the x-ray machine for industrial radiography. They are following the welder in the shop, in field fabrication, along the pipeline and through the intricate maze of a chemical plant's pressure system.

As a result better pipelines are being laid and better plants constructed.

By established fabrication codes of the American Society of Mechanical Engineers and the American Petroleum Institute an increase from 80 to 90 per cent is permitted in the allowed strength of a welded seam when inspected by radiography. This means a 12 per cent saving in the plate thickness and hence in the tonnage of steel used and nearly a 25 per cent saving in the volume of the welding.

I would like to emphasize that the use of radiographic inspection in such cases produces a better, safer product. But it is only isotope radiography, and the "one shot" technique developed by Isotope Products Limited which has reduced the cost so that the inspection saves more money than it costs. By this "one shot" technique, all the welded seams in a storage tank or pressure vessel (such as a Horton sphere) are taken in a single exposure—as much as 2,000 ft. of film in one shot and this on tanks up to 150 feet in diameter.

Radioactive isotopes are displacing the x-ray machine in the steel casting field also where the advantage of portability, manoeuverability and trouble free operation are particularly useful on the larger castings. In a couple of extreme cases, we have radiographed through 12 in. of steel on a casting in situ. This is, of course, a very special technique and can only be carried out in a practical time limit with the isotope Sodium 24. This isotope has a half-life of but 15 hours, and a single shot will be run through about 24 hours to obtain the full effective life of the isotope.

Such an operation, of course, must be carefully timed so that when the source is extracted from the reactor it is immediately transported to the casting site and put into exposure position without delay. By use of this radiographic technique before and after, successful welding repair was carried out on the cylinder of a large extrusion press which would otherwise have been out of service for more than a year. It has now been back in service for nearly two years.

Again, in the inspection field radioactive isotopes are being used in instruments such as the penetron and the gammagage for the measurement of wall thickness of tanks and pipes. Here the purpose is not so much improvement of quality as protection against deterioration of quality.

Education in Atomic Energy

by

Dr. Leo Yaffe,

Chemistry Department, McGill University, Montreal.

Reckoned from the operation of the first nuclear reactor, the so-called Atomic Age is just over 11 years old. Fifty years ago, assessment and evaluation of such a development in so short a span of time after its inception would have been futile. However, technology is advancing at such a rate and other circumstances beyond our mode of control, are catapulting us so rapidly into the Atomic Age that an assessment is really necessary.

Without wishing to encroach on my colleagues' territory, at least two things are obvious. First, most of the energy pattern of the world 50 years from now will be obtained from nuclear fuels. Secondly, radioactive materials are being used in industry at an almost exponentially increasing rate. The question arises, then "Are we educating our students, potential engineers, chemists and physicists so that they can take their place in this "Atomic" society without too much re-orientation ?"

What should a student know by the time he graduates and takes a position in this modern society of ours. First of all, he should have a thorough grounding in fundamentals of radioactivity and the concepts involved there. He ought to be familiar with the properties of α, β, and γ radiations, their interactions with matter, the mode of detection and measurement of the radiations. He should have studied the various types of nuclear reactions including, of course, that of the fission of uranium—the basis of the Atomic Age. He ought to be familiar with neutron diffusion theory and elementary reactor theory. He ought to have some familiarity with radiochemical techniques, manipulation of micro quantities, etc.

He ought to have been exposed to the fact that re-fuelling of a reactor is necessary, that chemical treatment to recover plutonium and unused uranium is mandatory. He should realize by now that these chemical techniques have to be done behind heavy shielding to protect the operator from the hazards of the intensely radioactive materials. This means that estimates of radioactive intensities have to be made, shielding has to be calculated and remote control instruments have to be designed.

In addition to this, of course, there are the usual problems of heat transfer, corrosion, etc. Some attention should be paid to structural materials which one can use in nuclear reactor construction. One of the most important properties one has to consider is the affinity of that material for neutrons—its so-called capture cross-section. This is as important a property of the materials as its tensile strength.

What are the various universities and institutes doing about this ? Obviously a mere catalogue reciting the above would become quite boring. I have taken some of the larger universities in this country and the U.S.A. and am briefly reciting what they are doing.

McGill University, where some of the most fundamental discoveries about radioactivity were made, has retained its interest in the subject. Physics students, of course, get the usual nuclear physics and atomic physics courses. In addition, the mechanical engineering department hopes to incorporate a nuclear engineering course into the graduate curriculum. At the present there is offered an Evening Extension Course in nuclear engineering which deals with some of the topics mentioned.

However, as yet, it is a one-lecture-a-week course and cannot deal as fully with the topics as the lecturer would like to do. The chemistry department has recently opened a radiochemistry laboratory where graduate students do research in the field, and several comprehensive lecture courses are given. The physics dept., of course, has the world-famous radiation laboratory where graduating students do fundamental research using the cyclotron as a tool.

The University of Toronto last year ran a series of seminars on nuclear engineering. The speakers were experts invited from various other places, mainly, of course, from Atomic Energy of Canada Ltd. Very little nuclear physics and no radiochemical research is undertaken.

McMaster University in Hamilton undertakes an extensive radiochemistry and nuclear physics program, both in undergraduate lectures and in graduate research. The University of Saskatchewan has an active nuclear physics school and a very active group doing research in applied radiochemistry, i.e. tracer research. Queen's, British Columbia, Manitoba, Laval Universities all carry on more or less extensive nuclear physics research programs.

In the United States, due to the very liberal government support, all of the larger universities carry on active research programs in one section or another of nuclear research. At Berkeley there is an extensive program, both physics and chemistry built around their various high energy machines. This work is supplemented by comprehensive graduate and undergraduate lecture courses. At M.I.T. the laboratory for nuclear science and engineering carries on a full program in various aspects of atomic energy. The University of Chicago has its Institute of Nuclear Studies which makes a very positive contribution to the atomic energy field.

Smaller programs are carried out at many of the other universities. Many of the smaller universities are allowed to use the facilities of the various national laboratories. For example, almost all the Eastern Universities send their students and professors to Brookhaven National Laboratory on Long Island. There they are able to use high energy machines, and a nuclear reactor. Another feature of U.S. atomic life is the Oak Ridge Institute of Nuclear Studies. To this Institute come mature workers for a two weeks intensive training course. They are given both laboratory work and lectures and learn how radioactive materials can be applied.

One of the problems of Atomic Energy in Education is that the supply of post-graduate students is slowly falling off. High starting salaries are attractive to new graduates. This is especially true in engineering where only a pitifully small number go into graduate work. This means, in essence, that the fountainhead of knowledge is drying up, and this problem should demand our concentrated attention. Engineers, for example, with post-graduate training in research and development are extremely scarce.

A university post-graduate training is not only a source of new ideas and new techniques, but a place where men are taught to think independently and thus make a more significant contribution to our society. I think at this stage, one should point out that heavy water, for example, which is so important to the atomic energy program, was discovered at a university, and the methods for its concentration were worked out at a university—so that one can see that this post-graduate training in research and development pays positive dividends.

Discussion

Dr. Thiesmeyer: Mr. Gray emphasized that in the next decade or so, the design aspects of the efforts to develop nuclear power on a competitive basis will be confined to one or two major firms of consulting engineers cooperating with the people at Chalk River.

In the United States the Atomic Energy Commission has encouraged numerous groups of large companies to study in detail the developments of nuclear science, and has given them full access to the information available to the Commission. It has allowed them, using their own initiative and ingenuity, to come up with workable plans. The attitude seems to be to let the ingenuity of United States scientists and engineers go to work and let the chips fall where they may.

Is this policy, of confining the design efforts to one or two Canadian firms dictated by something not seen in the overall picture, other than the fact that Canada is somewhat smaller and you do not want to have too many supplying this co-operation ?

J. L. Gray: I said "One or two organizations." At the moment we are doing virtually the same thing as the Atomic Energy Commission in the United States. We have a group at Chalk River composed of some organizations, one of which is the Ontario Hydro Commission, which will likely be the first to require atomic power. They are starting a study of the feasibility of the nuclear reactor, and they are being joined by representatives of many power groups in the country. We have representatives from two organizations in Quebec.

We are also forming a Committee —I think this has already been announced —with a representative from every power corporation and commission in Canada. They will meet normally to discuss the progress we have made and the implications of the work we are doing. As to whether this design organization about which I talk is a combination of power people or consulting engineering firms, I do not know the answer.

Question: In the development of atomic energy I suppose first of all there is a need to develop basic specifications which undoubtedly will require the services of physicists, chemical engineers, as well as metallurgists. There are two main branches, the thermodynamics branch and the mechanical branch.

Now the thermodynamics branch must certainly be of value in developing basic specifications. When you reach that stage, surely it becomes necessary for somebody else to be around to undertake the responsibility of seeing that the plant does not cost more than it should. It may be impossible to run it economically; or perhaps once you get it started you cannot get it stopped. Would you please enlarge on the role of the mechanical engineer in this whole business ?

J. L. Gray: I am not sure that Mr. Campbell has not answered most of the questions himself. I did say that of 100 engineers on this job, 47 would be mechanical, 32 civil and architectural, 13 chemical and eight electrical. Obviously the greatest number must be mechanical. As to the cost of the NRU reactor, I am not sure of the figures on the designing costs.

Mr. Burridge: Dr. Yaffe spoke of students and new men entering the field. I believe there are many like myself who are past that stage, and who would probably dearly love to be retired before we become senile, in order to take up the study of nuclear engineering. What can the engineer who graduated quite a few years ago do now in this connection ? Or what is he going to have to do ?

Dr. Leo Yaffe: If I were you the first thing I would do would be to read a good book. That is usually the advice a medical man gives you before you get married. I think it is still applicable.

Information Available

The atomic energy field is, unfortunately, plagued by the fact

that it was almost born in secrecy. This is very bad. Dean Mackenzie has said that it is unfortunate that the atomic energy field was heralded into the world with a loud boom, in other words, the atomic bomb. The so-called secrecy which shrouds the atomic energy field is largely a myth.

There are, admittedly, secrets; but very few of them are basic. The things that are secrets are certain design data and certain fundamental constants and actual values which interest only a few people. There has been a terrific amount of stuff published and several good books written on just about any aspect of the atomic field about which you care to learn.

There is this special extension course that I mentioned in nuclear engineering, which does deal with the various phases of the atomic energy field. I do not know that it gives you any more than just enough to whet your interest, but at least it tells you where you can find things. Unfortunately, when you have done that, I do not know what comes next. Several courses of study have been undertaken at Oak Ridge, and I understand they will accept Canadians.

Various industrial firms have sent some of their employees to Chalk River, where they have spent a year or two. They have merely integrated themselves into some department and gradually learned a fair amount, and have then gone back to their original company as, I am sure, a much more useful member of that company. I am not sure how widespread that practice should become or will become, but I think it is very useful.

Dr. A. J. Mooradian: Actually this phase of the atomic energy science has as much of the element of an art to it as general chemistry did in the early days. The number of variations is enormous, almost as great as in the chemical processes, you will find.

As for technical intuition, you will find that a man has intuition whose general knowledge indicates that this is the right way. I think the contribution to any industry of the engineer who has just graduated from a university is almost negligible for six months to a year after graduation.

It is no different in the atomic energy field. We have all types of engineers but there is no nuclear school in Canada. These men come to us raw. Inside of six months or a year they find themselves faced with problems in the nuclear field to which the answers cannot be found in even a good basic training in engineering and science.

Question: In the use of radioactive isotopes is there any hazard created by the radiation in the material ?

Dr. D. C. Brunton: No. With the type of radiation used in any of these measurement devices you could not introduce any reactivation into the material. In welding a pipeline or making a measurement on a sheet of paper you could not induce any secondary radioactivity. It is exactly the same after it passes through the material as before.

The only possible danger is that of contamination by an accident destroying the radioactive source itself and spreading it around. Quite severe precautions are taken to prevent any such accident, and immediate clean-up steps are taken should one occur; but it has not appeared as a problem, at any rate up to date.

Oil, Uranium, Coal

Question: Mr. Chairman, I wonder if the Panel could give us an idea of how the world supply of uranium compares with the supply of coal or oil and how this will affect the use of atomic energy in the future ?

Dr. Leo Yaffe: Like the proud parent who says "I just happen to have a picture of my child right here," I just happen to have some figures. This was a very difficult thing to assess, primarily because the people who have been doing the assessing up to this point have always had an axe to grind. The Oil people, for instance, claim that there may be a shortage of coal, so we'd better convert to oil, etcetera.

Recently there have been two important documents published in the United States, one by the Materials Policy Commission of the United States and the other is a book called "Energy in the Future," published by a consulting engineer named Putnam who has some important things to say about energy consumption and about the sources of supply and so on.

What he does is invent a synthetic unit which he calls a Q which is equal to 10^{18} B.t.u. He assesses oil, coal, and uranium reserves and these assessments are generally agreed to be quite accurate. The coal reserve amounts to something like 32Q. The oil reserve is about 6Q. This assumes a recovery of the fuel at a cost less than twice the present cost.

By 2000 A.D., at the present rate of consumption all of the oil will be used up, 10Q of coal will have been used, leaving only 22Q for future generations. At present one can see 1,700 Q of uranium. So it appears that we have enough uranium.

Mr. Putnam predicts that a hundred years from now the energy balance sheet will show coal 15 per cent, gas and oil 25 per cent, and nuclear fuel 60 per cent.

We have found remarkable methods in recent years for extracting uranium in exceedingly small quantities. The Atomic Energy Commission has developed a process of extracting uranium in the United States which is quite a step forward. This will expedite our atomic energy program. There are large installations going up in several parts of the country to do that.

Manpower

Question: Dr. Yaffe, is the United States faced with the same problem as Canada with regard to the dwindling amount of graduate students or graduate studies ?

Dr. Leo Yaffe: Yes, even more so, because they have the draft problem to consider. As a matter of fact we in Canada are a little fortunate. The United States draft problem helps us out a little. Somehow quite a few United States students seem to find their way up here because of this and also because of the recently passed McCarran Act, and other conditions.

You know there used to be a terrific flow of graduate students to United States universities to do post-graduate research and if they hold some paying teaching position, like a demonstrator's position, they are now liable for the draft. So these students have not gone down. We are keeping them here.

On the other hand there have been many graphs showing the terrific decline of graduate students in the United States and this is a serious problem. All we have to do is to look at the scholarships, the money offered students. It is the law of supply and demand. Money offered to students has increased substantially. It has to compete with starting salaries which are pretty good, and you do not get scholarships which compare to what a good full-time job will pay.

Question: Is it not short-sighted on the part of the Government not to insure this very desirable product ?

Dr. Leo Yaffe: I don't know who is being short-sighted. I personally think the students are being short-sighted. They are jumping into the first available job because the starting salary is high.

Dr. Thiesmeyer: Some Ph.D. graduates of the Pulp and Paper Re-

search Institute of Canada are offered $8,000 a year to start. This is not a plug for the Research Institute, by the way.

Question: Mr. Chairman, I wonder if Mr. Gray would have the figures on the number of people on the design staff that were engaged for the NRX reactor and how many are now engaged on atomic design and research.

Mr. J. L. Gray: I do not have those figures here. It is difficult to separate the NRX design figures because, of course, the whole plant must be designed, not only NRX. It involves several other buildings. Mr. McKay, would you have any idea how many design staff are engaged in NRX and how many are engaged in reactor design today ?

Mr. McKay: I do not have any very accurate information on the staff. That plant was originally designed by Defence Industries, which was based on a nucleus of Canadian Industries Limited engineers. They withdrew but left some of their members with us. I do not know the proportion; quite a small proportion, actually, but I think they originally had 150 or 200 engineers and draughtsmen on the side of planning. Perhaps 20 or 30 are still with us but that is about all.

Economics of Nuclear Power

Question: I wonder if Mr. Gray would tell us something about the cost of nuclear power; what would be the current cost of producing a nuclear power reactor today ?

Mr. J. L. Gray: I am afraid that is virtually impossible to answer at this stage. We have not produced a power reactor. We do not know what the reactor would cost or what it would cost to supply steam to supply the turbine. We do know we have to produce it at a capital cost that would compete with coal at $8 per ton and we have to do it in the next five or ten years. It is an immediate problem. We really have to produce a reactor whose capital cost is such as can be amortized and still compete with steam produced by burning coal at $8 per ton.

There are other problems involved. This capital cost must be controlled as far as other things are concerned, such as heavy water and the recycling cost of uranium. Then we have to get the cost of taking spent fuel from the reactor down to a very low figure, in order to meet this price of $8 per ton for coal. We have this problem with us right now and we think we can meet it.

Dr. Thiesmeyer: There are a couple of quotations I should like to add to the discussion if it is in order. The first is this: Dr. Smyth of the United States Atomic Energy Commission states: "I believe it possible that the nuclear power industry will stand or fall economically depending on the success with which chemists and chemical engineers develop cheap processes for purifying and refabricating nuclear fuel."

Then the other, which I thought was an expression of confidence regarding the question of costs, that big question—Can power be produced cheaply enough to be of general use ? His comment is: "The Atomic Energy Commission believes it can be done, and this is the opinion also of several private industrial groups that have been studying this problem for the past several years."

That is merely an expression of confidence. It does not give dollars and cents information, nor does it say how fast it can be done. However there have been some opinions expressed that this is going to be done in the next five years.

Also I would like to ask a question: I notice that some of the nuclear reactors are completely different in design. Are there going to be common laboratory reactors, as in some of the well-known equipment we have today ? Already the AEC is offering a deal to Universities for putting small reactors into use for research purposes. What would you say, Dr. Mooradian ? Is it your opinion that the universities will soon be doing something along these lines ?

Dr. A. J. Mooradian: There are some now. The University of North Carolina has a reactor of this type. Of necessity it will have to be like that. It certainly is a tool that we will have to use.

Mr. Gray was talking about taking a front end approach to this business. Before we can do that, our objectives as chemists is to supply the designers with a fuel element which will allow them a greater versatility in design than at the present time. In order to do that we will have to have test equipment of this type available, and lots of it.

Question: It has been said in this discussion that in 20 years there might be several. Does that envisage your complete plant such as you have in Chalk River, or would it just be the reactor itself for processing uranium, with all the associated services done in a central location ?

J. L. Gray: That is difficult to answer. I am sure the first ten or 15 years would just see the reactor located as near to a central position as possible, for instance Toronto and Hamilton. The dual process would probably be done in one location. The development differs as methods of fuel development are changed, as the type of fuel changes. It may well be done in the actual power plant itself, a continual process. I should expect that you would want one central location for a group of reactors.

Question: There is a lot of design talent going to waste and there is only a small percentage of the original NRX designers working on atomic energy.

Dr. Leo Yaffe: I think a lot of this design talent went back to the United Kingdom.

Mr. J. L. Gray: Some of it went back to Canadian Industries Limited.

Dr. Leo Yaffe: I remember quite a few of the initial design engineers. Some went back to Imperial Chemical Industries.

Question: In that case are they still working in atomic energy.

Dr. Yaffe: Some are and some are not.

Mr. J. L. Gray: I would guess that 50 per cent are working on NRX reactors and no longer in atomic energy work. It is purely a guess. I would think that half, probably, are back in the chemical industry, in Canadian Industries Ltd. proper. The group now working for the C. D. Howe Co. will have a job to do. There will be a large group required. We have only 16 engineers on our engineering design work at Chalk River, in the actual design. The staff there is quite small.

Hazard Assessed

Dr. Thiesmeyer: A lot has been said about the hazards associated with this project. It might be well for the record and possibly for any gentlemen of the press who may be here, to touch on this point. A number of reactor designs are self-regulating. As the temperature within them rises, the reactivity of the unit decreases, so that not all of them are of an extremely hazardous character, so long as water is not dissociated.

In the United States not so long ago they decided to take a reactor up to what they felt were its limits to see what would happen. They took one in which the moderator was water and they suddenly pulled the controls and the water boiled off beautifully as a geyser. Repeated trials showed that no serious damage was done, so that with similar improvements in technique as we go along, the extreme hazards that we

had to worry about in the early days of the atomic program are going to be diminished.

Dr. A. J. Mooradian: In that regard the atomic people in the United Kingdom have said they will not design a reactor which is not inherently safe.

Dr. Thiesmeyer: That is an important point to get into the mind of the public.

Question: How about the NRU ?

Dr. Thiesmeyer: Another interesting thing in the matter of design is the scaled up reactor experiment which was started at Oak Ridge. I understand it is going to be carried on further in Idaho. It is a homogeneous reactor in which water is the moderator, and fuel is in the form of uranium sulphate. It has been successful in a small way and they are going to step it up now, also with the idea of getting more information, not necessarily producing atomic power.

Dr. A. J. Mooradian: That is confined to the ability to take heat from the system.

Scientific Personnel

Question: Could the Panel tell us if there is any distinct shortage of chemical engineers or chemists or physicists on atomic energy projects; or is the suggested shortage only for the future ?

Dr. A. J. Mooradian: What I said in this paper I said in all honesty. There are far more programs than people to work on them. Our ability to get people to work on them is limited by the amount our government is going to sink into the project at this time. We have to balance the number against the quality at this point.

Question: Is it possible that if the larger number of post-graduate men in this field that Dr. Yaffe would like to see, were available at the moment, would there really be enough to go around to occupy them fully ?

Dr. Leo Yaffe: I think I have to make one point clear, that when I am talking of post-graduate students I do not want all of these post-graduate students to be in chemical engineering and specialists in atomic energy. What I am talking about is a nucleus of trained personnel for industry.

They should be people who have been trained to think independently and to produce ideas and new materials. The atomic energy industry then grows, not only on these people but on what they produce, and it does not necessarily have to employ these people afterwards. These people find jobs in other industries and are valuable men.

Dr. Mooradian: What industries ?

Dr. Yaffe: Various industries in Canada.

Dr. Mooradian: We lose by far many more highly trained people to the United States, simply because the latter are in a competitive economy, and they have found that research pays and that this is a good sound foundation on which to spend revenue. In Canada I think it is significant that we have just a tenth of the population of the United States. In the United States they can spend about ten times as much on each type of engineer as we can in Canada. We do not have a large call for highly trained men. Where are they going to go ?

Dr. Yaffe: If you look at the American scientific personnel you will agree that this was true before the last war to a large extent, but I think you will see that this export has slowed down.

Dr. Thiesmeyer: We can say that, to the great credit of some of the students, although a lot of them have gone to the United States, there are a few of them who have accepted jobs in Canadian industry at from $1,000 to $1,500 per year less than in the United States. They preferred to stay in Canada.

Dr. Mooradian: That is exactly the difference in salary that I came back from the United States on. It is a big question in the mind of any engineer. But I preferred to raise my children in Canada and that is the reason I came back. But should we be imposing this penalty on them ? We really have no sound foundation for keeping people here.

Dr. Yaffe: It is a question of which came first, the hen or the egg. How did the industries in the United States grow ? If you start training nuclei you soon have people going out to discover things. In the United States on those simple discoveries new industries mushroomed. There is no reason why the same thing should not happen here.

Mr. J. L. Gray: May I answer Dr. Phillips ? We have more opportunities for chemical engineers in Chalk River than other engineers. For those who come to Chalk River it is not entirely a question of salary but partly of program, partly leadership, partly general policy. But it is also part salary.

We have a lot of jobs for mechanical engineers. But there are practically no mechanical engineers in Canada that have any post-graduate training. They just do not go into that sort of thing. We need people who can do development work. We have all kinds of problems that a well-qualified designer can put on paper but to make these work properly is sometimes a little different problem.

The universities are not producing them, mainly because the students in the engineering game just do not want to do post-graduate work. A starting salary of $300 a month looks more attractive. Mechanical engineers are not properly trained for development work, in my opinion.

Dr. Phillips: From my experience and knowledge there is no trouble about salaries being offered for atomic energy work. They are fairly commensurate with salaries in other industries. Students are not going into atomic energy work for other reasons, particularly because they do not know yet just what is in store for them, what this will lead to, and where they will stand in thirty or forty years.

New graduates today seem to want great assurances of what salaries and advances they are going to get; and they even look far ahead to pensions, etc. There are other considerations, too. Some do not like the idea of working at secret things that they cannot talk about, and that they cannot get publicity on. They feel in going to work on atomic energy they become a sort of cloistered person.

There are all kinds of other excuses that they give for their lack of interest in working in atomic energy. They have heard the argument that they are getting in on the ground floor of something which has a big future but that does not carry enough weight.

I would like to remind Dr. Yaffe in closing, that there is a big wave of potential graduate students which should hit us about four or five years from now. It is true that there is a scarcity of graduate students all around, although he said the undergraduate roll has not changed very much. But it has been improving since 1951 and will go up sharply in the next four years, and we are all sure that the number of graduate students will go up equally.

Dr. Yaffe: That I am not so sure of. I was taking the ratio of graduate to under-graduate students now. I am well aware that the post-war babies are coming in on us and the universities are going to be flooded. The question is: How many will stay and do post-graduate work ?

Dr. Thiesmeyer: This gives me a wonderful opportunity to peddle my

(Continued on page 250)

Shoran Controlled Photography

by

Manuel A. Silva

Geodetic Engineer
Canadian Aero Service Ltd.,
Ottawa, Ontario

Electronic measurement of distance is new, and is bound to have an impact on surveying, particularly in outlying districts with short field seasons and transport difficulties. This clear and concise explanation of how Shoran was applied to a large-scale mapping program in Canada should be of interest to many members of the profession.

During four months in the summer of 1953, under the aegis of the Army Survey Establishment, Department of National Defence, 11,000 lineal miles of Shoran controlled photography were completed in the North West Territories, Northern Alberta, and Northern British Columbia. Eventually this photography will provide horizontal control for existing vertical photography covering 100,000 square miles of North Western Canada.

The term Shoran is a contraction of the phrase Short Range Navigation. It is an electronic measuring system for indicating distances of an airplane or other vehicle from each of two Shoran ground stations. In operation the aircraft transmits radio signals to both ground stations. These signals are received and immediately retransmitted to the plane.

By automatic measurement of the time required for the signals to traverse each round trip path, the distance from the airborne equipment to each ground station is accurately measured. This information, together with the knowledge of the flying height, and the geodetic positions of the ground stations, permits computation of the absolute airplane position.

Organization

During March, 1953, personnel and equipment began to assemble at Uplands Airport, Ottawa. A Shoran detachment was organized from personnel of the two companies. Detachment organization consisted of an Administration Section, an Airborne Section, an Electronics Section, a Geodetic Section and a photo laboratory. The Administration Section included the project manager, one accountant, two cooks, and two kitchen assistants. In the Airborne Section we had one chief pilot, four additional pilots, two navigators, two photographers, two aircraft engineers and three engineer's aides.

This section operated and maintained three Lockheed PV-1 Venturas, one Anson, and one Norseman. In addition to these aircraft it also operated a Dakota during mobilization and demobilization phases of the project. The Electronics Section was composed of an electronics chief, a maintenance engineer, a communications' engineer, six ground Shoran operators, four assistant ground Shoran operators and four airborne Shoran operators. The project Geodetic Section consisted of one geodesist and four computers. Finally our photographic laboratory was operated by one photographic technician. In total we had forty-three men assigned to this project.

Our Shoran equipment was calibrated in Ottawa during early mobilization days. A calibration range three miles long was selected parallel to runway 14-32 at Uplands Airport. Our range ran 200 feet off this runway. To insure safety we carried a radio set in our calibration truck tuned to the control tower. We received radio instructions and a green light from the airport control tower everytime we were about to enter or cross a runway.

Calibration

We calibrated one airborne Shoran set against each ground Shoran set, using the same operating channel in the airborne set throughout. Two of the ground sets were again calibrated against the other airborne set, following the same procedure as during our first calibration runs. These calibration runs are necessary to establish any variation in delay among the ground sets. This delay is the "time", represented as distance, consumed during the interval when the electromagnetic wave is travelling through the ground set itself.

Since we used two airborne Shoran sets, it was necessary to establish variation in delay between the two airborne sets. This variation was determined by the recalibration mentioned previously. Our calibration runs provided us with the

relative differences between ground sets when operating in combination with either airborne set. The absolute delay of the sets was not determined until our trilateration net was closed and adjusted.

In order to perform our preliminary line crossing computations, we required an approximate delay value for each ground set. To fulfill this requirement our calibration data between the one-mile and three-mile stakes was fitted with a parabolic curve of the type $y=AX^2+B$ by the method of least squares. The Y ordinate of the curve at a distance of 2¼ miles was selected arbitrarily for the delay.

Any value in the empirical delay curve could have been selected; however, the chosen ordinate should be the same for all sets and should approach in magnitude the design delay value of the sets when manufactured or 0.18 miles. Selection of the delay at 2¼ miles accounted for 97 per cent of the absolute delay, as revealed later by our net adjustment.

Weather Data Used

While our Geodetic Section planned the Shoran net and computed calibration observations, our aircraft engineers were busy working on the first Shoran aeroplane. The remainder of the Airborne Section completed flight maps and photographic coverage. In addition to numerous other duties, each man who was to operate a ground Shoran station took a three-day course in meteorology at Rockcliffe Airport. These men later provided the Edmonton Meteorological Office of the Department of Transport with regular weather observations throughout our area of operations.

These weather reports supplemented the information from existing weather stations, and at times were the only local source of weather data. In return for our services, the Department of Transport gave us a weather forecast every night for the following day and predicted the probable conditions for aerial photography and geodetic measurements throughout the area. Also we received a second forecast, about three o'clock every morning, from Edmonton, which gave us additional weather information, and predicted again operating conditions. We take this opportunity to thank the Department of Transport and to commend them on the accuracy of their predictions.

Mobilization

During the first week of May, an advance party departed for the Northwest Territories to prepare our base camp at the Yellowknife Airport. Relying entirely on air transportation, detachment personnel and equipment left Ottawa on May 17. By May 27 we had six ground Shoran stations installed in the field and ready for operation. The first five stations were planned for airport locations to avoid lakes during the break-up period.

However, at that early date the ice was gone on Lake Bistcho in Northern Alberta, allowing us to complete installation of our first six Shoran stations. The other five stations were located at Yellowknife, Fort Smith, Fort Simpson, Hay River and Fort Vermillion. To install the five stations at landing strips our Anson airplane, loaded to the last fraction of a pound allowed by air safety regulations, flew around the clock.

The weather during May was perfect for photography, but practically all the lakes were frozen and there was still some snow on the ground north of the 60th parallel. The first photo Ventura left Ottawa on June 1, 1953, arriving at Yellowknife around 8:00 p.m. the following day, stopping briefly at Edmonton for a propeller change. With this aircraft in the field, mobilization phase of the project was complete.

Method of Operation

Throughout the entire project we enjoyed an unusual amount of photo weather. Daily reports from our field stations indicated that it was possible to take aerial photographs 39 per cent of the time we were there. Most of the better photo days occurred during the months of May, June and July.

For this operation we revised the photo-light tables. The time during the day when photographs could be taken was increased by two hours. During June we took acceptable photographs as early as 4.45 in the morning and as late as 8.00 o'clock at night. Our air crews were up at three o'clock in the morning, quite frequently they worked through until ten o'clock at night before they landed from their last mission for the day.

The Shoran equipment performance was above par. Practically a complete set of spare parts was on hand at each ground station. When these stations became unserviceable, our ground Shoran operators repaired the sets at once. On one occasion the airplane circled the area for half an hour while the station was fixed. Then after the station was repaired, we completed that day a line we had been trying to do for two seasons.

Several times during the project our two photo aircraft operated out of separate bases. We based one of our planes at one time or another at Fort Nelson, Fort Simpson, Norman Wells, Sawmill Bay, Yellowknife and Fort Smith. This deployment of aircraft allowed us to reduce ferry time and to concentrate on priority areas assigned to us by the inspecting officer.

We were able to fly two photo airplanes in the same day several times during the project. Our maximum production during these days exceeded 1000 miles daily. Highest production rate was obtained when the aircraft operated in two entirely separate areas. The efficiency per airplane decreased considerably when operating two in the same photo zone.

Based on Trilateration Net

One of the most important factors in the economics of a Shoran project is the number of field stations required. The maximum efficiency of Shoran photographic coverage is obtained by controlling the distance between stations. This distance is dependent upon two factors:

1. The horizontal angle subtended at the airplane by the ground stations as allowed by project specifications.
2. The range limitation of the equipment.

These two factors limited the distance between stations to 150 miles for maximum efficiency on our project.

During the past few years the Geodetic Survey of Canada established a trilateration net throughout Northern Canada. We utilized stations in this geodetic net whenever possible. However, since in most cases the distances between these stations exceeded 150 miles, we found it necessary to establish a number of our own stations. During our operation we occupied a total of fifteen Shoran sites and re-occupied three of them. Of these fifteen, eight had been established by the Geodetic Survey and the remaining seven by our crews.

The combination of geodetic and photographic missions in one project allowed us to attain the greatest efficiency in the use of Shoran equipment and personnel. We concentrated on photographic work during the rare cloudless days, and we established our geodetic control during the days when photographs could not be obtained.

Errors Small

Last year we measured a total of fifteen lines by the method of line crossings. These lines formed two independent nets which subdivided the distance between stations established by the Geodetic Survey, allowing us to produce effective mapping control. Our contract required us to establish stations to the same order of accuracy as the geodetic stations. Our control met the specifications. In our southern net we measured eight lines and established the geodetic position of three stations.

The mean length of our lines in this net was 155 miles. These lines were observed in two sets of eight measurements, each set on a different day and at a different height. The mean probable error of one observation in the lines of the net was 0.00246 miles or approximately thirteen feet. The average probable error of the most probable value of the lines in the net was 0.00062 miles or approximately three feet.

The mean of the differences between two sets of eight observations in all the lines was 0.00262 miles or approximately fourteen feet. The lines were observed at a mean flying height of 10,000 feet. The adjustment of this net gave very impressive results. After adjustment was completed the largest correction applied to a line in this southern net was only four feet. This particular line was 121 miles long. At the other extreme, our smallest correction was 0.19 feet in a line 146 miles long.

Position computations of the stations produced good results. For example, in our northern net, prior to the final adjustment, we computed approximate positions for the stations we had established. After the adjustment was completed we found the errors in our preliminary fixes. The largest error, 0.8 seconds, occurred in the longitude of one station. The smallest error, 0.4 seconds, occurred in the latitude of the same station. Incidentally, in this net, we found we had a systematic error per Shoran set that amounted to two meters. To give another example of the accuracy of our work we should point out that the shortest distance between any one of the stations we established and a station of the geodetic net was 110 miles.

Rapid Checking

We introduced several time-saving methods in our data reduction processes. For instance, the rigorous computation of geodetic positions is difficult when long lines are involved. The formulas used are by nature complicated, and it is easy for a computer to let a small error go undetected until the problem is completed.

A method suggested by the United States Coast and Geodetic Survey was adopted. This method subdivides the length of any line into equal sections. We were able to divide all our lines in halves so that a direct or reverse position computation could be completed and checked in one hour. Our method employs natural functions and the calculating machine, doing away with the slow process created by logarithms.

Our nets were adjusted by the method of variable co-ordinates. First a preliminary station was obtained through a single chain of triangles. The next step consisted of computing rigid inversed distances between all points over which Shoran distances were measured. With this data, observation equations were formed and solved simultaneously by the method of least squares.

Reduction Process

At the completion of our project we had taken 6,000 photographs. It was necessary to compute the Shoran fixes for the plumb points of each photograph. The regular reduction process of the Shoran measurement to a set of Universal Transverse Mercator co-ordinates by calculating machine is a lengthy one. First the Shoran measurements are corrected for all instrument errors. In our case our equipment had three sources of instrument errors:

1. The delay discussed previously in this report.
2. The velocity of propagation of electromagnetic waves.
3. The frequency of the timing oscillator.

The delay correction is necessary because of the basic principles of the equipment. The Shoran measures distance as a function of the time required for a pulse of electromagnetic energy to travel a round trip path. Since the pulse of energy is delayed a constant amount in passing through the ground station equipment, a considerable error is introduced in the measurement unless the airborne timing circuits are set to consider this delay. We do not preset our airborne timing circuits; therefore a delay correction was necessary.

Velocity correction is required because the Shoran mileage counters are so calibrated that when the timing oscillator is tuned to 93109.5 cycles per second, the distance to each ground station is read directly in miles. This calibration of the airborne counters must assume a constant velocity of propagation of electromagnetic waves. However, the speed of radio wave depends upon atmospheric conditions and actually varies from point to point along the ray path. For this reason a velocity correction must be made to each of the Shoran readings.

The pulse travel time is measured in the airborne unit by means of a timing oscillator. The equipment design is such that true path distance is recorded, when this oscillator frequency, in cycles per second, is equal to one half the velocity of electromagnetic propagation in miles per second. Electromagnetic wave velocity, which is equivalent to the speed of light, is 186,219 miles per second at sea level under standard atmospheric conditions.

As Shoran measures the loop travel, it is convenient to use the loop velocity of 93,109.5 miles per second. Correct Shoran readings will be obtained when the airborne timing oscillator is adjusted to a frequency of 93,109.5 cycles per second. Timing oscillator frequency can differ from this reference value; therefore a correction is sometimes required.

After the calibration corrections and correction for the variations in the velocity of propagation have been applied, the Shoran distance reading gives the true distance along the curved ray path between the airplane and ground station. In order to reduce this corrected Shoran distance to ground distance at sea level further corrections must be applied. These corrections are necessary because of the geometric relationship between the curvature of the earth, the altitudes of airborne equipment and ground station above sea level, and the curved path of the Shoran ray.

Computers and Calculators Used

After all these corrections have been applied we obtain map distances to the plumb points of our photographs from the reference Shoran stations. Finally we convert these map distances to Universal Transverse Mercator co-ordinates by means of trigonometry.

This reduction process can advance only at the rate of twenty fixes per man per day. In our efforts to speed the process of data reduction, we investigated the possibility of adopting our problem to one of

the present day high speed digital computers. We solved our problem using a card programmed electronic calculator. After all the information is prepared and punched in the cards, this calculator will solve our problems at the rate of 5000 fixes per hour. We feel that we have now a short cut for our computations.

Wide Use Seen for Shoran

In conclusion, we feel our past summer's mission has been accomplished successfully. We believe our production can be increased and we look forward to producing the third dimension in photogrammetry. In the future we should be able to provide vertical control as well as horizontal control by electronic means. Meanwhile we will continue using Shoran for:—

1. Horizontal control of aerial photographs over inaccessible terrain such as jungle, swamps, muskeg and mountains.
2. Quick and efficient mapping of large areas.
3. Flight-line navigation with large savings through reduction in photo overlap, avoidance of gaps in photos, and in compilation costs.
4. Long distance trilateration with a unit area cost far lower than those of conventional methods of control.
5. Combined trilateration and aerial photographic missions, thus making use of all possible flying weather.

Acknowledgements

Much credit is due Army Survey Establishment for enlarging the effective use of this electronic method of establishing horizontal control. That the Shoran operation of 1953 was successful may be attributed, in the main, to the persistent efforts and foresight of Col. C. H. Smith and his associates of the Army Survey Establishment. These officers supplied the initiative throughout all the experimental stages and encouragement to overcome difficulties and setbacks encountered in making the application of Shoran workable.

At the same time we wish to pay our respects to those members of the Royal Canadian Air Force, the National Research Council and the Geodetic Survey of Canada, who played so prominent a part in developing the Shoran method of horizontal control, and to thank them for their willingness to cooperate at all times. √

THE ENGINEER AND NUCLEAR DEVELOPMENTS

(*Continued from page 246*)

literature, Dr. Phillips. Here is a book by a Dr. Karl D. Hartzell in the United States. It is called "Opportunities in Atomic Energy". This is a description of the different activities in the United States. It is full of things that should kindle the imagination of any worthwhile young man these days. This is one of the Vocational Guidance Manuals published by Grosset and Dunlap Inc. in the United States.

Gentlemen, I think we could go on and on. There are thousands of facets to this subject, as you all know. I trust we have hit a few of the more interesting aspects of the subject you have given up an evening to hear about. The material presented by the members of this panel has been independently prepared, and it is gratifying that they did not cover much of the same ground. We are much indebted to them for taking the time and effort to put this material together, and to come here and present it to us tonight. The meeting is adjourned.

Marconi Research Laboratory

Speaking recently to an audience of distinguished scientists and electronic engineers at the official opening of the Canadian Marconi Company's new research laboratories in Montreal, Dr. O. M. Solandt, Hon. M.E.I.C., chairman of the Defence Research Board, expressed the opinion that Canada is one of the most skilled industrial nations of the world.

He said that more and more this country is becoming dependent upon the quality and ingenuity in its products in order to retain a share of the world's market. He added that while Canadians might not be able to compete with their larger partner to the South in mass production, they certainly can compete in research, design and development.

Dr. Solandt stated that scientific research and development have resulted in weapons of tremendous offensive power in the past ten years. He said that should there be another war in the near future, it would be the power of the Strategic Air Command of the United States that would be decisive and that it seemed certain that no one would be willing to risk starting World War III unless they think they have a chance of winning it. As long as the nations of the free world maintain an overwhelming offensive power, no predatory nation will feel that they can win such a war. Dr. Solandt concluded with the observation that if the free world is to maintain this state of equilibrium, its peoples must maintain a scientific and technical initiative. The opening of the new Marconi research laboratories was a big step forward in this direction.

The guests were taken on a tour of the laboratories, where several advanced types of electronic apparatus were seen in operation, among them a revolutionary highly sensitive photoconductive cell; a device which will make atoms in materials ring like a bell at high frequencies in the shortwave broadcast bands; an electronic 'tape measure' for surveying; the electronic divider and the ferro-electric memory, both new components having important applications in electronic computer techniques.

The study of aeronautical audio problems has enabled Marconi engineers to develop and produce the first model of a noise-cancelling microphone with a built-in transistorized amplifier. This microphone, which was also on view, is a direct plug-in replacement for the standard carbon type, but with a far superior performance.

New quarters for the Radio Relay Department were also opened by Dr. Solandt. This group is engaged in the development of advanced radio relay systems for use in frequency bands upwards of 450 megacycles. A new terminal and repeater has been developed for medium and long haul 24-channel operation.

The new Marconi quarters are completely modern and contain a machine shop, a model shop, complete engineering and assembly facilities, as well as consulting and development services for government and industry.

Among the many guests who attended the ceremonies were Dr. J. T. Henderson, Department of Applied Physics of the National Research Council; Dr. R. E. Bell, Dr. Leo Yaffe and Professor H. G. I. Watson, of McGill University; Dr. I. R. McHaffie and Dr. F. Mathews, of Canadian Industries Limited; N. R. Olding, national operations engineer of the Canadian Broadcasting Corporation; W. A. Mather, president, Canadian Pacific Railway; J. G. Notman, president of Canadair.

The Approvals Laboratories of Canadian Standards Association

by

F. R. Whatmough,

Chief Engineer
Approvals Laboratories,
Canadian Standards Association,
Toronto

The Canadian Standards Association is a non-government, non-profit organization having a Dominion charter dating from 1919. It compiles standards in the engineering and industrial fields for both voluntary and compulsory use. It is the latter field which is discussed in this paper.

The head office of C.S.A. is at Ottawa on the premises of the National Research Council. There are two main divisions of C.S.A., namely, the Welding Bureau and the Approvals Laboratories. The operations of the latter only will be described. Its work, while less detailed than design, is spread over a considerable portion of the electrical industry. It is, therefore, an assignment of respectable size and involves the services of a staff of more than 180 persons.

The new modern Canadian Standards Association Laboratories located on Rexdale Boulevard in the Township of Etobicoke were officially opened on October 25, 1954, by Dean R. E. Jamieson, C.S.A. president and dean of engineering of McGill University.

The Laboratories, which consist of a single-story laboratory and office building of 50,000 square feet, are of modern construction, with emphasis on well lighted working conditions, by extensive use of glass partitions and the latest in lighting fixtures.

The method of distributing power in a great variety of combinations of voltages and frequencies to the various laboratories and test locations, is probably unique in Canada.

To provide for future expansion, the Association purchased ten acres in all and the new building is specifically designed for extending its scope, as well as for growth of existing testing programs. It is likely that the laboratories will be asked to provide a certification service on other products besides electrical and oil-burning equipment.

Origin

About 1910 there was an electrocution in a home which started the idea that some form of protective legislation should be embodied in the Ontario laws. No doubt this fatality had predecessors; but about this time some responsible people, including the utilities, saw the "hand-writing on the wall" because of the increasing use of electricity. In 1915 the Hydro Electric Power Commission was authorized by the province to form an electrical inspection department to govern the installation of electric equipment. In 1918 the Commission started a laboratory in its research division to supplement field inspection. It was known as the "Approvals Laboratories."

As the Canadian Electrical Code, Part 1, was accepted by other provinces, the approvals services of the Commission were stipulated by them. Because of this inter-provincial acceptance, it was later decided that the laboratories should not continue to operate under the name of the Hydro-Electric Power Commission. Consequently they became a division of the Canadian Standards Association in May, 1940, operating under an agreement with the Commission. In September, 1950, they were entirely divorced from the Commission.

Purpose and Scope

The purpose of the Laboratories is to reduce to an acceptable level fire and life hazards incident to the operation of electric equipment installed according to the requirements of the Canadian Electrical Code, Part 1.

The scope of operations depends on the interpretation of this Code. It includes all electric equipment intended to operate at any potential in electrical installations for buildings, structures, and premises with the following exceptions:

1. Installations or equipment used by an electrical or communication utility in the exercise of its function as a utility and located outdoors, or in buildings or sections of buildings used for that purpose.

If you had a flash-over on the cord of your toaster this morning, the fault is almost certainly your own; it is worn out and you should have replaced it long ago. New electrical appliances are remarkably safe in Canada, thanks largely to the work of the Canadian Standards Association Approvals Laboratories, quietly carried out and too little known to the general public. Mr. Whatmough's paper, presented to the Toronto Branch in February last, makes interesting reading; even your wife could get a good deal from it.

2. Car wiring, car houses and passenger and freight stations used in the operation of electric railways and supplied with electric current from the railway power circuit.

3. Aircraft and marine work.

The widely diversified equipment approved by the laboratories includes: wire and cable; conduit; both metallic and non-metallic raceways with their fittings, attachment plugs and receptacles; branch-circuit circuit-breakers; fuses; cleaning machines; cranes and hoists; elevators; fans and blowers; lighting fixtures and fittings; domestic and industrial heating and domestic cooking apparatus; industrial control; lightning protection (not lightning rods); medical and dental equipment; motors; generators; office appliances; oil- and gas-burners; outlet boxes and fittings; panelboards; picture machines and appliances; portable lamps; radio and television receivers and transmitters; rectifiers; refrigerators; service-entrance equipment; shaving and massage equipment; signal appliances; signs; lampholders; switches of all kinds; switchboards; sound recording and reproducing equipment; temperature regulating appliances; time indicating and recording appliances; tools of all kinds; transformers; welding machines; wireways and busways with allied fittings; and a long list of unclassified equipment which at present is called "miscellaneous," for example: pumps; compressors; shoe-repairing equipment; germicidal units; photographic equipment; canning machinery; dairy equipment; automotive testing equipment; material handling equipment; instruments, etc.

Some of the foregoing equipment is approved for locations where there is danger of explosions from the possible entrance of hazardous vapours. Dust-tight equipment for use in locations involving hazardous dusts is also approved. Most of the appliances listed for these locations are conduit fittings, lighting fixtures and motors and their control.

Operations

The Toronto laboratories, in general, handle all applications originating in Canada and the United States. Certain exceptions have been made as follows:

a. Manufacturers in British Columbia may avail themselves of the technical services of the British Columbia Research Council.

b. United States manufacturers, may, if the product is not too complicated, use the services of the Electrical Testing Laboratories.

c. Likewise United States manufacturers may work with the American Gas Association on electrically-controlled gas-fired equipment, such as cooking ranges and clothes dryers.

d. For Great Britain and Northern Ireland there is an arrangement with the British Standards Institute. The latter maintains a staff of engineers for approvals work.

e. For Western Europe there is a similar arrangement with the Netherlands testing laboratories at Arnhem, known as "KEMA".

In addition to these laboratories there are branch offices as follows:

a. A representative in London for the British Isles and Western Europe.

b. A representative in Vancouver for the Canadian and United States Pacific Coast.

c. A representative and an engineering staff in Montreal to handle the reinspection of approved simple products in Quebec, as well as to do minor approvals engineering.

Departments

There are three departments of the Laboratories, under a manager reporting to the administrative board. The latter appointees consist of five members of the C.S.A. board of directors. The board is responsible to the directors of C.S.A.

The departments are:

a. An engineering department conducts engineering correspondence and technical interviews on the samples or products submitted. It completes approvals reports. About 50 per cent of the personnel are engaged in this work.

b. A reinspection department conducts one or more inspections of approved products at the manufacturer's premises, or sends samples to the Laboratories, to ascertain if they comply with the report.

c. An administration department keeps cost, handles samples, purchases laboratory equipment, maintains building equipment and so forth.

Specifications

It is on the specifications of Part II of the C.E. Code that a great deal of the Laboratories' technical work is based. In addition to these specifications, requirements based on Laboratory experience and on other reputable standards are used. Requests for Part II specifications and for their revisions follow a procedure laid down in the C.E. Code, Part I. Requests may come from interested industries, from the laboratories, from electrical inspectors, etc.

There are about 100 such specifications of which 90 per cent have been published. The remainder are being compiled. Requests for specifications are sent to a main specification group, the Part II Committee of the C.E. Code. Its membership is 12 plus a chairman and a secretary. Its members are: six from the Canadian Electrical Manufacturers' Association, two from among the provincial inspectors, one from the Laboratories, one from the fire underwriters, one from the Canadian Electrical Association and one from N.R.C. The chairman is drawn from the Laboratories and the secretary from the Ottawa office. From the American Standards Association there is one nonvoting member. B.S.I. has been invited to join on the same basis. This committee steers and co-ordinates the subcommittees.

The material for a specification is usually compiled by the laboratories and by conference with manufacturers and other interested parties. The specification is completed, and accepted or rejected by the appropriate Part II Committee. It is then sent to the Part I Committee for letter ballot. Here inspection and broader interests are involved.

If this committee of diversified interests passes a specification, it goes to the C.S.A. Technical Council. When the Council's electrical group passes the specification, it is published by C.S.A.

However, the Part I Committee has the right to veto any Part II specification; it has the legal power to prohibit the sale, installation, etc., of hazardous electric equipment. The Part I Committee has charge of the Part II Committee. The former also compiles the C.E. Code, Part I. This is enforced with minor deviations in all provinces except New Brunswick, Nova Scotia and Newfoundland. The C.E. Code, Part I, covers installation and Part II details the design and construction of electric equipment intended for installation.

The Laboratories are also interested in the C.E. Code, Part IV, (Radio); in Part V, covering the installation of electric equipment in coal and metal-working mines; and Part VI, covering the design and construction of such equipment.

Processing Approvals

In processing approvals a preliminary fee is quoted and representative samples are examined and

tested by the engineering department. This is done mostly in the Laboratories, but often at the manufacturer's plant.

If the equipment is acceptable to the engineering department—about 90 per cent of it has to be changed in some degree—an approvals report is prepared which is sent to an approvals council. Its membership consists of the inspectors and the N.R.C. and fire underwriters' representatives of the Part I Committee. If a two-third favourable vote is received the equipment is approved.

In general tests are as follows:—

a. The rating is checked; it shall not exceed a permissible plus tolerance.

b. The normal operating temperatures of the various components are determined.

c. The abnormal operating temperatures are ascertained. This is usually a fire hazard check test. In connection with these tests, safety features provided to protect against abnormal temperatures and other conditions are also checked.

d. Leakage currents are measured in some cases.

e. The insulation resistance and dielectric strength under various temperatures and conditions are measured.

f. Miscellaneous tests, e.g., overload, endurance, calibration, physical, chemical, etc. are made, depending on the kind of equipment.

A careful examination is made for compliance with C.S.A.'s construction requirements. Much equipment, such as switchboards, industrial control apparatus, elevator controls, etc., is so complicated that an engineering appraisal, rather than an attempt at piece-meal approach is made. Sometimes special acceptance for job lots or for a one-time design is granted. Approvals to date exceed 13,000, some of them used over hundreds of times in 35 years. This work involves 40,000 engineering files, most of which are microfilmed.

To ensure that the manufacturer keeps his product up to the approved standard, a follow-up reinspection at his factory is carried out. In 1953 there were 8,700 such inspections in America, the British Isles and Western Europe, against 4,300 reinspection agreements.

Number, Monogram or Label

The Toronto laboratories at present handle about 300 applications per month, so there are always about 2,000 applications in process. The listings of approved equipment are kept in a classified card system, reflected in a "blue book" having well over 800 pages. The equipment is classified, and listed alphabetically under the client's name. This book is kept up to date by supplements and is re-issued biennially.

A manifest of approval is required on each item, if practicable. This may have one of three forms—a number, the C.S.A. monogram or a label. Labels are sold for a restricted variety of products. In 1953, 20,000,000 were sold.

The reader may have the impression that the Laboratories are mainly a testing organization. This is not the case. Testing is a means to an end and accounts for only about 10 per cent of any approvals job. The remaining time is taken up in examining, in interviewing clients and in the preparation of reports. In addition, a great deal of time is required for compiling specifications and technical requirements, and in conducting technical correspondence with manufacturers and with the provincial electrical inspectors across Canada.

A description of testing methods used for some common appliances may be of some interest.

Testing Methods

Snap Switches

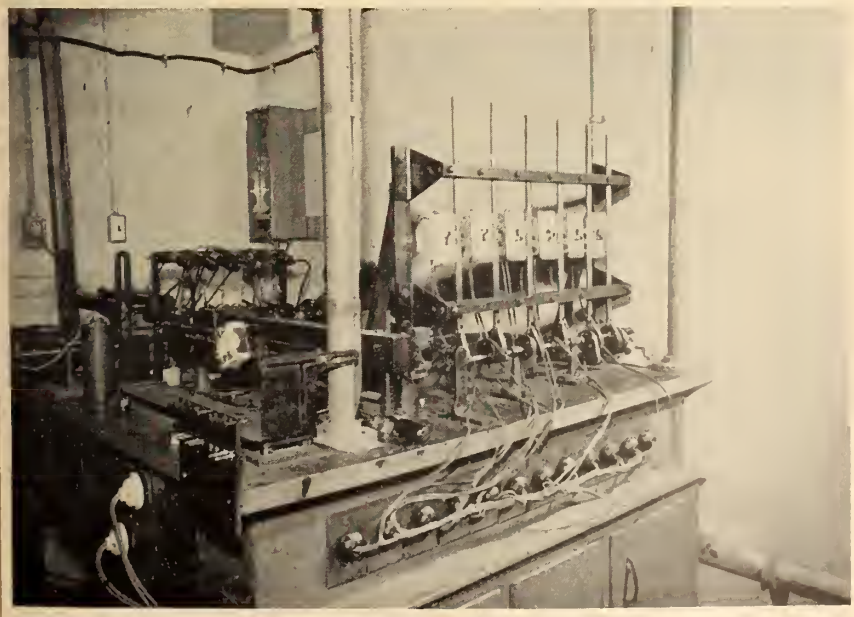
Snap switches used undergo rigorous endurance and overload tests. They are subjected to 6,000 consecutive operations under their electrical rating; the load is of non-inductive resistance. To accomplish this quickly a machine to operate six samples simultaneously is used.

This is followed by overload tests of 125 or 150 per cent rated current, made and broken 50 consecutive times. During the test the exposed non-current-carrying metal parts are grounded. There must be no mechanical nor electrical failure nor manifestation of fire. Insulation tests and other tests, depending on the type of switch, are made to ensure reasonably safe construction.

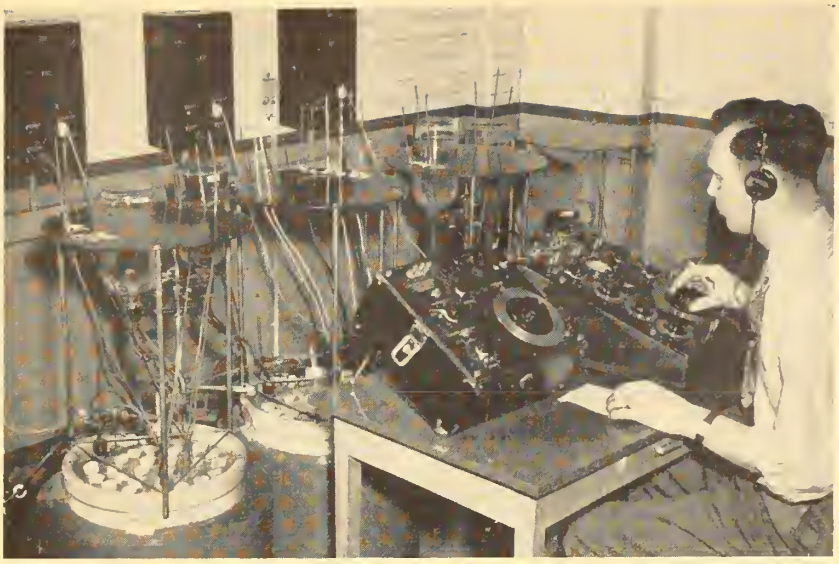
Heating Pads

Among the various tests on heating pads is one for investigating their inherent ability to resist moisture. If the latter penetrates through the coverings and insulation on the resistance wire, a fire can result. Some sleeping drunks may urinate on pads and consequently may burn themselves and this could also happen to those who perspire heavily.

The test against the penetration of moisture is made as follows. The pad is placed in a horizontal holder of dimensions to cause the edges of the pad to fold upward, thus forming in effect, a shallow pan. One pint of weak saline solution is poured on the pad and is allowed to soak in for 15 minutes. The pad is operated at 120 v. a-c. on high heat for the first five minutes of the 15-minute soaking period and is then disconnected. At the end of the 15-minute soaking period, the pad is removed from the pan and a dielectric-strength test of 400 v. a-c. is applied between two metal foil sheets placed one on each side of the pad and in intimate contact with it. To ensure



Endurance test for Snap Switches.



Testing moisture-resisting properties of insulatiod on type RW and RT wires.

this a compressive load of 25 p.s.i. is applied to the pad. This test is followed immediately by an insulation resistance test using again the metal foil sheets. Using a 500 v. megger, the insulation resistance shall not be less than 15,000 ohms.

Iron Plug

One of the tests on the familiar pressing iron plug is an impact test. The testing machine picks up one end of the cord to which the plug is attached as it hangs in a vertical position and lifts the cord to a horizontal position. Since the cord is fastened at its opposite end, the cord swings through an arc of 90°. The plug is released, striking a vertical hard maple board. One thousand and more of such cycles are made. There shall be no fracturing of the mould parts of the plug. In addition, samples are subjected to compressive loads of 125 and 150 lb. No fracture shall occur. Elevated temperature tests at 200°C. for 72 hours are also applied.

Fuses

To study the watt losses of fuses, which are miniature air heaters, thermal tests are applied. Temperature limitations are specified for various parts of a fuse when conducting 110 per cent of its rated current. In addition, the inverse time-current curves of fuses are studied by specifying maximum blowing times at 135 and 200 per cent of rated current. The heat losses of cartridge fuses have a great effect on the ratings of enclosed switches.

For short circuit tests the available current is 10,000 amperes d-c. at rated voltage. The fuse must clear the circuit without any manifestation of fire. To determine the latter, surgical cotton is placed on top of and around the fuse, which is screwed into its receptacle as in actual practice. There must be no ignition of the cotton, thus demonstrating proper venting of the flaming gas to the outside air at temperatures below ignition.

Dielectric Strength

As a rule all electrical equipment must pass dielectric strength tests, the values of which are determined by its electrical rating and application. Usually, such insulation tests are required by C.S.A. on all products before they leave the factory.

Air Heaters

If portable air-heaters were not checked for incipient fire hazard, the incidence of houses catching fire from this source would not be as low as it is. With the heater connected to 110 per cent rated voltage, or at least 120 v., a test is made to see if drapes, wainscotting, wallpaper, carpets and floors will ignite. Here is one: the reflected heat rays are directed against a vertical soft wood wall on which have been fastened two layers of cheesecloth of specified gauge and weight. An approved air-heater may char, but will not ignite, the cloth or wood.

Clothes Washers

Have you ever thought of the reliability of the operation of the safety release on the wringer of your washing machine? We have all heard of women's arms being pulled into wringers. If a washer has a wringer of the roller type, the peripheral speed of the rolls shall not be greater than 275 inches per min. The roll pressure shall not be greater than 800 pounds with no load between the rolls, and the wringer shall be provided with a safety release plainly marked to indicate its function. The release shall be operable from either side of the wringer and a steadily applied force of not over 20 pounds shall be sufficient to operate the relcase. No parts of the wringer shall be

Temperature and rating tests on cartridge enclosed fuses.

thrown violently out of the assembly and the release of compression of the rolls shall be immediate and positive, with a 2-inch separation between the rolls throughout their length.

To ensure this a ¾-in. board is passed between the rolls after the pressure has been properly adjusted by hand, and the release is operated.

Safety Glass

Do you know that there is a safety glass screen on your TV set, protecting you from implosion of the cathode ray picture tube? Without such protection, many people would be badly cut, if not killed, in the event of the collapse of the picture tube. The Laboratories' problem is to determine if the TV cabinet, its safety screen and the screen fastening are adequate to contain the tremendous forces resulting from breaking of the picture tube. To assess the strength of the safety glass (armour plate glass), a steel sphere weighing 1.18 pounds is swung through the arc of a circle from a point 51 inches above the centre of the face of the picture tube to strike the safety screen. There shall be no openings developed in the safety screen, but it may be cracked.

Up to 21-inch picture tubes this test is standard; above 21-inches an implosion test is required.

Heater Cords

Heater cords are subjected to considerable flexing, the worst with the electric iron. To ensure reasonable strength of stranded conductors and the design of the cord's insulation, lay of twist, etc., a flexing test machine is used. The cords, with a specified weight placed in the centre of the test length, are fastened to a stationary upright on one end and to a movable upright on the other. They are fastened so that they will twist and untwist, as the movable upright travels back and forth. They must withstand 3,000 cycles of twisting and untwisting without electrical breakdown. Some better grade cords are required to withstand 10,000 cycles.

Thermoplastic Wire

Thermoplastic wire may have its insulation fractured if the wire is installed at low temperature or thrown around in coils, e.g. thrown onto platforms from trains. In Russia and in Poland some tanks were immobilized by the concussion of bursting shells; sometimes the ignition was grounded due to failure of the thermoplastic-insulated wire.

A testing refrigerator is used to determine the flexibility of wires and cables at low temperatures. It can be operated as low as —67°F. There is a 3-pound weight which is let fall on wires or cables placed within the cooling chamber. This test simulates a hammer blow on a cable at low temperatures.

Machine for testing reflexing qualities of heater cords.

The effects of high temperatures on thermoplastic compounds are also important. These are brittle at low temperatures and soft at high temperatures. Weights are placed on a test specimen after a preheating period in a special oven, normally one hour. The decrease in the thickness of the insulation is recorded as a percentage. The weight used is dependent on the weight and thickness of the compound being tested.

Rubber and thermoplastic compounds absorb moisture although commonly thought of as waterproof. To test for moisture absorption specimens are immersed in tanks of water which are maintained at a specific temperature for periods up to 24 weeks, depending upon the grade of compound under test. A potential of 600 volts is applied to the conductors throughout the test period. Leakage tests on the insulation are also conducted each week.

Oil Burners

An important section of the Laboratories' engineering department is the approval of oil-burners. Furnace conversion-type burners are tested and industrial types of burners can be tested to capacities up to fuel rates of 25 gallons per hour. Oil burners and space heaters and combinations of the latter with gas-electric or all electric ranges are also tested for approval. Firing tests may require up to 250 hours. In addition, there is an investigation involving the function of safety controls, operating temperatures and so forth. This is followed by a critical examination of test results and of the design of the unit as regards safety.

Explosion-proof Equipment

In explosion-proof enclosures intended for use in hazardous locations, in addition to proper widths and fits of joints and bearings, a specified strength safety factor is required, according to the kind of material. Calculations for strength are often involved and sometimes hydrostatic pressure tests are made. The pressure is built up slowly to the required value, based on the maximum pressure developed in explosion tests.

Conclusion

The relatively small population of Canada, coupled with the fairly strict enforcement of provincial and municipal legislation, has given this country the reputation of being the toughest place in the world with respect to the sale, installation and use of electric equipment.

The safety of the public in the use of such equipment is the mutual problem of the manufacturer and of the inspector, with the Laboratories acting as an instrument of the latter. The Laboratories are conscious of their function; in dealings with the manufacturer and inspector they have endeavoured to interpret code requirements fairly and consistently. √

Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

THE PANAMA CANAL PROBLEM

Civil Engineering, v. 24, n. 7, July, 1954, pp. 58-59.

The necessity for increased capacity and operational improvement of the Panama Canal—a much-neglected waterway, now approaching obsolescence—has been long recognized. The traffic volume is the highest since 1914. With the saturation point approaching, it is essential to provide, without further delay, the additional transit capacity and operational improvements required to meet future needs.

TWO MAJOR PROPOSALS

The two major proposals for increased facilities are:

1. Improvement of the existing canal by completing the authorized Third Locks Project, adapted to include the features of the well-conceived Terminal Lake Plan. A total of $75,000,000 was expended on this project, mainly on lock-site excavations at Gatun and Miraflores, before work on it was suspended. The Terminal Lake Plan provides for removing all lock structures from Pedro Miguel and for regrouping of all Pacific locks at or near Miraflores, thus enabling uninterrupted navigation at the Gatun Lake level between the Atlantic and Pacific locks, with a greatly needed terminal lake anchorage at the Pacific end of the canal. As thus improved, the modified Third Locks Project can be completed at relatively low cost—estimated at under $600,000,000. The soundness of this proposal has been established by 40 years of satisfactory operation of a similar arrangement at Gatun.

2. Construction of a practically new Panama Canal known as the Sea-Level Project, initially estimated in 1947 to cost $2,500,000,000, and which would be of less operational value than the existing canal it was designed to replace, but which, under present conditions, would likely cost several times that amount.

SUPPORT FOR FIRST PROPOSAL

The Terminal Lake-Third Locks Project has been strongly urged as the proper form of modernization by experienced civilian engineers who took part in the construction of the present canal. They have spoken from personal knowledge of the original construction. Their views are shared by many independent engineers and navigators who have studied the subject. All these insist that the present lake-lock type should be preserved as supplying the best canal for the transit of vessels which it is economically feasible to construct. They, together with many of the leading atomic warfare authorities, stress the points that the defense of the canal is an all-inclusive federal responsibility which must be met by active military and naval measures; that passive protective features embodied in construction design are inadequate; and that the proper basis for planning canal improvements are capacity and navigational efficiency. Moreover it must be borne in mind that the effective destructive power of the atomic bomb has been tremendously increased since the formal recommendation for a sea-level canal. Any canal, whatsoever the type, can be destroyed by atomic bombing, if permitted to strike.

THE MEETING OF ROLLS AND ROYCE

Harold Nockolds, *The Vickers Magazine*, Summer, 1954, pp. 4-8.

When the Hon. Charles Stewart Rolls and Frederick Henry Royce were introduced to each other in a Manchester hotel in 1904, neither they nor the man responsible for bringing them together could possibly have realised what that meeting would lead to. It had been arranged by Henry Edmunds, a director of Royce, Limited, electrical and mechanical engineers, to see whether Rolls, who was a successful automobile agent in London selling French cars, could be persuaded to undertake the sale of the little 10 h.p. two-cylinder car which Royce had designed and produced experimentally in the company's workshops at Manchester. The luncheon, followed by a run in one of the three experimental cars (which had previously captivated Rolls by its refined performance) marked the birth of a reputation for engineering quality which is unlikely to be surpassed in any sphere of industry, and which had consequences far beyond the production of motor-cars. Indeed, the manufacture of Rolls-Royce and Bentley (made in the Rolls-Royce factory since 1931) today forms only a small part of the Company's activity. The aero-engine now engages the greater part of Rolls-Royce resources, with factories also in Canada and Australia, and the tale of expansion is being continued with a series of petrol and diesel engines for vehicles of all kinds for industrial use.

THE CHARACTERS OF THE TWO MEN

This impressive growth of Rolls-Royce can definitely be traced to the characters of the two men whose names have added a new word, denoting supreme quality, to the English language. Royce, the largely self-trained engineer who started life as a newspaper boy in London, had come to motor-cars by way of designing and making a variety of things from an electric door-bell set to dynamos and cranes. His was no one-track mind; it was quite natural that he should quickly master the problems of aero-engine design when the First World War put an end to car manufacture for the time being. He would as readily have tackled the problems of gas-turbine design had he lived. Rolls, too, was a man of restless and enquiring temperament, always seeking new fields in which to use his talents. Third son of the first Baron Llangattock, this handsome, wealthy young man had enthusiastically tried cycle-racing, motor-racing and

ballooning, making a name for himself in each. As soon as the making and selling of Rolls-Royce cars were firmly established, he became absorbed in flying — after a flight with Wilbur Wright at Le Mans in 1908. He went on to make the first there-and-back crossing of the English Channel. Although he died in an aeroplane accident before the company was called upon to make aero-engines, his deep interest in flying was surely a portent of things to come.

HISTORIC AGREEMENT

The meeting in Manchester resulted in an agreement signed on 23rd December, 1904, for Royce, Limited, to supply C. S. Rolls and Company with four different types of chassis, all of which would bear the name Rolls-Royce. It was not until two years later, when C. S. Rolls and Company had given up foreign cars and had concentrated on selling Rolls-Royces, that the Rolls-Royce Company was formed and later the Derby factory opened. During that time the policy for the manufacture and selling of the cars was shaped by Rolls's partner, Claude Johnson; that policy, in essence, has been followed to this day and is the underlying secret of the Rolls-Royce tradition. Johnson's great achievement was to capitalize that striving for perfection which dominated the lives of both Rolls and Royce — the one in terms of performance and action, and the other in terms of design and manufacture.

DEVELOPMENT OF THE PARTNERSHIP

The development of the partnership can be told briefly. In the six years after that first meeting the Rolls-Royce reputation was built up by a series of successful cars, culminating in the famous Silver Ghost. Every opportunity was taken to demonstrate the quality of the cars in public, the greatest success being Rolls's victory in the Isle of Man T.T. race at the wheel of a 20 h.p. model. Then the company suffered two heavy blows which, but for the guiding hand of Claude Johnson, might have proved fatal. First Rolls was killed at a flying meeting at Bournemouth in 1910, and in the following year Royce himself succumbed to the cumulative effects of years of overwork and was forced thenceforth to spend winters in the South of France and summers in Southern England. Although it was not realized at the time, he was never to return to the factory. Instead, he gathered around him a personal staff of designers and draughtsmen under Mr. A. G. Elliott (who today is joint managing director of the Company) and exercised his profound influence on the design and development of Rolls-Royce cars and aero-engines by remote control.

The outbreak of war in 1914 completely disrupted the work at Derby. From cars the company turned to aero-engines, producing the famous Eagle, followed by the Hawk, the Falcon, and the Condor. After the war, when car production was resumed, there was no question of giving up aero-engines, although there was little opportunity for expansion in the interval between the end of the war and the beginning of commercial aviation. In that period, however, the Rolls-Royce Eagle engine achieved fame as the power unit of the two-engined Vickers Vimy bomber which made the first direct flight across the North Atlantic in 16 hours, 12 minutes.

THE DEVELOPMENT OF A PUMP-FED LIQUID-FUEL AIRCRAFT ROCKET

Flight, v. 66, n. 2376, Aug. 6, 1954, pp. 176-180

The term "rocket" is applicable to any device which produces a propulsive jet by the combustion or dissociation of one or more fuels, without the combination of oxygen from the atmosphere. Although fundamentally the simplest form of propulsion unit imaginable the rocket can assume any of a great variety of forms.

Ignoring the take-off-assistance application, for which a short-duration, expendable unit is adequate, rockets can be applied to aircraft either as boosters for limited periods when extra power is needed or else they can be the primary propulsion unit, i.e., the aircraft can be powered solely by the rocket motor. The characteristics of all rockets are such that, unlike all other forms of aero engine, they provide thrust that does not decrease with increasing altitude; in fact, it actually increases. Consequently, a rocket can provide an extremely effective booster unit where rate of climb and high-altitude performance are of paramount importance— as they are on all types of fighter aircraft. Rocket-thrust can provide valuable assistance, also, in rapidly accelerating a supersonic aircraft through the speed of sound.

FIRST DEVELOPMENTS IN U.K.

It was in 1946 that the U.K. Ministry of Supply asked Armstrong Siddeley Motors Ltd., of Coventry, to develop a liquid-fuel rocket motor with a thrust of 2,000 lb. for use as a booster unit for fighters. The company began rocket work at the end of that year, with Mr. S. Allen, the experimental engineer in charge of all combustion research, at the head of the new team. His first two recruits were Mr. D. Hurden and Mr. H. L. G. Sunley.

All existing information of practical value was gathered together, including numerous reports and selected items of research equipment, from Germany.

Gradually, the form of the new rocket began to crystallize; there was, however, nowhere that these ideas could be put to the test. The development of small combustion chambers was considered as a first step, but there were then virtually no data available about scale effect; so, on balance, it appeared preferable to start off with a full-size chamber and so meet all the problems at the correct size first time. The company's subsequent experience has justified this decision.

TWO GREAT UNKNOWNS

The two great unknowns were how the fuels would be injected, and how they would be ignited.

Preliminary calculations suggested that the nozzle would have to pass 60 gal./min. (if both propellants were injected together) with a pressure-drop not exceeding 100 lb. per sq. in. — say, from 400 down to 300 lb. per sq. in. After experiments with one pattern of two-liquid injector, a different design was developed and tested with supplies of fresh and salt water fed simultaneously by a pair of trailer pumps. The spray was caught in a honeycomb can, the amount of fluid in each cell providing an indication of the distribution and a hydrometer being used to determine the specific gravity in each cell, and hence the degree of mixing.

Investigations of ignition problems was another undertaking which could proceed without any special facilities. By the time this stage was reached, in 1947, the correct burner had been developed, and one was screwed into a "simulated"

chamber consisting of a pair of metal drums, one inside the other, open at one end and with a water-cooling flow through the double wall.

NEED FOR A TEST HOUSE

The erection of a proper test house was at this stage essential to further progress. The site was chosen at the company's airfield at Ansty, and the work was finished during 1947. During that year the rocket staff moved out of the main Parkside works and all rocket development has since been concentrated at Ansty.

One of the most spectacular results of the many snags encountered occurred soon after pump-running was started. The first liquid-oxygen pump was of all-aluminium construction, to save weight; it was put on an electric-motor drive and the liquid oxygen was circulated through flowmeters. After a short time, the whole pump exploded with a brilliant white flash and a dense cloud of vapour. Subsequently it was established that a bearing had failed, allowing the shaft to move axially and causing the centrifugal impeller to rub in its casing. The combination of liquid oxygen, aluminium powder and friction heat did the rest. This was in January, 1949.

THE FIRST REAL RUN

The next milestone was the first genuine run of the rocket with the fuel pump, the date being February 23rd, 1949. The nucleus of the eventual Snarler aircraft rocket had then been developed, and most of the remaining work centred on the control system.

The Snarler was first started and run on its complete control system on March 29th, 1950. At this date it was, therefore, almost a complete power unit, and the next step was to get it into the air. First, however, the new rocket motor had to undergo a Ministry of Supply special category test designed to ensure that the unit had sufficient life and reliability, and this took the form of a large number of firings, on some of which the tanks were allowed to run dry. The test actually run included 24 firings and 74 pump-clutch engagements, the total firing time being 71 minutes at full thrust and 15½ minutes at one-third thrust. This was successfully completed in May 1950.

AN AIRCRAFT SELECTED

The aircraft selected for testing the Snarler was the Hawker P.1040 prototype (forerunner of the Sea Hawk), serialled VP 401. During the summer of 1950 the Hawker company installed a flight-cleared Snarler in the extreme tail, this process being facilitated by the fact that the Rolls-Royce Nene turbojet had a bifurcated jet-pipe exhausting at each trailing-edge wing root. Close co-operation was maintained with Armstrong Siddeley throughout, both companies being members of the Hawker Siddeley Group.

With the Snarler installed, the aircraft became the Hawker P.1072, and it began its trials on November 20th, 1950, in the hands of the late Trevor Wade, then Hawkers' chief test pilot. Based at the Armstrong Siddeley airfield at Bitteswell, it made six flights, each with about two to two-and-a-half minutes' burning time. The Mach limitation of the airframe was such that the Snarler could be fired only during a steep climb—and, as it was unpressurized, flying was restricted to altitudes below about 30,000 ft. The present Hawker chief test pilot, Neville Duke, did some of this work.

THE FIRST FLIGHT

The initial flight of the P.1072 was the first ascent by any pump-fed liquid-oxygen rocket in a piloted aircraft. The day was dull and overcast, and the P.1072 could be heard only distantly through dense cloud. Those on Bitteswell airfield were quite ignorant of whether Wade had fired the rocket or not, and were still waiting expectantly when the fighter appeared low down at full power. Passing overhead, Wade did a smart roll; all had gone well. Incidentally, the Snarler is fully aerobatic.

On the strength of its performance, Armstrong Siddeley were given a great deal of other rocket work to do, and this will make good reading when details can be published.

The Rocket Division have an expansion programme planned up to the end of 1956, and some indication of its scope is given by the fact that the size of the staff is scheduled to be doubled by the end of this year. Armstrong Siddeley have laid the foundations with a small, enthusiastic team—the future rests squarely on the output from British technical colleges and universities.

PROCESSING INGENUITY—THE ADDITIONAL INGREDIENT IN CANADIAN CAR PRODUCTION

S.A.E. Journal, v. 62, n. 8, August, 1954, pp. 78-81.

What Canadian automotive plants lack in production volume they make up in many cases with unusual manufacturing ideas. Ingenious tooling and equipment permit Canadian manufacturers to make many automotive parts at costs comparable with, or less than those, of U.S.-made parts.

Canadian manufacturing developments stem from these two circumstances:

1. Lack of space and equipment force unorthodox approaches to production problems.
2. Our tool designers, supervisors, and shop people come forth with unusually creative ideas.

In the first category we have quite a number of developments prompted by the confinement of increasing production volumes in static spaces.

One of these is a Bullard type automatic radiator core soldering machine. It needs only one operator to stack the core sections into a dipping frame, and a fraction of an operator to remove the completely soldered core. All operations are automatic.

An item falling into the same category and concerning the same part is an electrostatic paint spray booth. It occupies only a few square feet of space, and uses only one-half of the labour and only one-third of the paint used by conventional spraying methods.

IDEAS FROM PROCESSING STAFF

Ideas from our processing men have sometimes resulted in new and unique Canadian developments.

An important original development was the introduction of taping wiring harnesses in our first postwar automobile. This was done against the advice of our colleagues to the South, who maintained that braiding was simple and braiding machines were cheap. In fact, they could be bought from junk dealers for $15 to $20 apiece.

But we persisted, and ironed out all the problems arising from such a radical departure. A few years later taping was generally adopted, and has now developed into a fine art.

A unique method for covering wind-hose is used in our cutting and sewing department. The sewing machine is fed by an airmotor driven drum, which has an automatic tension adjustment and a micro-switch which stops the machine if the

thread breaks. A single operator can comfortably handle four machines.

SUGGESTIONS FROM OTHER EMPLOYEES

An idea from one of our employees —to replace the clips soldered on the inside of headlamp rims with easily attachable formed springs, to hold the rubber seal—was quite a departure from the old method.

A major development by our welding engineer and his associates has started to change the thinking across the line. It consists of a rectangular unit, in the shape of a large box, and can weld from eight to sixteen spots in sequence. It is built completely from standard capital equipment. The surface mounts two sets of heads, which can easily be changed to accommodate changed conditions.

We are using three of these units now to weld the underbody cross-bar assembly. Our labor cost has been cut in half, and the actual cost of the complete equipment was less than 12% of that quoted by a maker of specialized welding equipment. If the design of the cross-bar changes next year, our specialized machine, if used, would become obsolete.

On our simple and standardized version we just disconnect a few hoses and cables, lift the whole top, and line it up to suit the new part.

Another unit basically the same as the above three, but also adapted to deliver the part for the next operation, is used for welding cams to sash-channels. There are 14 different lengths of sash-channels; but to switch the machine from the shortest to the longest requires only 3½ sec.! An added feature is a safety device which keeps the fingers of the operator away from the electrodes. We know that our machine does a hundred pieces per hour more than the best machine in use elsewhere.

AN ACCIDENTAL DISCOVERY

A recently developed detachable tip for welding electrodes, of which a quantity was accidentally made from No. 1 metal, instead of the expensive No. 2, was found to be every bit as good. Whether our new method of forging the final shape of the tip added new properties to the otherwise quite unsuitable material has as yet not been determined. But a price difference of 20% in the material price is quite a sum, when you use between 2,000 and 3,000 tips per month, and that particular copper costs over a dollar per pound.

You might assume that everybody knows everything about stampings. And whether the metal is blanked, drawn or trimmed, all the dimensions for the necessary dies can pretty well be taken from a handbook of tables and formulas. But right now, while tooling for our '54 models, we found ways to make nice savings on some parts. On a grille bar, which is as long as the car is wide, we were able to save over a square foot of steel and eliminate some of the draw wrinkles at the same time.

A headlamp ring, which, when drawn from stainless steel needs two draws and a re-strike. When made of brass—as we do it, it needs only one draw, and saves about 6c. per lb. of material besides.

WE STILL FACE DIFFICULTIES

We occasionally succeed in attaching a "Made in Canada" label to some difficult part. But there are many cases where, no matter how hard and how often we try, we don't seem to be able to make the grade.

For instance, take door hinges. Our yearly needs are about three-quarters of a million pieces. No Canadian supplier to date has been able to afford the essential special equipment, which might cost nearly as much per hinge as we pay for a duty-free imported hinge now.

Other items are sill or scuff plates. All the attempts made to date to find somebody, not only with the ingenuity but also with a lot of "guts", to etch or stamp the required pattern on these plates, have failed. That's because a volume of 300,000 to 400,000 pieces, is still not enough to pay for the tooling in a single year.

I know that these scuff-plates have not changed in years. And nobody, outside of the Styling Engineer, has ever paid much attention to them. But if somebody told us today that we could make the plates the same, or practically the same, for two or three years, I am convinced that we could start tooling up for them tomorrow.

Door pad binding strips and trim panel mouldings cannot be made in Canada because no one has the costly equipment needed to weld nails on their backs at certain intervals.

Forging dies are the oldest and simplest form of dies. And a drop hammer today looks exactly like the first one I saw forty years ago. Yet Canadian shops find it impossible to tool up for a forging, like a steering knuckle support, and make it pay, unless someone perhaps could find a die-sinker willing to work for 75c. per hour.

WHY NOT AUTOMATIC HANDLING?

Automatic handling of stampings can easily be accomplished in the U.S. because the equipment can be used year after year with only slight modifications.

Mechanical feeders, loaders and transfers are permanently attached to the presses and other tools doing the same type of part year after year. In Canada we could never think of automatic handling. That's because each press makes several widely differing parts. On medium and small items the dies are changed almost daily. Between these stampings the similarity of the die-shoes and the tonnage are the only comparable factors.

We look across to Flint and see that the dies are set up in November and then left there until October of the following year. That's why we really consider ourselves lucky that we are at all able to make hoods and fenders for our more popular models in Canada, where we have to change all the dies from left to right hand components and vice versa, every week-end.

The ensuing storing and multiple handling, combined with the repair of unavoidable dents and scratches, are problems which sometimes bring even the most patient planner to the end of his resources.

The processing ingenuity required of the tool engineer and the designer has, in our Canadian mode of manufacturing, to be extended and go all the way down to the operator.

IMPORTANCE OF PRODUCTION VOLUME

The American, with a production volume 15 times or 20 times greater, can afford to provide tooling and equipment which is fool-proof in every sense of the word. No matter how indifferent the operator is, he can only produce perfect parts.

We have tools which are sometimes crude and not very far away from the basic form in which they are used by a tradesman. So we must rely on the wholehearted contribution of a percentage of craftsmanship, skill, and ingenuity from our operator.

The vast gap which exists between our respective production volumes can perhaps be illustrated by an inquiry which one of the head buyers from Chevrolet directed to our own purchasing agent.

He said: "Say, Erie, I've got to buy parts for a special Right Drive model. We need only 5,000 of them. How do you buy 5,000 pieces of anything? I've never bought so little in all my life!"

Annual General a

Royal York Hot

PROGRAM*

The Design of Compressed Beams:
Dr. D. T. Wright, Dept. of Civil Engineering, Queens University.

The Jetaire Circuit Breaker:
J. P. Skillen and D. H. McKeough, Canadian Westinghouse Company Limited.

Recent Developments in the Design and Manufacture of Hydraulic Turbines in Canada:
R. S. Sproule, M.E.I.C., Hydraulic Division, Dominion Engineering Works.

Niagara River Remedial Works:
Dr. Otto Holden, M.E.I.C., Chief Engineer, Hydro-Electric Power Commission of Ontario.

*Subject to change.

- Thirty-one interesting and instructive papers.
- Two panel discussions.
- Special ladies' program.
- Organized sightseeing visits.
- Advance registration forms will be mailed to members early in April.

Power Transmission by Underground Cables:
Dr. L. G. Brazier, Research Department, British Insulated Callender's Cables Ltd., London, England.

From Firesticks to Jet Engines:
Professor J. M. F. Vickers, Department of Mechanical Engineering, University of Toronto.

Silicones in Industry:
D. C. R. Miller, M.E.I.C., General Manager, Dow Corning Silicones Limited.

Fatigue Life of Steel I-Beams at Normal and Sub-Zero Temperatures:
Dr. G. Welter and Prof. J. P. J. Dubuc, Jr.E.I.C., Ecole Polytechnique.

Electronic Equipment at Toronto Stock Exchange:
E. L. Schmidt, Vice-President, The Teleregister Corp., Stamford, Conn. A visit will be made to the exchange, where a short explanatory paper will be followed by a demonstration of the equipment in action.

Development and Operating Experience With Gas Turbines:
Paul J. Lusser, M.E.I.C., Manager, Brown Boveri Canada Limited, Calgary.

Precipitation and Related Facts re Hurricane Hazel:
Mr. Ronald Clinch, of H. G. Acres & Company.

Economic Advantages of Hydraulic Models:
J. B. Bryce, M.E.I.C., Hydraulic Engineer, Hydro-Electric Power Commission of Ontario.

Automatic Electrode Boilers for Iron Ore Company of Canada:
M. Eaton, M.E.I.C., Chief Electrical Engineer, Shawinigan Chemicals Limited.

Possibilities of Complete Solar Heating in Canadian Houses:
Professor F. C. Hooper, Department of Mechanical Engineering, University of Toronto.

The Intake for Sir Adam Beck Generating Station No. 2:
O. E. Johnston, M.E.I.C., and D. G. Harkness, Engineers, Hydro-Electric Power Commission of Ontario.

Electrical Equipment in Large Transport Aircraft:
Clayton Glenn, Engineering Department, Trans-Canada Airlines.

rofessional Meeting

oronto, May 11, 12, 13, 1955

Canada's Oil and Gas Producing Industry:
G. M. Furnival, M.E.I.C., Vice-President, The California Standard Company, Calgary.

Tomorrow's Educational Crisis:
Dr. G. E. Hall, President, University of Western Ontario.

Power Development on the Niagara River:
Dr. R. L. Hearn, M.E.I.C., Chairman, Hydro-Electric Power Commission of Ontario.

Newer Types of Magnetic Amplifiers:
Dr. R. R. Jackson, Radio and Electrical Engineering Division, National Research Council.

The Part Helicopters are Taking in Engineering and Construction Development in Canada:
W. H. D. Hanchet, Jr.E.I.C., Canadian Pratt and Whitney Company.

Water Pollution — A National Problem:
Dr. A. E. Berry, M.E.I.C., Director, Sanitary Engineering Division, Ontario Department of Health.

Cutting Construction Costs With Modern Techniques:
W. Sefton, M.E.I.C., Chief Engineer, W. V. Zinn & Associates Limited.

Low Frequency Communications and Engineering:
R. S. Thain, Defence Research Board, Ottawa.

Ground Water Problems in South Western Ontario:
Professor W. M. Walkinshaw, M.E.I.C., Department of Civil Engineering, University of Toronto.

A Complete Sanitation Design for Metropolitan Toronto:
L. B. Allan, M.E.I.C., Commissioner of Works, Municipality of Metropolitan Toronto.

Double Doppler Radar Investigations of Aurora:
A. G. McNamara, Radio and Electrical Engineering Division, National Research Council.

Possibilities of Generating Atomic Electric Power at Competitive Rates:
Dr. W. B. Lewis, Vice-President (Research and Development), Atomic Energy of Canada Limited.

Problems Connected With Construction in the Far North:
Squadron Leader H. D. Monteith, Jr.E.I.C., R.C.A.F. Headquarters, Ottawa.

Photoelasticity for Design Improvement:
Professor I. W. Smith, Dept. of Mechanical Engineering, University of Toronto.

New Developments in the Canadian Mining Fields:
Prof. H. R. Rice, Dept. of Mining Engineering, University of Toronto.

Management — Another Panel Discussion:
Chairman, T. R. McLagan, M.E.I.C., President, Canada Steamship Lines.

The Traffic Problem in Canadian Cities — A Panel Discussion:
Chairman, W. E. P. Duncan, M.E.I.C., General Manager, Toronto Transit Commission.

REPORT OF COUNCIL

For the Year 1954

Together with Committee and Branch Reports

The annual report of any organization, business, professional or social, hardly qualifies as popular reading; and yet every organization has to have one. It is the official report of the officers to the stockholders on the year's operations. Like the others, the Engineering Institute has to have such a report. This is it. Council hopes that many members will read it, as in no other way can the organization of the Institute be known and appreciated.

1954 set up several new "highs". Each of these will be dealt with under separate headings, but perhaps some general observations as well will be appropriate. The year's activities through the branches, continued to expand. This in turn expands the work of Council and the committees and then filters down to increased activities at Headquarters, and in the field office at Toronto. The discussions on Confederation have increased the interest of engineers all over Canada in the organization. It is a hopeful sign.

Confederation

The proposals of J. Herbert Smith for an integrated set-up between the provincial professional associations and the Engineering Institute, have been well received from coast to coast. The special committee of the Institute have met four times (in Quebec, Toronto, Ottawa and Montreal) and have examined the possibilities of Confederation from every angle. A final report to Council is now being prepared and there is every indication that it will report that the committee believe Confederation to be a desirable development, and that Council should engage immediately in discussions with the committee of the Dominion Council of Professional Engineers. Both committees have kept closely in touch with each other, but on an informal basis. It can be reported that real progress has been made toward an ultimate proposal.

Education

A conference on engineering education was held jointly by the American Society of Mechanical Engineers and the Institute, at Clarkson College of Technology at Potsdam, N.Y., in October. Although related primarily to mechanical engineering, it developed into quite general considerations for all branches of the profession. A further conference on the same subject is being planned for 1955, but this time on the Canadian side.

ECPD

The Engineers' Council for Professional Development had an active year under the presidency of Dr. L. F. Grant, HON.M.E.I.C., a past-president and now field secretary of the Institute. A highlight of the year was a conference on education held in Zurich by EUSEC (Europe and United States Engineering Conference) at which ECPD was represented by a group of four delegates, headed by Dr. Grant. The 1955 annual meeting will be held in Toronto on October 13 and 14, 1955.

International Conferences

The third Conference of Commonwealth Engineering Institutions took place in London, England from May 24 to June 4. The president and general secretary were there to represent the Engineering Institute. Institutions in other parts of the Commonwealth represented by their presidents and secretaries were Australia, New Zealand, India, South Africa and the United Kingdom. As well an observer was there from Rhodesia and that country during the conference was admitted to membership. The next conference is to be held in 1958 in Australia.

Another international conference was held following the Commonwealth Conference, in Brussels, Belgium. To this were invited delegates from the three international conferences, namely, The Conference of Commonwealth Engineering Institutions, The European and United States Engineers Conference (EUSEC) and the Pan American Conference (UPADI). The Institute was represented by the general secretary.

Following the conference in Brussels all the Commonwealth delegates were the guests of the Institution of Mechanical Engineers during one of their international meetings held at Schaveninge, in the Netherlands.

UPADI

The Pan American Conference of Engineering Societies (The Union Pan American des Ingenieors) held its second conference in Sao Paulo from August 2 to 6. The Institute was represented by James A. Vance who is a member of the board of UPADI and Vern King, Woodstock, Ontario, and E. R. Jacobsen of Sao Paulo.

The next conference of UPADI will be in 1956 at Mexico City.

IAESTE

The Institute's interest in the work of The International Association for the Exchange of Students for Technical Experience continued throughout the year. The results in 1954 were much better than the previous year. Over fifty senior students from the United Kingdom and Europe came to Canada to work with a variety of industries. Twelve Canadians went abroad for similar experience. Those Canadians who reported to the Institute upon their return have indicated that they were very satisfied with their experience and that the arrangements made in the foreign countries for them were excellent.

At the annual meeting of IAESTE held in January last year the Institute was represented by the general secretary whose expenses were met by UNESCO. The 1955 meeting was held in Vienna in January but the Institute was not represented.

President's Visit to the Branches

For the first time a new pattern of presidential visits to the branches was tried. With fifty-four branches and branch sections, it has become impossible for the president to visit every one of them. For some years there has been talk of cutting down the visits but 1954 was the first year it was tried on a nation-wide basis.

Dr. Stephens will have visited twenty

of the branches during his term of office. Along with this he atteuded the Maritime Professional Meeting which was taken by the Nova Scotia branches as being a visit to all of them.

It is planned that the 1955 president will visit all or nearly all of the branches which Dr. Stephens did not include in his itinerary.

In many instances the president's visit to one branch was taken as a regional meeting, and officers and members from nearby branches came to that centre for the meeting. This was noticeable in such centres as Belleville, where members from Peterborough and Port Hope joined with members in Belleville. Perhaps the most successful of meetings of this kind was the one held for the branches at London, Windsor and Sarnia. Strangely enough this meeting was not held at any one of those centres but instead was at Chatham. This centre was chosen by the branches themselves as they could get to Chatham easier than they could get to any one of the other branches.

There is no doubt but that this method has been successful. This will bring a great relief to members of the Institute who subsequently are invited to the presidency.

Films

The Institute has taken a step in the purchase of films for use by the branches, that may well lead to an almost entirely new field of activity. In the past the Institute has secured a small number of unusual films but many of these are now out of date and the library of films is far from satisfactory.

Late in the year a special film, Leonardo da Vinci, was purchased at a price of four thousand dollars. The Life Members organization, through their committee, contributed one thousand dollars towards the purchase of four copies.

The film shows much of the work of this distinguished engineer and scientist. It is hoped that it can be shown by the branches to the public in order to develop within the public a better appreciation of the background of the engineering profession.

The film will be in circulation in 1955 and as there are four copies the needs of every branch can be met. It is hoped that it will be shown not only to branch members but to high school students, university students, libraries, art associations, service clubs and so on.

International Relations

Throughout the year the Institute had several opportunities for promoting good international relations As well as the meetings in London, Brussels, Schavenings and Sao Paulo, the Institute was represented at several of the annual meetings of sister societies in the United States.

Several members of the British institutions and others from other parts of Europe as well, visited headquarters with letters of introduction from their home societies. In every instance an endeavour was made to entertain them and to aid them as far as possible in accomplishing the objectives which brought them here.

Royal Honorary Member

One of the most colourful highlights of the year was the presentation of a certificate of honorary membership to His Royal Highness, the Duke of Edinburgh. The presentation was made at Rideau Hall in Ottawa with His Excellency, the Governor General, and several aides-de-camp present. The prosideut of the Institute, Dr. Stephens, made the presentation, supported by four vice-presidents, past-president and honorary member Dr. C. J. Mackenzie, and the general secretary. Since that time the Institute has been further honoured with the presentation of an excellent photograph of His Royal Highness which carries his personal autograph. This is now on the walls at Iustitute headquarters.

Highest Income

The income was by far the highest in Institute history, just over $500,000.00. The increase iu fees was a great help, but the increase in advertising rates was the chief reason for this new record. A reveuue of more than half a million dollars really puts the Institute into business. As a result of this increase the Iustitute showed a substantial surplus at the year's end, instead of a deficit as was the case last year.

Record Expenses

As would be expected, the expenses were up also. Chief among these increases was the cost of *The Engineering Journal* and another increase for the year is now threatened by the printers. Cost of all services and supplies has risen again, although there are encouraging signs that something uear stability is being reached.

Employment

Throughout the year, the employment department, both in Montreal and Toronto, had heavy demands upon it. The shortage of eugineers seemed to increase towards the end of the year and there was never a time throughout the twelve months but that a substantial number of vacancies were recorded with the Institute.

The number of engineers from outside of Canada who were seeking employment was smaller than in previous years. Nevertheless there is a fairly steady flow. There has been some change as far as non-Canadian engineers are concerned in that employers have shown a tendency to send one of their owu people abroad to make selections rather than to wait for suitable personnel to turn up through the government employment services and the Department of Immigration.

Annual Meeting

The annual meeting was held at the Chateau Frontenac in Quebec City on May 20 21 and 22. For the first time the number of technical papers was increased substantially by means of putting on three sessions at the same time in three separate rooms. This has been so successful that the same plan is being followed for the 1955 meeting at Toronto.

One effect of the increased number of technical papers has been that the attendance at each meeting has been smaller. However, the total of the attendance for all the meetings was greater than we have had recently.

Field Office

The field office at Toronto under the management of past-president, Dr. Grant, has done another year's good work. This office was opened as an experiment to see if better service could be given to the branches all over Canada as well as those in and around Toronto.

Reports from all quarters indicate that the office has served a very useful purpose. Colonel Grant has made several trips both east and west to visit branch executives and centres where there are small groups of members but not enough to form a branch or a branch section. These visits are appreciated greatly by the more or less isolated members, and beyond a doubt have done a lot towards giving them a better appreciation of the Institute.

Report of the Field Secretary

In 1954 the field secretary made two trips to the Maritimes. During the first trip, which was from February 1 to March 5, he visited Newfoundland; however on the November trip covering sixteen days, there was not time to go farther than Cape Breton. In February he visited the Saguenay Branch at Arvida; Lower St. Lawrence at Rimouski; Northern New Brunswick at Bathurst; also Amherst, Moncton, Prince Edward Island, North Nova Scotia at New Glasgow, Cape Breton at Sydney; then over to Newfoundland for a visit to Corner Brook and St. John's branches. En route from Corner Brook to Grand Falls he spent sixteen hours marooned at Gaff Topsail in a blizzard, the last seven hours being spent on a train which two engines (an emergency engine having arrived) were steadily bucking from front and rear in an attempt to get it moving! The field secretary will not soon forget "The Topsails" of Newfoundland. Although he arrived at Grand Falls a day late, he had a most delightful evening with fifteen members of the Institute there; then he went on to visit the St. John's Branch. On his way back he visited Halifax, Saint John and Fredericton branches; and orphan groups at Wolfville (Wolfville - Windsor - Middleton); Bridgewater (South Shore members) and Edmundston, N.B.

On the November trip, outward bound he went as far as Northern New Brunswick, Moncton, Amherst, Prince Edward Island (where he took part in the discussion for the formation of a professional association) North Nova Scotia and Cape Breton. On his return trip he visited Halifax, Saint John and Fredericton; with a pleasant side-trip to Yarmouth for a dinner meeting with members in that district.

Looking at his schedule for the calendar year, it might appear as though he had neglected the West. However, that is not really so. A trip was made as far as Fernie, B.C. in November, 1953; and at the time of this report going to press, your field secretary is making a six weeks' tour of the West, going as far as Whitehorse, Y.T.

Unfortunately trips as described above use up the choice times of the year so far as visits to branches in Ontario and Quebec are concerned. However, the field secretary is pleased to report that he was able to attend the inaugural

meeting of the Brockville Branch in January, 1954, and also their annual meeting in December. He wishes to take this opportunity to congratulate the latest addition to branches of the Institute on the outstanding progress they have made during their first year as a branch.

There were visits to Hamilton in January and October. On both occasions talks were given to the Professional Development Groups in which he is always interested. There were visits to Kitchener in January and London, Ontario, in December; on these occasions he met with the branch executives to talk over a Business Administration Course slanted at engineers, to be conducted by the University of Western Ontario. This is an ambitious scheme and has had to be postponed until the fall of 1955.

He enjoyed a quick trip to North Bay in March, and a two day visit to Ottawa in November.

During the Students' Conference held in Quebec at the time of the annual meeting of the Institute last May, it was agreed that the field secretary would try to arrange for better liaison between engineering students and the faculties at the different universities; this he has started to do with marked success.

Comments are often made on the strenuous trips the field secretary takes: during the February trip to the Maritimes, he visited eighteen places and attended thirty-one meetings. He would like to emphasize here that this is only possible because of the unfailing consideration and support he receives from the branch executives and members wherever he goes; and he would like to thank them here for their sincere and continued co-operation.

He would again like to say that there is no orphan group too small for him to visit, if the members will just advise him of their wish. This also applies to members who are ill and cannot attend meetings. He will be pleased to call on them whenever he is in their vicinity.

The office of the field secretary in Toronto keeps in touch with and guides the professional development courses across Canada. Should any branch wish information about starting a course, the office will be glad to send details and be of assistance.

The office in Toronto did more employment and placement work in 1954 than during any year since it opened. Members are most welcome to call upon the services offered by the Institute in either of the two departments: that of situations wanted and that of situations available.

The field secretary looks forward to many interesting visits to branches and members across Canada in 1955.

L. F. GRANT, HON.M.E.I.C.
Field Secretary.

Colonel By Memorial

No report of the year's activities would be complete unless mention were made of the decision to erect in Ottawa a memorial to one of Canada's earliest engineers, Colonel By. The occasion of this presentation is the one hundredth anniversary of the change of the city's name from Bytown to Ottawa.

Great credit must go to the committee of the Ottawa Branch which have arranged this matter in every detail. During the spring or summer of 1955 it is planned to unveil the fountain, alongside the Rideau Canal in the centre of the city. This will carry a suitable plaque recognizing Colonel By's contribution to the development of Canada and the Institute's appreciation of his accomplishments.

Roll of the Institute

The membership of all classifications now totals 15,271. New names added for the year amounted to 1,149, but deaths, resignations and removals amounted to 1,009, making a net gain of 140.

During the year 1,106 candidates were elected. These were classified as follows: Members 272, Juniors 129, Students 702, Affiliates 3. Forty-three reinstatements were effected. Life Membership was conferred on one hundred and twenty-nine members under By-law 26.

Transfers from one grade to another were as follows: Junior to Member 213, Student to Member 3, Student to Junior 585, a total of 801.

Removals From the Roll

There has been removed from the roll during the year by resignation and for non-payment of fees: Members 200, Juniors 504, Students 215, Affiliates 4, a total of 923.

Deceased Members

During the year the deaths of eighty-seven members of the Institute (including one Honorary Member) have been reported as follows:

HONORARY MEMBER

Turnbull, Wallace Rupert

MEMBERS

Allen, Archie Menzo
Archibald, Charles Blair
Baird, Earle Meharg
Barnes, Frank H.
Bond, David F.
Clark, Francis W.
Clark, Harold Sawbridge
Coles, Eric Morrell
Cooper, Ashton Burton
Cossitt, Lawrence Sulis
Crease, Frederick
Creer, Alfred Douglas
Cunningham, Adam
Dawson, Kenneth Lockhart
Dean, Clayton D.
Donkin, Robert Percy
Dunn, Alexander Carmichael
Dunn, Harold Stewart
Fairbairn, John Morrice Roger
Farmer, John Taylor
Forbes, James MacGregor
Freeman, J. Reginald
Gurney, Edward Holt
Huber, Albert Lloyd
Hunter, John William
Hutton, Charles Gordon
Gillett, George Herbert
Gransaull, Paul Roderick
Hemmerick, George
Holland, Albert
Holloway, Edward S.
Kinnear, Clifford Rutherford
Laferme, Leopold
LaRochelle, Joseph Eugene
Laurence, Harold F.
Lavoie, Edouard
Lindsey, Charles R.
Mansbridge, Alfred Swatton
Marr, Norman
McCaffrey, Walter Raymer
McGregor, James
McIsaac, Ronald
McKinnon, Ronald Morrison
McPherson, Joseph Edward
Meals, Casper Dull
Meloche, Rodolphe
Mills, Thomas Stanley
Morssen, Charles Michael
Normandin, Arthur Benjamin
Paget, James R.
Parsons, Roy Henry
Phillips, Edward Horace
Pitts, Gordon MacLeod
Poyner, Walter James
Rankin, Robert Arthur
Rannie, John Leslie
Rechenmacher, Walter Wilfred
Riehl, William H.
Rolfson, Orville
Ross, Alexander Stirling
Schermerhorn, Henry Lewis
Scovil, Stuart Southmayd
Sharpe, Albert Ernest
Slinn, William Harmon
Smith, Ronald Burns
Townsend, Charles Joseph Harrison
Trahan, J. Alide
Turner, Frank Eric
West, Arthur Elemere
Wilson, John Armistead
Young, Roderick Bearce

JUNIORS

Baugh, Rupert Don
Campbell, Donald Thomas
Eyolfson, Kristjan
Hiebert, John
Maxwell, Walter Bernard
Moulds, James Henry
Nugent, Ronald Emeric
Robitaille, Leo
Sandilands, Robert Henry
Schleihauf, Robert Lee
Simmonds, Charles Clifford
Vorres, Alexander Andrew

STUDENTS

Brettschneider, Murray
Hawkes, Michael George Derval

AFFILIATE

Sisson, Heber Percival

Total Membership

	1953	1954
Honorary Members	30	33
Members	6,855	7,083
Juniors	5,724	5,735
Students	2,457	2,357
Affiliates	65	63
	15,131	15,271

Respectfully submitted on behalf of the Council

D. M. STEPHENS, M.E.I.C.
President

L. AUSTIN WRIGHT, M.E.I.C.
General Secretary

Admissions Committee

During the year 1954 the committee held nine meetings and examined 1,375 cases. These consisted of: —

Applications for Admission	352
Applications for Transfer	149
Applications through Professional Associations:	
(a) Admissions	157
(b) Transfers	83
Student Applications	628
Special Cases	6
	1,375

In the report of Council will be found the number of members admitted to each class during the year.

A. D. Ross, M.E.I.C.,
Chairman

Nominating Committee

Chairman .. E. R. Eaton, Sudbury, Ont.

Branch	*Representative*
Amherst	L. F. Kirkpatrick
Belleville	O. H. Scott
Border Cities	C. G. R. Armstrong
Brockville	T. W. Brackinreid
Calgary	T. D. Stanley
Cape Breton	C. N. Murray
Cent. Br. Columbia	M. L. Zirul
Corner Brook	H. B. Carter
Cornwall	H. W. Nickerson
Eastern Townships	J. Lemieux
Edmonton	E. L. Smith
Fredericton	H. G. Hughson
Halifax	W. H. Chisholm
Hamilton	N. Metcalf
Huronia	B. C. Lamble
Kingston	J. W. Brooks
Kitchener	A. J. Girdwood
Kootenay	E. B. Broadhurst
Lakehead	S. Flook
Lethbridge	N. H. Bradley
London	I. D. Patterson
Lower St. Lawrence	R. Thomas
Moncton	R. F. Weir
Montreal	L. A. Duchastel
Newfoundland	William Watson
North Nova Scotia	Clyde F. Cameron
Niagara Peninsula	C. G. Cline
Nipissing & Upper Ottawa	J. S. Cooper
North Eastern Ontario	I. M. Foster
Northern New Brunswick	A. R. Bonnell
Ottawa	T. Foulkes
Peterborough	B. Ottewell
Port Hope	E. M. Wynn
Prince Edward Island	
Quebec	J. St. Jacques
Saguenay	A. B. Sinclair
Saint John	H. S. McCleave
St. Maurice Valley	John F. Wickenden
Sarnia	J. W. Graeb
Saskatchewan	A. H. Douglas
Sault Ste. Marie	R. A. Campbell
Sudbury	P. R. McAdam
Toronto	E. R. Graydon
Vancouver	E. L. Hartley
Vancouver Island	J. Alton
Winnipeg	T. E. Storey
Yukon	H. W. Love

Board of Examiners

In all, during the year 1954, 17 Members and 5 Juniors were admitted by Council subject to examination as well as 4 transfers from Junior to Member.

Most of these cases were referred to the Provincial Associations or the Corporation but 3 Members and one Junior satisfied the requirements of the Board and were recommended to Council for admission. One application for Member is still under review by the Board.

In addition to the foregoing, the board also examined the curricula and examination standards of nine well known engineering schools in countries outside of Canada. All of these were found acceptable by our standards and recommendations were submitted to Council for their names to be added to the list of engineering schools recognized by Council. Five additional schools are still under review and will be reported on in due course.

J. L. de Stein, M.E.I.C.,
Chairman

Canadian Chamber of Commerce

Your representative has had the privilege of sitting as member of the Executive Council for several years — interrupted only by leave of absence for 1952 when his duties as president of the E.I.C. precluded any possibility of attendance at Chamber meetings. On the resumption of attendance in 1953 the writer became your representative and, in addition, assumed the chairmanship of the Chamber's committee on "Junior Chamber Relations".

As in former years meetings of the executive council, numbering 36, took place fortnightly in Montreal. Over the years it has been a matter of satisfaction that this membership has included a generous number of prominent members of the Engineering Institute — past presidents, vice-presidents and members of important committees.

The annual meeting of 1954 in Halifax, for the first time in 22 years, marked the 25th birthday of the Chamber. Actual organization of the Chamber took place in 1925 but during the war years operations were suspended. The annual meeting was an outstanding success, part of which can be ascribed to the fact that the host board — the Halifax Board of Trade — was operating under the presidency of our distinguished Institute past president, Dr. Ira P. Macnab.

As was to be expected the celebration of the quarter century mark formed an appropriate occasion on which to review the past and to take a speculative look into the future.

As for the past, one can regard the Chamber's operations with some satisfaction. In 1946, for example, there were only 190 boards and chambers attached to the organization. Today there are 700. This voluntary national federation as indicated previously, has been working for 25 years to make its views felt in government and it can be said that its efforts have been reasonably successful. Your representative commends the perusal of its annual report to anyone interested in this work and, indeed, it is his opinion that every engineer interested in his own advancement cannot afford to ignore the work done by the Chamber.

Following the annual meeting in Halifax a delegation of officials of the Chamber, headed by the president, called upon the Prime Minister and members of his cabinet to lay before them the policy statements and resolutions approved by the delegates at the annual meeting. Said the distinguished engineer Trade Minister, C. D. Howe, "I can assure you that we in government give the views of your Chamber careful attention. I shall not say that the government would endorse every declaration of policy or that it has acted on every one of your resolutions. But your batting average, as far as I can see, is pretty high."

The principal items dealt with were health insurance, taxation, government spending, film board operation, the check-off and government regimentation. Space does not permit elaboration and again your representative commends to those interested a perusal of the Chamber's annual report and statement of policy declarations — a copy of which is attached hereto.

A very special feature of the year's activities was the visit of the delegation of the Canadian Chamber of Commerce to the Mexican Confederation of Chambers of Commerce in Mexico City on February 9. A detailed report of the conference has been published and there can be no doubt that as a result Canadian-Mexican relations were immensely strengthened.

Your representative mentioned previously that our Canadian engineers were pulling their weight in the councils of the Chamber. There is much to be gained by us in our participation in this activity and it appears reasonable that the Chamber will benefit by our continued interest.

J. B. Stirling, M.E.I.C.,
Institute Representative

Employment Service

During the latter months of the past year, the Employment Department experienced a great deal of activity in all branches of job opportunities. Some however were more numerous and of greater variety than others and there were fewer Canadian engineers seeking changes of employment. As was reported previously, there still remained a demand for electronic engineers in all levels. Job opportunities were somewhat narrower for civils; mechanicals and electricals were sought by a number of organizations for a variety of duties. The bulk of vacancies listed required the services of the junior engineer. The senior man, whether Canadian or Foreign graduate still remained much more difficult to place satisfactorily.

Many successful placements were made and approximately 400 jobs listed. However, owing to the diversity of engineering jobs open it was difficult to match all applicants to these vacancies immediately.

Although correspondence dropped in volume over previous years this department answered approximately 1850 letters. Information requested by engineers from the United Kingdom was still prominent and a number visited this office seeking employment contacts. The policy of the department still remained that little assistance can be offered until the applicant is available for personal interview. The office had a number of requests for advertisements to be placed in our "Wanted Section" by applicants not presently located in the country. From experience it was found that advertisements of this kind brought in very little response by our employers, therefore, it was necessary to refuse such requests and limit this service to those easily available for interview.

As in the past, many successful placements were made with summer students and again the services of this department are available to these young men seeking opportunities with engineering firms for

the summer months. It is interesting to note that employment for summer students this year seems more easily attainable, because many had difficulty during 1954.

The Employment Bulletin, now well established, continues to prove effective as a means of informing employer and employee of the employment situation. It has enjoyed a broad circulation not only in Canada but also in the United Kingdom and will be maintained during the coming year.

At this time the department wishes also to report the valuable work handled by our Toronto Office with reference to employment. Employer contacts have been made, and many interviews arranged resulting in successful placements.

In general 1954 has been noteworthy not only for the activity in the last few months, but also the promising outlook at the year end for 1955.

(Miss) A. Summers,
Employment Service

Finance Committee

The revenue to the Institute in the year 1954 climbed to an all time high, reaching an amount in excess of half a million dollars. This is due primarily to the authorized increase in fees, which became effective last year, and to an increase in advertising rates for the *Journal*, also to a small net increase in membership. This was partially offset by greater costs principally in the publication of the *Journal*, which has been increased in size in an endeavour to give greater service to the members. The cost of publishing the Institute Directory exceeded the receipts from advertising by over twenty-one thousand dollars which was charged in the year's accounts. It was therefore deemed advisable to lay aside sufficient funds annually to cover the cost of a directory issue about every third year, and to provide for other possible publication contingencies.

Comparative Statement of Revenue and Expenditure

Year ended December 31

REVENUE

	1954	1953
Membership Fees:		
Arrears	$ 6,958.66	$ 8,437.08
Current*	180,667.08	137,452.56
Advance	566.37	639.00
Entrance	6,931.56	5,974.70
	$195,123.67	$152,503.34
Publications:		
Journal sales	220.50	165.01
Journal advertising	295,856.82	230,469.00
Directory advertising	23,428.84	—
	$319,506.16	$230,634.01
Income from Investments	3,134.34	2,816.25
Refund of Hall Expense	2,488.50	126.00
Sundry Revenue	111.17	217.54
	$520,363.84	$386,297.14

*Membership fees include *Journal* subscriptions.

EXPENDITURE

	1954	1953
Building Expense:		
Property and water taxes	$ 1,592.20	$1,586.16
Fuel	1,047.91	1,136.12
Insurance	606.36	619.61
Light, gas and power	733.63	693.36
Caretaker's wages and services	1,950.00	1,830.00
Maintenance, alterations and repairs	1,518,09	1,458.12
	$ 7,448.19	$ 7,323.37
Publications:		
Salaries	30,104.71	24,529.51
Printing and sundry expense	144,605.55	137,836.16
Advertising commission	74,638.75	58,206.32
Directory expense	44,961.81	—
	$294,310.82	$220,571.99
Office Expense:		
Salaries	75,123.68	63,096.75
Telegrams and postage	4,445.58	4,718.63
Telephones	1,704.04	1,742.30
Office supplies and stationery	6,548.51	9,866.24
Audit and legal fees	500.00	1,010.00
Miscellaneous expense	5,128.70	4,393.18
Depreciation—furniture and fixtures	1,278.55	1,247.85
	$ 94,729.06	$ 86,074.95
General Expense:		
Students' conference	1,077.05	1,798.99
Council and annual meetings	5,091.24	4,975.52
Travelling	11,227.44	9,740.17
Institute prizes	464.71	469.54
Library salary and expense	8,583.04	9,502.34
Interest, discount and exchange	1,011.43	704.45
Committee expenses	1,017.71	1,530.00
Cost of membership in other societies	1,708.54	2,315.80
Sundry expense	1,415.68	1,302.21
Pension plan	4,875.63	2,626.35
	$ 36,472.47	$ 34,965.42
Rebates to Branches	27,273.78	23,974.93
Total Expenditure	460,234.32	372,910 60
Transferred to Reserve Funds:		
Building	24,000.00	16,000.00
Pension fund	10,000.00	—
Contingencies	8,000.00	—
Publications	10,000.00	—
Reserved for Bad Debts	1,000.00	—
Surplus or (Deficit) Transferred to Surplus Account	7,129.52	(2,613.52
	$520,363.84	$386,297.1

An amount of $24,000 was added to the building fund during the year, and $8,000 was allocated to our contingency fund for the first time in two years. As the pension fund needed to be augmented under present conditions, $10,000 was placed in it. These funds should have further monies allocated to them each year but are in better condition than they have been in the immediate past.

Your Finance Committee held regular sessions prior to Council meetings to agree on recommendations to be presented to Council for action, or to take action themselves on matters within their jurisdiction.

As in the past, we have had the full cooperation of the general secretary and the executive assistant general secretary and the able assistance of their staff throughout the year, which has been of immense value to your committee and is appreciated by every member of it.

IRVING R. TAIT, M.E.I.C.,
Chairman

Treasurer's Report

In reporting the financial position at the close of 1954 it is gratifying to mention that increased expenditures during the year were more than offset by the higher revenue from each main source — fees publications and investments. This favourable margin permitted an addition to surplus account of $7,129.52 after satisfactory allocations to the authorized reserve funds as shown in the audited financial statements. In keeping with the aim to build, during periods of peak prosperity, a financial stability that will stand the Institute in good stead in "leaner years", the value of library books has been written down to One Dollar.

During the year high grade industrial and public utility bonds were added to the investment portfolio at a cost of $29,987.50. At 31st December, 1954, the market value of the Institute's investments, including

Comparative Statement of Assets and Liabilities

December 31

ASSETS

		1954	1953
CURRENT ASSETS:			
Cash on hand and in banks		$ 10,751.50	$ 1,315.34
Accounts receivable—less reserve		29,978.34	21,523.70
Arrears of fees—estimated		3,500.00	3,500.00
		$ 44,229.84	$ 26,339.04
INVESTMENTS—AT COST:			
Property of The Engineering Institute of Canada	$117,403.27		87,814.26
Property of special funds account—see contra	20,256.03	137,659.30	19,857.54
(Approximate market value $135,800.00)			
SUNDRY ADVANCES		1,650.00	2,850.00
DEPOSIT WITH POSTMASTER		500.00	500.00
PREPAID INSURANCE AND DIRECTORY EXPENSE		488.00	4,422.57
LIBRARY—nominal value		1.00	1,448.13
FURNITURE AND FIXTURES—at cost less depreciation		11,506.94	11,230.69
LAND AND BUILDING—book valuation		36,000.00	36,000.00
		$232,035.08	$190,462.23

LIABILITIES

		1954	1953
CURRENT LIABILITIES:			
Accounts payable		$ 14,050.07	$ 14,679.57
Payable to The Harry F. Bennett Educational Fund		—	4,842.86
		$ 14,050.07	$ 19,522.43
SPECIAL FUNDS:			
As per statement attached		20,256.03	19,857.54
RESERVE FUNDS:			
Building		80,000.00	56,000.00
Building maintenance		1,500.00	1,500.00
Pension fund		20,366.50	10,366.50
Contingencies		13,000.00	5,000.00
Publications		13,964.33	15,000.00
SURPLUS ACCOUNT:			
Balance as of December 31, 1953	$63,215.76		
Less: Library book value written down to $1.00	1,447.13		
	$61,768.63		
Plus surplus for year as per statement attached	7,129.52	68,898.15	63,215.76
		$232,035.08	$190,462.23

AUDITORS' CERTIFICATE

We have examined the statement of assets and liabilities of The Engineering Institute of Canada as of December 31, 1954 and the statement of revenue and expenditure for the year ended on that date and have obtained all the information and explanations we have required. Our examinations included a general review of the accounting procedures and such tests of accounting records and other supporting evidence as we considered necessary in the circumstances.

In our opinion the above statement of assets and liabilities and accompanying statement of revenue and expenditure are properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Institute at December 31, 1954 and the results of its operations for the year ended on that date, according to the best of our information and the explanations given to us and as shown by the books of the Institute.

PEAT, MARWICK, MITCHELL & CO.,
Chartered Accountants.

MONTREAL, QUEBEC, JANUARY 27, 1955.

those held on behalf of its Special Funds Account, stood at approximately $135,800.

CHAS. H. JACKSON, M.E.I.C.,
Treasurer

Canadian Standards Association

Every yearly report seems to emphasize the growing importance of C.S.A., and the increasing extent of its work, The year now under review is no exception, and as a matter of fact, there were more new standards published than in any previous year and more work is under way. Eighty-five standards were actually issued, of which fifty-four were entirely new, compared with about forty last year, and in addition to this, a number of committees are working on revisions, and numerous insert-slips have been issued to cover minor changes that hardly call for a new edition of the complete standard concerned.

The scope of the new standards is becoming wider year by year, as can be gathered from the fact that the 1954 new codes vary all the way from plumbing brass to insecticide vapourizers and from drawing office standards to television antenna towers.

The standards for Mechanical Engineering Drawings, namely, No. B78.1, is the first of this type to deal with Canadian practice, and is one of a group known as the A. B. C. series dealing with the unification of engineerng work in the United States, Great Britain and Canada. This standard will be widely used in the government offices and in the Service contracts and will gradually find a place in the curriculum of the technical colleges and vocational schools. The standard on domestic television antennas, C 22.4-112, is another one of unusual interest, as it exemplifies the growth of television in the country and the need of both guidance and control.

A comprehensive group of standards has been issued during this last year on wood preservation. Thirty-five individual specifications in this group deal with such matters as preservation, analysis and terminology in this particular field.

The revised standards issued during the year have also dealt with numerous and divers fields, such as building material, electrical engineering, reinforcing materials for concrete, plywood and so forth.

One very special publication, known as G134.1, not exactly a standard, has made its appearance. It deals with steel and iron products from the point of view of listing what is the common practice of manufacturers, and also explaining, or at least exemplifying, the terminology that has arisen in this field.

The handbook is a useful addition to the existing sources of information available to all types of personnel concerned with specifying, designing, purchasing and use of steel and iron products.

Another new field in which standardization projects have been authorized is that of wood adhesives. Pre-stressed concrete, another modern development, is represented by a special committee under the Sectional Committee on Concrete, which will deal with the need and nature of specifications required in the use of this new application of reinforced concrete.

Even hospital hazards and related subjects, such as medical housekeeping and electrical equipment are included in the work now being prosecuted, and soil mechanics is responsible for a Working Committee on Boring and Sampling being recently established.

Again, the Canadian Electrical Code is constantly being revised, and further specifications expected in the very near future will deal with such matters as vinyl-asbestos floor tile, cleated plywood boxes and even venetian blinds if the interest is sufficient.

In October the new Approvals Laboratories, located at Weston, Ontario, were opened by the president, Dean R. E. Jamieson, M.E.I.C., who had by that time returned from Europe where he represented the C.S.A. at the Geneva meeting of the International Standards Organization Council.

In this new building the Approvals Division has some 50,000 sq.ft. of floor space on the ground level, which offers excellent facilities for all their laboratory operations and testing work.

The past year has been both busy and successful and every branch of the Association anticipates a still busier year in 1955.

The Association suffered a very severe loss in the death of Colonel W. R. McCaffrey, M.E.I.C., its general manager, on July 12, 1954. He will be missed at our meetings as his personality was so attractive and his service so valuable during the many years he has been with the Association. F. A. Sweet, M.E.I.C. who has been technical officer of the C.S.A. for the past fourteen years was appointed to succeed Colonel McCaffrey as general manager.

Prior to the death of Colonel McCaffrey the Association suffered another serious loss with the death of its second vice-president, Eric M. Coles, M.E.I.C., whose plane was lost over Puget Sound in April last.

P. L. PRATLEY, M.E.I.C.,
Institute Representative

Legislation Committee

During the year two matters of importance were studied by this Committee:

Revision of the Quebec Bar Act

Early in the year, a proposed revision of the Quebec Bar Act was submitted to the Legislature.

In the proposed revision there was one article which, if approved, would have very greatly and unjustly restricted the activities of many engineers. This article (Article 8, Section II) gave the legal profession the exclusive right to do many things which are now often done by engineers in the ordinary course of their duties.

The Corporation of Professional Engineers of Quebec registered a formal protest, and the E.I.C. supported the Corporation. A number of other professions whose rights were threatened by this proposed revision also objected to such exclusive rights being granted. As a result of these many protests, this particular paragraph of the proposed revision of the Quebec Bar Bill was modified so as not to conflict with the rights of other professions.

Royal Commission on Patents, Copyrights, Trade Marks and Industrial Designs

On June 30, the chairman of the above Royal Commission invited the Engineering Institute of Canada to make any representations before the Commission that it considered relevant.

After consultation with a number of people actively engaged in the field of patent work, both members of the Institute and non-members, a letter was sent to the Royal Commission on July 28 giving the Institute's views on certain matters. Very briefly, it was stated that—

(a) In all major respects the Canadian Patent Act is excellent.

(b) Section 41 of the Act discriminates against the new production of the chemical engineer and chemist in relation to products intended for food or medicine and produced by a chemical method. Such discrimination is bad and should be eliminated.

(c) Long delays occur in dealing with patent applications.

(d) Care should be taken in avoiding confusion between the purpose of the Patent Act and that of legislation relating to combines and restrictive trade practices.

(e) The Industrial Design Act badly needs revision.

On October 15, the opportunity was taken to submit a further memorandum in which the points previously brought up were emphasized, and a further matter the importance of finding a better definition of the term "patentable invention" than at present in use, was stressed.

As a result of these letters, the Institute was invited to appear before the Commission at public hearings. In view of the fact that many members of the Institute actively engaged in patent work, and on whose advice the letters were written, are appearing before the Commission on behalf of other organizations, it was decided to decline the invitation to appear.

It is not considered necessary to pursue this matter any further, although should it develop that the Institute can make any further contribution, the matter will be taken up again.

E. D. GRAY-DONALD, M.E.I.C.,
Chairman

Library and House Committee

On behalf of your Library and House Committee, the following report is submitted:—

Due to the extensive renovation program carried out in Headquarters building during 1953, very litt e work was undertaken in the past year. The offices of the general secretary and of his assistant were redecorated, but nothing else was done.

No other matters requiring the attention of the Library and House Committee arose during 1954.

F. L. LAWTON, M.E.I.C.,
Chairman

Library Report

There have been several changes in the Library staff during the past year, and naturally this has led to a certain lack of continuity in the department. However, the overall picture for 1954 shows increased activity in almost all aspects of library work.

Work continues on the never-ending task of the cataloguing and classifying of new books. 413 have been processed, and a total of 1896 cards typed for the card catalogue. As the number of books classified is larger than that of new books received in the library during the year, it is hoped that, with the enthusiastic cooperation of all members of the staff, the new books will be fully processed by the end of 1955, then a start will be made on the re-classifying of those older books

which so far have not been arranged by subject.

During the year, a total of 309 books having a value of over $2,400 were received for review in *The Engineering Journal*. We would like to take this opportunity of thanking the publishers for their continued co-operation. Of the book notes published in the Library Notes section of the *Journal*, 250 were prepared by the library staff, and 88 were supplied by the Engineering Societies Library in New York.

The library received 147 standards during the year, short reviews of these also being included in the Library Notes. The Engineering Institute of Canada is a depository library for Canadian standards, and contains a complete set which members may consult at any time. Members may also order through the library the Standards of the Canadian, British and American Standards Associations.

Of the more than 600 periodicals received regularly in the library, many come in exchange for *The Engineering Journal*. During 1954, a further 10 were added to the exchange list, making the total value of material received in this way over $900.

There has been a marked increase in the number of orders placed for members. In 1953 an even 500 were sent out, while in 1954 there were 642. This total was made up of 409 orders for books, pamphlets and photostats, and 233 for periodical publications of other professional societies with which the Institute has exchange agreements. Any book or pamphlet may be ordered through the library, and although these cannot be supplied at less than retail prices, members are saved the inconvenience in the case of imported books, of dealing with customs and foreign exchange.

During the year, 30 bibliographies on a wide variety of subjects were prepared for out-of-town members, and there are now on file 735 bibliographies covering almost as many subjects.

A total of 2,820 people used the library during 1954, and 2,512 requests for information were received over the phone, and 937 by mail, making a combined total of 5,820 requests, if it is assumed that all those using the library were in search of information. This is an increase of 200 over 1953. Almost 3,000 items were circulated outside the library, and 5,700 books, magazines, indices, etc. used in the library. It is interesting to note that 700 items were loaned to other libraries, an increase of 100 over last year; 66 items were borrowed from other libraries for members' use.

The library is open to all members, and there are now 810 who have deposits in the library. The deposit is made to ensure the safe return of books loaned, rather than to charge a rental fee as is the practice in some libraries. It is expected that each member wishing to borrow books will place his own deposit. The attention of members is drawn to the library regulations which are published each month in the Library Notes section of *The Engineering Journal*.

All enquiries received from members are handled as quickly as possible. In most instances there is little or no delay, but some enquiries require considerable work. Members are asked to give as much information as possible when making requests, in order to help us speed up our services, which we are always endeavouring to do.

(Miss) Shirley Courtis,
Chief Librarian

Membership Committee

This committee reports to Council that it has, so far, failed to find any means of increasing the membership of the Institute from eligible non-members comparable to the setting up of new Branches. The committee is of the opinion that an increase in the number of Student Members could be secured by sustained action by the addition of a permanent staff member charged with this responsibility. Student Members shortly become Members.

H. R. Sills, M.E.I.C.,
Chairman

Life Members' Committee

A meeting of the committee was held on November 12. The report of the work to date with the results of the voluntary contributions was read, showing a total of 531 Life Members and voluntary contributions of $2,003. Most of this amount was contributed in 1953, as no contribution was requested in 1954. Even so, in spite of this a small amount was received. It is the intention of the committee to increase the voluntary fund in 1955 and Life Members will be advised.

After full discussion the members of the committee agreed unanimously to use $1,000 of the fund to pay for one of the four copies of the film "Leonardo da Vinci", which are being purchased by the Institute for general circulation by all branches in their respective communities.

At the end of 1954 membership was:

Canada	473
Britain	17
United States	37
Foreign	3
	530

Life Members reside in nine provinces in Canada, in 133 towns and cities and are members of forty-two branches. About 45 per cent of the members have retired from active work.

J. A. Freeland, M.E.I.C.,
Chairman

Papers Committee

The one specific duty allocated to this committee, was to arrange in co-operation with Headquarters, for the papers for the annual meeting to be held in Toronto in May 1955.

The committee considered that all members of the E.I.C. should be advised that worthwhile papers would receive every consideration, and if acceptable, would be given a place in the annual meeting program. A notice to this effect was published in the November issue of the *Journal*. This notice did not produce many suggestions.

Accordingly the Committee has been chiefly concerned in considering papers that have been submitted for consideration by the members of the Committee itself, and, of course, by Headquarters staff who keep continually in touch during the year with authors and subjects, that they consider might be suitable for presentation at the annual meeting.

As the annual meeting will be held in Toronto, the Toronto Branch was asked to suggest, and arrange for, a large proportion of the papers particularly those that would be of interest to Ontario members.

The committee member from Toronto, H. W. Paterson, was able to organize a local group who have been very helpful.

This year the committee has endeavoured to finalize the program earlier than usual so that copies of papers to be presented at the annual meeting would be in the hands of Headquarters staff early enough to have pre-prints made to facilitate making arrangements for discussion, and to arrange for publication, if the paper was thought to be suitable for the *Journal*.

For two years now, a procedure has been roughly established for the consideration of suitable papers. The mere fact of having authors and subjects considered by a committee, brings to the final approval of a paper the wide experience of a number of members and should eventually tend to raise the quality of papers presented; at least it should eliminate unsuitable papers from the program, one or two of which, seem to be advocated each year. Even so, control of the quality of the papers still leaves something to be desired.

The committee would like to see steps taken to foster the desire of our members to prepare satisfactory papers for the annual, and other meetings of the Institute, but are not yet in a position to make definite suggestions as to how this can be done.

The committee hopes that its work will be continued next year with a certain continuity of membership so that the ideas that have been expressed at meetings may not be lost but, in the course of time, put into effect and an effective procedure established for the solicitation, consideration, and final acceptance of papers.

Mr. E. C. Luke of Headquarters staff contributed immeasurably to the work of the committee in his capacity as secretary.

E. R. Smallhorn, M.E.I.C.,
Chairman

Committee on Professional Interests

The committee has been studying the question of unionization of engineers since early fall, and while we have not yet come forth with any conclusion as to what recommendations we would like to place before Council, there has been a good deal of correspondence between the members of the committee, and the chairman has had several very interesting conversations with members of the Institute who are interested in this subject. I think I can state definitely that at the moment there does not seem to be any great urge on behalf of Canadian engineers to join or belong to, or become affiliated with, any union.

I think that one of the most interesting things that has happened recently is the case of the engineers employed by the B.C. Electric Company who have won their point and are now free to join or not to join any union, whereas previously, as I understand it, they were included in a bargaining unit. To my mind, this question of unionization of engineers is a subject that will require continual study by this committee, and I am hopeful that we will come forth with some concrete proposals in the near future.

E. B. Jubien, M.E.I.C.,
Chairman

Committee on Prairie Water Problems

The Prairie Water Problems Committee did not hold any actual meetings

during 1954, but its members kept an active interest in the development of western waters.

During the year the P.F.R.A. have completed a new irrigation dam on the Little Bow River, north of Lethbridge, Alberta, called the Travers Dam. This dam eliminates a section of the irrigation canal which has been very difficult to maintain and will improve the regulation of flow for the irrigable areas formerly administered by the Canada Land and Irrigation Company.

A very heavy program of construction on the distribution system of the St. Mary's — Milk River development was carried out during the year. The system has now been extended between Taber and Medicine Hat so that in 1955 some land very close to Medicine Hat will have water available. During 1954 water was made available to some 70,000 new acres, and it is anticipated that it will be available to an additional 40,000 in 1955. It is very gratifying to the committee to realize that the expectations of the St. Mary's — Milk River development are being realized.

G. A. Gaherty, M.E.I.C.,
Chairman

Committee on the Training and Welfare of the Young Engineer

As in previous years Professional Development Courses for young engineering graduates have been promoted by Colonel Grant, field secretary, during his visits to the branches. During 1954 the following courses were in operation: —

Toronto	3 courses
Hamilton	3 "
Niagara Falls	2 "
Winnipeg	1 course
Kootenay Branch	1 "
Saguenay Branch	1 "

Halifax has started one course since January 1955.

London Branch is negotiating with the University of Western Ontario to give a Business Administration course but this is not yet settled.

The Field Secretary's Office also reports that the courses seem to be most popular in the large branches because it is easier to get a variety of speakers in the cities. In the smaller branches it is the junior engineers who want non-engineering information, and once they start a course they continue from one year to another for the reason that they enjoy the meetings so much and seem to get so much out of the talks.

There may be courses running that we do not know about but all the above Branches have written in to the field secretary's office so that we can report definitely on those.

George B. Moxon, M.E.I.C.,
Chairman

Publications Committee

The thirty-sixth year of publication of *The Engineering Journal* proved to be its biggest. The number of copies printed exceeded 200,000 and the average monthly circulation was 16,159 copies.

Of the 1153 pages of reading material or a monthly average of 96, 521 were devoted to technical papers, or a monthly average of 43 pages. The remainder was made up of items of topical interest.

It will be noted that the volume of technical and editorial matter was practically the same as that of advertising matter. This high ratio of reading matter is not usually found in Canadian technical publications.

Your committee and the *Journal* staff made every effort to publish technical papers covering every phase of engineering development. An analysis of the nature of the 70 papers printed follows:

Chemical	4
Civil	19
Electrical	12
Mechanical	19
Miscellaneous	16

The committee extend their thanks and appreciation to all authors, correspondents and advertisers.

Some new and special features were adopted in 1954. In May a section was inaugurated featuring news received from various provincial professional engineering associations. During the last war it was necessary to forego the printing of abstracts of engineering papers which had been a feature of the *Journal* for a number of years. Commencing with the August issue this abstract section was revived and 35 abstracts were presented in the five remaining issues. During the coming year it is hoped to increase the number of these abstracts.

The November issue was devoted to the Kitimat project. This included 11 papers totalling 98 pages of text.

The gross cost of production increased over that of the preceding year but the revised advertising rates approved by Council more than offset it. The average cost was 87.4 cents per copy or $10.49 per year per subscriber.

Last year your Publications Committee recommended that a larger reserve of technical papers for publication be kept available to prevent the occurrence of periods of scarcity of material. We are happy to report that results were satisfactory. Again this committee stresses the need for this condition in order to provide a variety of articles and thereby satisfy the requirements of our readers.

21,650 reprints of technical articles were ordered last year, an increase of 16 per cent over the preceding year. This, together with the many letters of commendation received during the year, indicate a continued satisfaction and interest in the *Journal*.

A sub-committee has been formed under the chairmanship of Professor R. de L. French to study the advisability of the publication of Transactions. Its task will start with a study of similar publications by other engineering groups and will also cover the multitudinous aspects of this problem related to the Institute.

A reader's interest survey was initiated in the fall in the form of a questionnaire sent, monthly, to 100 members picked at random and located in various parts of Canada. It is hoped that in one year the canvassing of 1,200 representative members of the Institute will help guide future Publications Committees and the editorial staff in their policies. The number of replies has been quite gratifying, some monthly returns amounting to 57 per cent of the questionnaires sent.

Your committee held five meetings during the year. All were well attended by its members and by the Headquarters staff.

G. N. Martin, M.E.I.C.,
Chairman

E.I.C. Annual Meetings

May 11-12-13, 1955

Royal York Hotel,
Toronto, Ont.

May 23-24-25, 1956

Montreal, Que.

June 12-13-14, 1957

Banff, Alta.

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Abstracts of Reports from Branches

Note—For Membership and Financial Statements see pages 278 - 280

Amherst Branch

In its second year of activity this Branch held six meetings during the year.

At the March meeting J. K. Young gave a very interesting and highly informative talk on the "Design of Steel Culverts" which was very well received.

In April the Branch held an Iron Ring ceremony at Mount Allison University with a buffet luncheon at the famous Marshlands Inn in Sackville. Twelve of the Branch members received the iron ring. A delegation from Halifax joined this meeting and carried out the ceremony.

In May the Branch held its annual meeting and the new executive was appointed with D. R. Robson as chairman; J. K. Young as vice-chairman; G. A. Jesty as secretary-treasurer; and O. R. Sweetser, E. H. Henderson, F. C. Wightman as the executive committee. L. E. Burrill was appointed in June to serve as councillor for the Branch for a two-year term.

In October J. N. Ritchie gave a very informative talk on the "Proposal for Unity", and this was followed by a lengthy discussion.

In November Amherst was honoured once again with a visit from Dr. L. F. Grant who talked on Branch affairs, E.C.P.D., and confederation.

Belleville Branch

During 1954, eight general meetings were held, the minutes of which have been filed. The topics of the addresses given covered a variety of subjects including the Kitimat Power Project, the Seven Islands Iron Ore Development, St. Lawrence Seaway, Shell Moulding of Plastics and Corrosion of Materials. Good attendance at these meetings indicated a continuing interest in the activities of the Institute.

A professional development course consisting of 20 lectures sponsored by the Belleville Branch in co-operation with Queen's University was held during the fall and winter of 1954. Fifty-five people were enrolled in the course and the high attendance spoke well for its popularity.

The Branch sponsored a $25.00 prize to be given to a Grade XIII student at the Belleville Collegiate who planned to take an engineering course and who had the highest standing in english, algebra, trigonometry, geometry, physics and chemistry. This prize was won by George Hosang and was presented by A. O. Drysdale at the commencement exercises of the Collegiate on October 27.

Border Cities Branch

There were nine successful meetings held throughout the year. A wide variety of topics was presented. Two joint meetings were included, one with the Chemical Institute of Canada—Essex-Kent Section, and the other with the American Society of Tool Engineers—Windsor Chapter. A plant tour of the new Albert J. Brain pumping station and Windsor filtration plant was of great interest. The third annual engineers' dinner dance sponsored by the Branch was a huge success.

A professional development course was not given during the 1953-54 season. Steps are being taken to stage a course this year.

For the third year the operation of the Ladies' Auxiliary has been a success. Three general meetings were held during the year. The interest groups, namely, leathercraft, bowling, bridge and smocking, are continuing with even greater success than last year. The membership totals 95.

Brockville Branch

During 1954, its inaugural year, the Brockville Branch held a variety of meetings. Starting with a background of experience of other branches as reported in the *Journal*, we felt our way carefully to determine the wishes and needs of the members. Seven regular meetings were held, plus an annual meeting, and two special meetings.

The June regular meeting took the form of an evening boat cruise and picnic. The September meeting was a field trip to the plant of the Canada Starch Company. Of the remaining five regular meetings, three were dinner meetings and two were evening sessions followed by light refreshments, as was the case also for the annual meeting in December.

The average attendance of members at the meetings was about fifty per cent, in addition to which a few prospective members were welcomed as guests. The best attended meeting, a joint meeting with the C.I.C., featured as speaker T. S. Johnston, president of the Interprovincial Pipe Line Company. This was closely followed by a talk and movie on Alcan's Kitimat development. In May a joint dinner meeting with the provincial Association of Professional Engineers was also well attended. The subject was "A Plan for Unity". The special meetings, both of which took the form of dinners followed by dancing, were the January inaugural meeting and the presidential visit in October. In this way the branch had the honour of hearing directly from two presidents in one year. At the annual meeting it was recommended to the incoming executive that the exploration of various possible forms of meeting be continued during 1955; and also that the program include experimentally a proportion of meetings to hear papers with a specialized technical flavour. This policy was not followed during the first season because the size of the Branch and the variety of engineering fields represented. One problem for which no solution was proposed during the past season was that of maintaining contact with our ten per cent of non-resident members.

Calgary Branch

During the year eight general meetings were held. Topics discussed at these meetings were: "What Makes a Substance a Mineral in Law as Distinct From the Engineering World"; "Building Research and the New National Building Code"; "The St. Lawrence Power and Seaways Project"; "Canadian Standards Association"; "25 Years in Designing and Building Dams"; "Random Remarks on Roads"; "Can You Take a Picture of It?" and "Television Techniques".

Another men's smoker was held in September. This proved to be an outstanding success and was an excellent way to get the fall program rolling.

The Branch enjoyed a presidential visit during the year at which time a general meeting was held on February 9. The president and his party met with the Executive Committee on February 8.

The annual "Slide Rule Soirée" was held again in February. This formal affair is becoming one of the highlights of the Branch year.

The regular Monday luncheon meetings are proving as successful as ever with both interest and attendance at a high peak.

The Calgary Branch for various reasons has not undertaken as yet any Professional Development courses.

Interest in Branch activity has remained high and 1954 has been another very successful year.

Cape Breton Branch

There were six meetings in 1954, five of which were held in the Isle Royale Hotel, Sydney, N.S. The average attendance at these meetings was 33, except for the June lobster party which was enjoyed by 78 members and friends at the summer home of W. E. Clarke, a Life Member since July of this year.

A joint meeting with the Sydney group of the Chemical Institute of Canada was held on March 26 at which Dr. F. Morrison was the speaker. Logue Industrial Equipment Limited of Sydney assisted us in putting on this meeting. The April meeting of the Branch was addressed by Alexander McKendrick, a British refractories engineer. Garteraig (Canada) Limited made Mr. McKendrick's visit possible. The Institute field secretary visited the Branch in November and a Branch meeting was held sponsored by the Railway Power Engineering Company.

A Professional Development course was not organized this year.

It was with some satisfaction to members that the Leonard Medal was awarded jointly for a paper written by two members of the Branch, C. M. Anson, and the late C. B. Archibald.

Individual representatives attended the annual and professional meeting of the Institute at Quebec City in May and the Maritime professional meeting at Digby in September.

The proposal on unity in the engineering profession made by J. Herbert Smith when president of the Ontario Association of Professional Engineers, was discussed by members of this Branch. In general i

was received favourably and with agreement on the desirability of principles contained in the proposal.

Central British Columbia Branch

The Central British Columbia Branch covers the south central portion of British Columbia. Since the economy of the area is chiefly based on the primary industries such as agriculture, logging and mining, a large proportion of the Branch's membership is engaged in the field of civil engineering connected with these industries.

During the year, the Branch held five executive and four general meetings in the cities of Kamloops, Vernon, Kelowna and Penticton. All the general meetings were dinner meetings held jointly with the Central B.C. Branch of the B.C. Engineering Society. The average attendance at meetings was about 35.

Meeting programs featured films and talks. Highlights of the year's activities were field trips to inspect the new Royalite Oil Refinery at Kamloops and the Okanagan Flood Control Project at Penticton.

Corner Brook Branch

During the year 1954 the Corner Brook Branch held four business meetings which were fairly well attended. Two technical meetings were held at which papers were presented and followed by discussion periods and refreshments. Two meetings featured the showing of industrial films. The film "The Kitimat Project", made available through the courtesy of a local firm, was particularly enjoyed.

In February a special meeting was held to honour the visit of Colonel L. F. Grant, past-president and field secretary of the Institute. Colonel Grant gave a talk on the St. Lawrence waterway, which was of great interest to the members. Refreshments were served at the close of the meeting.

A Ladies' Night was held at the Rod and Gun Club Lodge in July. Practically the whole of the membership, their wives, lady friends and guests attended. Refreshments were served before the dance and at midnight a very enjoyable dinner took place.

This gives an outline of the main activities of this Branch for the year and we look forward to an even more active one in 1955.

Cornwall Branch

During the year 1954 a total of ten meetings have been held. The first of these was a joint meeting with the Chemical Institute of Canada to hear Dr. W. M. Campbell of Chalk River discuss the chemical engineering aspects of atomic energy. He ably discussed a new and complicated subject in a manner easy for all to understand. The next meeting in February was a smoker during which the group heard Col. Medland of the Association of Professional Engineers of Ontario discuss his trip to Labrador, and various aspects of unity. The annual dance at the Cornwall Golf and Country Club was its usual success.

In April, on a suggestion by Dr. Wright, a meeting was arranged during which S. E. Fennell, Q.C., of Cornwall, chaired a panel discussion of four outstanding industrial managers in this area: C. I. Bacon of Cornwall Street Railway, I. W. Douglas of Courtaulds (Canada), I. E. Mason of Howard Smith Paper and F. Robertson of Canadian Industries. Problems of management were well threshed out.

The meeting introducing A. G. Murphy, port manager for Montreal, covered the highlights of harbour engineering. Mr. Murphy has recently been appointed chief engineer of the St. Lawrence Seaway for Canada. At the final spring meeting G. Lorne Wiggs discussed heating, stressing in particular the Manufacturers' Life Building in Toronto. As he is both a good speaker and probably the outstanding authority on radiant heating in this country, the evening was one to remember.

The fall program opened with a visit to T.C.F. of Canada Limited, manufacturers of transparent cellulose film, commonly known as cellophane. The following meeting was a joint one with the American Institute of Electrical Engineers in Massena. After dinner in the company cafeteria, two departments of the Aluminum Company of America were visited.

Members' Night in October was of outstanding interest. Messrs. Corbett, Miller, Nesbitt, Rothwell, Stidwill and Wyatt each presented 15-minute talks on industrial engineering, health engineering, the Eddy current coupling, hydraulic speed control, land-sub-division and permutit water treatment.

At the annual meeting in December the Branch was favoured by a visit by B. G. Ballard of the National Research Council, who is vice-president of the Engineering Institute of Canada, and Col. H. G. Thompson, executive assistant general secretary of the Institute. The meeting took the form of a dinner at the Golf Club. It closed with a showing of the outstanding colour film on Kitimat, "Man with a Thousand Hands" which is distributed by the Aluminum Company of Canada.

The Cornwall Branch did not operate a profcssional development course during 1954.

Eastern Townships Branch

The Eastern Townships Branch was one of the most fortunate branches this year in that it was gratified with a visit from the president, Dr. D. M. Stephens, September 15, 1954. This visit coincided with the resumption of activities after the summer holidays, and was made the occasion of a dinner and dance at the Hillcrest Lodge where the president spoke on the future of the engineering profession. Dr. L. A. Wright and a few other distinguished guests accompanied the president on his visit.

Another highlight was a joint meeting of the Corporation of Professional Engineers of the Province of Quebec and the Engineering Institute of Canada on December 10, 1954, at which the Corporation's president, Georges Demers, and the secretary, Leopold Nadeau, were present.

After the buffet dinner, Mr. Demers gave some news of the Corporation's activities. Mr. Nadeau answered some searching questions from the floor, and everyone came out of the meeting thinking what fine fellows engineers were.

The Branch has been active on the subject of confederation. Several committee meetings were held, at which views were discussed, existing reports on confederation studied, and the Branch's thinking generally straightened out on the subject.

A draft was finally prepared and copies of it sent to both Institute headquarters and Corporation headquarters.

Whenever possible, joint meetings will be held, as some sort of a start towards unity.

Edmonton Branch

During the year 1954, the Edmonton Branch sponsored 11 activities, consisting of dinner meetings with technical talks, smokers, an annual dance in October and an annual picnic in June.

A Public Speaking Group, in its second year of activity, was responsible for one of the dinner meetings this year. The meeting took the form of a panel discussion by three members of the Public Speaking Group on the subject "Edmonton's Traffic".

The average attendance at the meetings was around 100. The executive feels that this is not a large enough attendance for the membership and have plans for its improvement.

The Edmonton Branch has a very active Engineers' Wives Division. The Engineers' Wives sponsor many activities for their own membership and they also have a mixed bridge which meets every second Friday evening, and is proving to be a great success. They also held a cocktail party which brought so many favourable comments that it is likely to become an annual affair.

The Edmonton Branch has enjoyed a very successful year, and plans are for an even bigger year in 1955.

Fredericton Branch

The year 1954 was a very active one for the Branch. There were 12 executive meetings and ten Branch meetings. The executive meetings were usually held on the first Monday of each month and the Branch meetings on the third Monday.

One of the highlights of the year was the May meeting. Members of the other three branches in New Brunswick were invited to join this Branch on May 7 to hear J. Herbert Smith speak on his "Plan for Unity". One hundred and forty members heard his presentation of the professional and technical obligations of the professional engineer and his plan for unification of all engineering organizations in Canada. A resolution was unanimously carried that the meeting was in favour of the plan.

The Branch co-operated extensively with the University of New Brunswick during its celebration of the Centennial of Engineering Education at the University. The celebration was climaxed by the Founder's Day program in which the Institute took a very active part.

The chairman, Charlie Weyman, presented a clock to the University president, Colin B. MacKay on behalf of the Institute. Dr. John B. Stirling, a past-president of the Institute, was presented a key by the University Engineering Society president, Laurie Coles. The key was an exact replica of a key to Canada's oldest university building, the one in which Canada's first lectures in engineering were delivered one hundred years ago to the day. It was cast and finished by the mechanical engineering department of the University. Dr. Stirling then delivered the Founders' Day address which was most enthusiastically received.

In January, our members and their ladies heard a talk by Dr. Arnold McAllister on some aspects of the Bathurst mining developments.

In February, the Branch and the U.N.B. Engineering Society jointly sponsored a very successful formal dance and in March, Alderman Horace Hughson, M.E.I.C., spoke on "Civil Defence".

The annual meeting and election of officers was held in April and the season

was brought to a close with a semi-formal dance in June.

On September 7, President Stephens visited the Branch accompanied by Dr. Wright. While the executive met with the president and the general secretary, Mrs. Stephens was entertained by the ladies. In the evening the presidential party was entertained at a corn-boil a few miles from Fredericton.

A smoker was held in October. In November the Branch met in Grand Falls with non-resident members and several guests from the State of Maine. Mr. Birchard of Fraser Companies Limited spoke on "Engineering Education" and in December the group heard Horace Pettigrove of the Labour Relations Board discuss some labour-management problems.

Four Professional Development lectures were held during the year; one each on taxation, insurance, current affairs, and banking. The program for the next year will be reduced. New speakers and member interest are becoming more difficult to obtain.

Halifax Branch

During the past year a total of 11 meetings including the annual meeting on December 15, 1953, were held.

The joint annual banquet took place on January 28, 1954, with Mayor Donahoe speaking on "Your Profession". On February 11 Dr. S. J. Mazur spoke at the Nova Scotia Technical College on "Experimental Matters in Computing Stresses" and the student's night meeting was held in the Sea Gull Club on February 22 at which Col. L. F. Grant spoke on "Canadian Engineering Achievements". J. C. MacGuire of Imperial Oil Ltd., Sarnia, spoke on "Petroleum Refinery Modernization" at the Nova Scotian Hotel on March 18. The Association of Military Engineers have for some time held one joint meeting a year with the Branch. This year the joint meeting with them on April 6 took place at their Mess at the Armouries. Major Mitchelltree spoke on "Army Engineering Research in the Arctic". On April 22 E. D. Brown, General Manager, National Gypsum (Canada) Limited, spoke on "National Gypsum's New Development at Milford, N.S.". This meeting was held at the Nova Scotian.

On May 11 a joint buffet supper meeting of the Branch and A.P.E.N.S. was held at the Y.M.C.A. to hear J. Herbert Smith speak on "A Plan for Unity". On October 20 the first meeting of the fall season took place at the Bluenose Lodge, Lunenburg, at which Dr. George Lawrence, a research director at the Chalk River atomic plant spoke on "Atomic Power Plants". Since Col. Grant decided to visit the Branch again in 1954, a Students Night was held before Christmas at the Sea Gull Club where the students were entertained and Col. Grant spoke on "A Canadian Problem".

In addition to the aforementioned the chairman met with the students at St. Mary's and Acadia Universities and held separate meetings with Dr. Grant in Wolfville and Bridgewater for the members in that area. He also spoke to the Calgary Branch during a visit west.

The Professional Development Committee is continuing its work, so well begun last year. In 1955 activities are under Chairman Professor Vail and under Father Fogarty on Public Speaking and Diction.

The real highlight of our year, of course, was the joint meeting of the Professional Association and the E.I.C. in the Atlantic area held at the Digby Pines from September 8 to 11. The work of putting on this show every four years at the Pines in Digby falls upon this Branch. This year's chairman, Rod Fournier, can well be proud of his achievement and credit goes to him and his committee. As one result of this meeting the ladies of this Branch have formed a ladies' group, which should be a distinct addition to Branch activities.

Hamilton Branch

During 1954 membership levelled off after a definite upward trend in the last few years. Total membership now stands at 465 as it was in 1953. There has been an increase in both the Member and Junior groups but this has been offset by a substantial decrease in the Student group due mainly to the fact that fewer graduate engineers are being hired in this area.

The seven meetings held this year were well supported by the membership. In addition, two field trips were staged and both met with the usual success. It was necessary to abandon the buffet supper or dinner type of general meeting due to poor attendance.

Again the Annual Engineers' Ball, held in October, was the success this function should be and despite the ravages of "Hurricane Hazel". It is certain that this function has its place in the year's activities.

Five committees deserve special mention this year. The Students' and Juniors' Paper Competition Committee for the annual night which, while not having the usual numbers of contestants as in previous years, was as excellent and as entertaining. The Ball Committee is to be congratulated for the social and financial success of their efforts. The Budget Committee produced an accurate forecast so that the Branch's finances were in order throughout the year. The Professional Development Program Committee was again very successful and proved that this program is a very worthwhile endeavour for this Branch. The Program Committee is to be congratulated also, for their work produced a very acceptable, informative and varied series of lectures and field trips for the Branch membership.

We record with regret the untimely death of E. M. Coles.

In the 1953-54 season the Professional Development Program was extended in the scope of its activities, having four separate groups, with a total registration of 74 members.

For the 1954-55 season the program was changed, more publicity was given and more promotional work undertaken. The plan is now based on three groups. Enrolment is high, and the organization is as follows:

Group I, an introductory course following the pattern of other years, with chairman R. M. Howchin; Group II, an advanced course with a revised program, chairman W. A. Filer; Group III, concerned with business management and incorporating the case-study method, chairman W. H. Hahn. E. W. Hill is program director of the Professional Development Program.

Huronia Branch

This was the first full year of operation for the Huronia Branch. Nine meetings were held throughout the year and the executive is pleased with the progress of the Branch and the interest shown by the membership.

A meeting at which the St. Lawrence Power Project was the topic commanded the largest attendance. At this meeting the Branch was honoured by the presence of Dr. R. L. Hearn who gave a very informative talk on the Power Project, the Ontario Hydro in general and on how the Ontario system is tied in with power companies in other provinces of Canada, and States of the U.S.

The other eight meetings were made up of a plant visit to Wm. Kennedy and Sons, Ltd. in Owen Sound, and meetings on such varied topics as town planning, corrosion, sewage treatment and mixing of liquids.

Since the Branch covers a large area, the policy of the executive is to hold meetings in as many of the various centres as possible. In this past year two meetings were held in Owen Sound and the remainder in Orillia.

During the coming year the executive plans to hold one or two meetings in Barrie as well.

Kingston Branch

Early in 1954 executive members of the Kingston Branch travelled to Brockville to present a pennant to the newly formed Brockville Branch. With the formation of the Brockville Branch the membership of this Branch has decreased considerably this year.

A series of monthly meetings was held from January to May, the highlights being the annual general meeting, a joint dinner meeting with the Chemical Institute of Canada, and a joint meeting with the Kingston Metallurgical Society. In addition, the annual Student's Paper Night was held in February.

The fall program was commenced with the Kingston Branch participating in a joint meeting with the Brockville and Cornwall Branches in welcoming the E.I.C. president at Brockville. Two additional meetings were held, a very interesting one being a panel discussion on the plan for confederation.

Kitchener Branch

In February of 1954 the Kitchener Branch held a joint meeting in Brantford with the Grand Valley Group of Engineers who will come to the Kitchener Branch in March of this year. A very successful dance was held at Leisure Lodge in April and in May a very interesting field trip to the Steel Company of Canada was arranged. In June there was the annual golf tournament and in September the annual stag at St. Jacobs. Some very good technical meetings were of course held through the year and these were very well received.

One of the most interesting meetings was a visit to the Television Station in Kitchener in December with the wives of the members invited. A luncheon was served afterwards at the Officers Mess Knollwood Park, Kitchener, which is the usual eating place.

This Branch has not attempted any professional development course since it has been preferable to work in with the Hamilton Branch program. However consideration is being given to a course at Western University in the Spring of 1955.

The Kitchener Branch has not had a particularly successful year financially speaking. However, the deficit can be attributed to high meeting costs shared by a relatively small membership. But apart from the financial condition the Branch has had a very successful year.

Kootenay Branch

The Kootenay Branch enjoyed a very active year during 1954. A total of nine executive meetings and ten Branch meetings were held during the year.

The Branch membership showed a slight decrease during the year. This was largely due to the completion of a number of large construction jobs in the district.

After a lapse of one year the Professional Development course was again sponsored by the Branch, and has proved very popular with both members of the Engineering Institute of Canada, and those of other technical societies. A total of thirty-one members were enrolled.

Junior Night was again well received by the membership. It was chaired by W. E. Lawrie, and papers were presented by George Bowers, who spoke on the "Manufacture of Saw Bits", and Eric Jones, who spoke on "Mathematics—Queen of the Sciences". Plans were immediately made to have another Junior Night the following year.

Ladies' Night was held in September and proved very popular and entertaining for the members and their wives. J. V. Rogers gave a very interesting talk and showed slides of his recent tour around the world.

President and Mrs. D. M. Stephens, and Dr. L. Austin Wright, spent three days in the Kootenays. A total of three meetings were held during their stay; a luncheon meeting in Nelson, B.C., a luncheon meeting in Trail, B.C., and a banquet in the Tadanac Community Hall, sponsored by the Committee of Technical Societies, and held under the auspices of the Kootenay Branch.

Film Night was attended by 130 members and their friends. The following three sound and color films were shown: "Man with a Thousand Hands", by International Harvester Co., showing the construction of the Kenney Dam, the Kemano Powerhouse, and the power line from Kemano to Aluminum Plant at Kitimat, B.C.; "Lightning Masters", by General Electric Co., outlining the progress made in developing lightning arrestors to protect the many power lines spanning the nation; "Australia's Coral Wonderland", showing pictures of the undersea life in Australia's coral reefs.

Lakehead Branch

During 1954 the Lakehead Branch held its regular monthly meetings. These meetings took various forms. There were two field trips, one in the spring to see the operation of the Abitibi Power and Paper Co. Ltd. Pyrite burning plant at their Thunder Bay Mill in Port Arthur, and one in the fall to Red Rock, some seventy miles east of Fort William, to see the new stacker reclaimer for pulpwood and also the new Inglis paper machine in operation. Both of these trips were very educational.

A third meeting featured a lecture and film on the construction of the addition to the CNR ore dock here in Port Arthur. The CNR extended the invitation to the Lakehead engineers to see their operation.

During 1954 the Lakehead Branch had two dinners for the president. The first time President R. L. Dobbin was snowbound in Sault St. Marie. On the second occasion the president did not put his trust in air travel. He arrived safely by train. The Branch enjoyed his visit and his talk on the Coronation.

Other meetings of the year featured either films or speakers. The annual meeting took place in June at which time changes in office took place.

The Branch did not sponsor any Professional Development course this year.

Lethbridge Branch

The year 1954 was highlighted by two field trips, and official visits by two presidents. In February, President Dobbin visited the Branch, and President Stephens was able to arrange his visit in November to coincide with the annual joint meeting with the professional association. Both meetings were well attended, and over one hundred persons attended the second meeting which is a record attendance.

In April the regular meeting was held in Medicine Hat where several Branch members reside. This visit was combined with a field tour through the new Steam-Electric Generating Station, and through various potteries and glass works. It was hoped that it would be possible to make an annual visit to Medicine Hat.

In September, a field trip and joint meeting with the Montana Section of A.S.C.E. was held at the Tiber Damsite in Montana. Both tours were well attended, and we were fortunate in obtaining excellent weather for both occasions.

A Ladies' Night was held in December. The ladies were invited to the meeting welcoming President Dobbin in February. Ladies' Nights have proved to be very popular with this Branch. All regular meetings of the Branch were dinner meetings. Entertainment and community singing were included in addition to the main programs.

London Branch

In January, 1954, a very successful Ladies' Night was held at the Hotel London. The attendance was not as large as anticipated, but everyone there reported a most enjoyable evening.

At the February meeting, Dr. T. A. Boyd, of the research laboratories division of General Motors Corporation, gave a very interesting paper entitled "Trail Blazing in Industry Today".

In March, Professor W. L. Sagar, president of the Ontario Association of Professional Engineers, brought the members up to date on the status of the proposed union of the Association with the E.I.C.

The April meeting was turned over to Dr. G. Edward Hall, president of the University of Western Ontario. He discussed the new Junior Engineering Course starting at Western in September 1954.

The May meeting took the form of a field trip to see the new hydro developments at Niagara Falls. One bus load of members made the trip.

In June the members were conducted on a tour of the Upper Thames Valley Authority dam at Fanshawe. The U.T.V.A. secretary, L. N. Johnson, reviewed the progress to date and some of the future plans.

Monthly meetings were resumed in October when Allan J. Barker, director of the London and Surburban Planning Board, reviewed the Board's activities.

In November, J. J. Carsons, manager of the manpower planning and development department of the Ontario Hydro, outlined the Commission's current program.

The annual "Feather Party" in December was an outstanding success. There was a very gratifying turnout and a good evening was enjoyed by everyone present.

Lower St. Lawrence Branch

Two executive meetings and four Branch meetings took place during the year.

Col. L. F. Grant, the Institute field secretary visited the Branch and presented a paper on the St. "Lawrence Seaway Project".

In April the engineers and their wives attended a social event under the patronage of Leo McLaren, chairman of the Branch. After refreshments a banquet and a dance took place. Brigadier Maurice Archer, vice-president of the National Harbour Board was the guest speaker of the evening banquet. He spoke on the economic possibilities of the St. Lawrence River, its Maritime traffic from the Great Lakes to the Atlantic Ocean, and the future development of the seaway. He also outlined the importance of the hydro-electric development in the river's international zone.

In May, some 20 engineers attended a presentation of five films at the Curling Club. The local plant of the Canada Wire and Cable Company presented two films on the construction of cables. Three films on construction of roads, bridges and seawalls were also shown. These were loaned to the Branch by Georges Demers, who received them from La Société des Ingénieurs civils de France.

Moncton Branch

A total of nine technical, business and social meetings were held during the year. Papers were presented dealing with "Heavy Duty Oils", "The St. Lawrence Seaway Project", "Power Possibilities of the St. John River", and "Progress in the Dieselization of Canadian Railways". One meeting was devoted entirely to a discussion of problems confronting the engineering profession. All meetings were luncheon or dinner meetings.

A very successful ladies night was held on April 23. Branch officers for 1954-55 were installed at the annual meeting on May 17.

President D. M. Stephens, accompanied by Mrs. Stephens and the general secretary, L. Austin Wright, visited the Moncton Branch on September 13. In the evening, a mixed dinner meeting was addressed by the president and Dr. Wright. In the afternoon the two officers from headquarters met with the branch executive. Also in the afternoon, Mrs. Stephens was entertained at tea by the wives of the executive at the home of Mrs. M. F. K. Leighton, wife of the Branch chairman.

Montreal Branch

Members participating actively in the work of carrying on the activities of the Branch numbered approximately 120 in 1954.

The subject of confederation of the Engineering Institute with the professional associations and other technical bodies has become one of importance and of close study during the year. The chairman and several members of the Institute committee set up on this subject, are members of the Montreal Branch.

Membership of the Branch shows an increase in all classes. The program continued on an excellent plane, with one meeting being conducted entirely in the French language. Another innovation was the holding of a meeting immediately after business hours at which refreshments were served.

Membership and Financial Statements o

BRANCHES	Amherst	Belleville	Border Cities	Brockville	Calgary	Cape Breton	Central British Columbia	Corner Brook	Cornwall	Eastern Township	Edmonton	Fredericton	Halifax	Hamilton	Huronia
MEMBERSHIP															
Resident															
Hon. Members			5								4		1	4	
Members	24	35	60	26	255	45	21	16	24	29	266	77	240	169	22
Juniors	5	27	85	25	181	23	22	11	13	38	270	23	54	223	31
Students	2	5	8	6	28	5	5	2	9	13	76	63	60	58	7
Affiliates		2	2	4	1	1			4	14	2		1	8	10
Total	31	69	160	61	465	74	48	29	50	94	618	163	356	462	70
Non-Resident															
Hon. Members			3												
Members	1	4	13	4	15	5	2	6	2	27	29	15	83	1	
Juniors	2	6	11	2	31	6	3	9	1	29	41	10	32	2	
Students	1	4	4	2	6			2		3	14	2	33		
Affiliates							1			2					
Total	4	14	31	8	52	11	6	17	3	61	84	27	148	3	
Grand Total Dec. 31st, 1954	35	83	191	69	517	85	54	46	53	155	702	190	504	465	70
" " Dec. 31st, 1953	37	80	240		429	85	62	31	76	160	677	175	483	465	48
Branch Affiliates, Dec. 31st, 1954		8	—2		50	19	13		4	16	6				10
FINANCIAL STATEMENT															
Balance as of Dec. 31st, 1953	49.89	236.99	655.15	100.00	503.44	249.24	252.90	106.74	183.77	388.31	1,644.18	299.76	422.15	240.88	388 60
Income															
Rebates from E.I.C. Hq	55.05	256.80	581.70	160.00	235.20	58.50	118.50	250.30	174.30	346.60	375.50	378.40	198.20	978.00	163.20
Payments by Prof. Assns.	61.05				931.95	219.30					1,216.86		941.50		
Branch Affiliate Dues		84.00	7.00	39.00	309.00	200.30	117.85		12.00	267.13	110.45			68.50	87.00
Interest					37.37					4.43			3.80	50.31	
Miscellaneous		81.30	621.25	960.55	74.66	649.50	18.07	53.95		272.74	81.15	898.71	399.55	186.31	
Total Income	116.10	422.10	1,209.95	1,159.55	1,588.18	1,127.60	254 42	304.25	186.30	890.90	1,783.96	1,277.11	1,543.05	1,283.12	250.20
Disbursements															
Printing, Notices, Postage①	9.90	49.01	212.04	10.99	606.03	40.75	61.75	5.20	47.13	34.60	903.17	146.44	361.63	489.31	120.20
General Meeting Expense②	2.00	196.00	216.05	36.95	459.34		104.96	23.91		127.96	55.00	383.27	205.00	201.25	56.15
Special Meeting Expense③	47.96		702.05	1,073.95	189.30	747.51		241.87	148.60	369.04	535.34	664.62	608.55	134.35	55.00
Honorarium for Secretary											100.00		100.00	29.00	
Stenographic Service	10.00		30.00				5.00						36.00	21.00	9 56
Travelling Expenses④		24.60		37.00									75.00		
Subs. to other organizations															
Subs. to *The Journal*		36.00		17.15	71.34	96.00	36.00			70.08	8.00			16.00	36.60
Special Expenses		25.00	56.56		25.22	10.00	5.00		27.19	10.25	6.50		120.25	250.00	
Miscellaneous		.15		17.14	14,38			2.00	26.50	1.60	30.00	4.66	3.00	75.28	
Total Disbursements	69.86	330.76	1,216.70	1,193.18	1,365.61	894.26	212.71	272.98	249.42	613.53	1,638.01	1,198.99	1,509.43	1,216.19	277.61
Surplus or *Deficit*	46.30	91.34	*6.75*	*33.63*	222.57	233.34	41.71	31.27	*63.12*	277 37	145.95	78.12	33.62	66.93	*27.41*
Balance as of Dec. 31st., 1954	96.19	328.33	648.40	66.37	726.01	482.58	294.61	138.01	120.65	665.68	1,790.13	377.88	455.77	307.81	361.19

①Includes general printing, meeting notices, postage, telegraph, telephone and stationery.

②Includes rental of rooms, lanterns, operators, lantern slides and other expenses.

③Includes dinners, entertainments, social functions, and so forth. ④Includes speakers, councillors or branch officers.

the Branches as at December 31, 1954

Kingston	Kitchener	Kootenay	Lakehead	Lethbridge	London	Lower St. Lawrence	Moncton	Montreal	Newfoundland	Niagara Peninsula	Nipissing and Upper Ottawa	Northern Nova Scotia	Northern New Brunswick	North Eastern Ontario	Ottawa	Peterborough
5	.	.	.	.	.	.	.	6	.	7	.	.	.	.	3	1
66	33	23	45	31	63	21	51	1,658	36	104	21	35	28	25	389	50
48	33	17	47	22	67	31	23	1,201	30	132	9	16	34	41	239	62
79	9	5	5	1	4	21	10	1,044	18	18	3	6	8	3	142	10
9	5	13	4	.	3	2	1	19	.	2	3	..	1		2	.
207	80	58	101	54	137	75	85	3,928	84	263	36	57	71	69	775	123
..	..	.	.	..	..	..	.	.	.	.	.	.	.	.	..	..
4	..	13	18	21	31	..	1	81	10	3	5	2	.	.	27	5
4	..	15	22	13	29	.	..	75	18	2	9	1	.	.	61	7
4	.	6	4	3	13	..	.	59	11	.	4	.	.	.	26	2
.	.	..	.	..	..	.	.	2	.	.	.	.	.	.	..	..
12	..	34	44	37	73	..	1	217	39	5	18	3	.	.	114	14
219	80	92	145	91	210	75	86	4,145*	123	268	54	60	71	69	899	137
349	83	111	135	94	162	74	87	3,885	124	270	65	53	65	66	841	137
9	5	13	5	47	..	2	5	4	.	2	3	..	..	..	8	10
676.53	175.72	282.44	345.00	310.19	620.29	94.53	779.83	8,722.61	315.12	762.74	303.22	141.97	78.33	408.17	1,244.89	192.64
508.50	259.50	264.30	387.30	146.70	623.05	226.35	132.60	8,217.00	303.20	676.50	189.60	19.70	145.80	179.70	1,523.20	385.50
..	..	.	.	171.45	..	..	72.00	..	.	.		66.30	22.00	..	..	
108.00	54.00	40.00	60.00	135.00	..	.	28.00	24.00	.		42.25	..		.	70.00	4.00
	1.73	.	3.00	..	..	..	58.49	158.80		16.60		.		1.24	48.16	3.02
344.25	117.50	906.28	797.31	156.60	468.60	190.00	450.93	2,732.41	610.07	825.90	631.06		128.97		..	30.01
960.75	432.73	1,210.58	1,247.61	609.75	1,091.65	416.35	742.02	11,312.21	913.27	1,519.00	862.91	86.00	296.77	180.94	1,641.36	422.53
88.15	61.30	92.96	124.32	119.44	278.76	17.67	53.37	2,825.01	66.33	285.65	94.35	9.08	20.00	17.52	418.28	155.64
843.40	75.60	21.84	135.15	124.55	229.50	46.64	16.00	322.10	35.61		25.00		18.00	29.62	32.25	27.50
147.50	298.31	1,001.31	796.06	212.80	623.91	175.08	548.21	4,259.91	749.06	608.19	812.63	46.65	132.75	134.50	409.85	111.26
			22.00	25.00	.	6.42	50.00	900.00		75.00	.	.		25.00	100.00	..
	10.00					..				8.00		16.15		29.65	.	
										75.00		.				
		25.00				10.00									270.00	
36.00	24.15	.	20.15		..		20.15	4.00		.	16.30					
	18.50	15.26	118.16			15.00	.	831.90	67.48	100.25		9.50			531.28	
	1.20	2.60	8.64	73.31	19.50		35.69	649.88	10.15	131.02		10.30	.36	5.79	15.10	15.20
1,115.05	489.06	1,158.97	1,224.48	555.10	1,151.67	270.81	723.42	9,792.80	928.63	1,283.11	948.28	91.68	171.11	242.08	1,776.76	309.60
154.30	*56.33*	51.61	23.13	54.65	*60.02*	145.54	18.60	1,339.41	*15.36*	235.89	*85.37*	*5.68*	125.66	*61.14*	*135.40*	112.93
522.23	119.39	334.05	368.13	364.84	560.27	240.07	798.43	10,062.02	299.76	998.63	217.85	136.29	203.99	347.03	1,109.49	305.57

*For voting purposes only, there should be added to Montreal Branch an additional 675 members, 368 resident in the United States, 213 in British possessions, and 94 in foreign countries

MEMBERSHIP AND FINANCIAL STATEMENTS OF THE BRANCHES

Continued

BRANCHES	Port Hope	Prince Edward Island	Quebec	Saguenay	St. John	St. Maurice Valley	Sarnia	Saskatchewan	Sault Ste. Marie	Sudbury	Toronto	Vancouver	Vancouver Island	Winnipeg	Yukon
MEMBERSHIP															
Resident															
Hon. Members	1							1			2		..	1	..
Members	13	16	138	68	65	73	73	374	20	32	774	302	92	299	9
Juniors	6	10	150	64	19	108	81	50	13	28	810	254	40	187	10
Students	4	2	230	7	9	33	13	74	6	5	175	127	5	145	1
Affiliates		1	1	..	1		1	.	1	3	8	1	.	29	20
Total	24	29	519	139	94	214	168	499	40	68	1,769	684	137	661	40
Non-Resident															
Hon. Members			.	..	.				.		..	..	..	..	..
Members			9	1	7	8		11	3	3	28	35	17	14	2
Juniors		1	13	2	3	6		27	7	..	47	65	21	41	2
Students		1	17	3	3	3		11	5	1	7	25	6	16	..
Affiliates			..		..			2	.	1	2	.	–	6	..
Total		2	39	6	13	17		51	15	5	84	125	44	77	4
Grand Total Dec. 31st, 1954	24	31	558	145	107	231	168	550	55	73	1,853	809	181	738	24
" " Dec. 31st, 1953	31	38	574	144	125	257	151	481	52	80	1,761	745	175	716	20
Branch Affiliates, Dec. 31st, 1954	.	7		4	11	1	1	2	5	4	1	1	1	35	8
FINANCIAL STATEMENT															
Balance as of Dec. 31st, 1953	219.43	51.34	661.36	551.87	602.10	289.17	400.51	402.31	944.86	573.35	2,512.43	415.50	473.21	2,585.15	..
Income															
Rebates from E.I.C. Hq	85.00	100.00	830.13	515.95	201.60	663.00	348.00	149.80	133.20	259.50	3,239.00	1,678.16	373.00	441.00	200.00
Payments by Prof. Assns.	..	.		43.04	94.00	..		892.81	..	..	75.40	..	.	898.95	..
Branch Affiliate Dues	.	..	..	7.00	143.00	.	..	.	54.00	48.00	10.00	..	3.00	177.00	50.00
Interest	.	..	.	.	.	3.74		.	8.04	3.82	57.93	18.12	..	36.00	..
Miscellaneous	.	.	48.68	702.29	29.78	550.00	556.75		249.00	13.25	1,404.50	626.50	88.88	955.80	109.05
Total Income	85.00	100.00	878.81	1,268.28	468.38	1,216.74	904.75	1,042.61	444.24	324.57	4,786.83	2,322.78	464.88	2,508.75	359.05
Disbursements															
Printing, Notices, Postage①	.	4.13	259.43	45.71	82.59	203.17	38.28	75.21	29.15	127.21	1,996.42	315.83	48.33	481.48	18.30
General Meeting Expense②	60.10		12.00	122.08		39.44	110.00	518.67		81.25	515.59	272.29	50.86	110.43	131.89
Special Meeting Expense③	31.25	49.78	284.72	928.41	185.67	606.11	679.52		485.60	145.45	1,407.40	666.55	281.79	1,042.91	41.50
Honorarium for Secretary	.		150.00	60.00		20.00	.	120.00	25.00	..	125.00	70.00	50.00	150.00	..
Stenographic Service	7.70		50.00		30.00	9.84	.	50.00	.	.	.	30.00	..	181.86	..
Travelling Expenses④	.				140.65		13.45	128.93			.	40.00	17.15	67.45	..
Subs. to other organizations								.			..	..	..	3.00	..
Subs. to *The Journal*				16.00	28.00			.	24.00	20.00	..	..	..	68.00	..
Special Expenses		12.00	30.10			132.74	25.00		2.50	9.18	300.00	232.98	..	30.00	..
Miscellaneous	.30		63.07		13.13				.	5.00	475.22	110.42	44.80	29.25	..
Total Disbursements	99.35	65.91	849.32	1,172.20	480.04	1,011.30	866.25	892.81	566.25	388.09	4,819.63	1,738.07	492.93	2,164.38	191.69
Surplus or *Deficit*	*14.35*	34.09	29.49	96.08	*11.66*	205.44	38.50	149.80	*122.01*	*63.52*	*32.80*	584.71	*28.05*	344.37	167.36
Balance as of Dec. 31st., 1954	205.08	85.43	690.85	647.95	590.44	494.61	439.01	552.11	822.85	509.83	2,479.63	1,000.21	445.16	2,929.52	167.36

① Includes general printing, meeting notices, postage, telegraph, telephone and stationery.

② Includes rental of rooms, lanterns, operators, lantern slides and other expenses.

③ Includes dinners, entertainments, social functions, and so forth.

④ Includes speakers, councillors or branch officers.

The program committee consisted of Chairman R. A. Phillips, J. E. Hurtubise, W. H. Gauvin, and Secretary L. L. Langille. There were 20 general meetings on Thursdays, sponsored by sections of the branch, as well as 31 separate section meetings and plant visits held on other than Thursday evenings. The range of subjects treated was consequently wide.

The Chemical Section, under Chairman L. A. Phillips, held 4 section meetings and arranged two Thursday meetings. The Civil Section, with Chairman L. E. Mitchell, was responsible for three general meetings and for a program of six section meetings. The Electrical Section in a joint program with the American Institute of Electrical Engineers held 11 section meetings. The chairman was D. A. J. McDonald. M. J. Oldershaw was chairman of the Management Section, carrying out four section meetings and five general meetings. The Mechanical Section, with Chairman P. J. Kunstler, arranged two Thursday meetings as well as five section meetings. The Transportation Section planned three general meetings and one section event, a forum on materials handling. The chairman was H. N. Young. A special section, with chairman W. H. Gauvin, arranged three of the general meetings.

The Student Guidance Committee received 425 high school students at three meetings, one in English and two in French.

The Junior Section included in its fall program a seminar of four sessions dealing with problems of the young engineer. The section chairman was L. J. Hammerschmid. The year's program included the annual meeting, the annual students night, a golf tournament, an oyster party and the tenth annual dance.

Committees on Entertainment (L. Scharry, chairman), Publicity (J. A. Paget), Policy and Coordination (C. E. Frost), Membership (G. Aiello), Reception and Attendance (E. D. Gray-Donald), carried on special work during the year.

The annual joint E.I.C.-C.P.E.Q. Golf Tournament was held in June 1954.

Newfoundland Branch

The Newfoundland Branch enjoyed a very successful year. Ten meetings were held, of which three were purely business meetings. The programs covered a wide range of subjects with outside speakers and members of our own branch taking part.

Special features during the year were the Annual Dance and Students' Night. The dance was the most popular event and proved very profitable. The Students' Night is held annually at which three students from Memorial University present papers on subjects of their choice. A prize is awarded at the annual dinner meeting.

The Engineers' Wives Club was very active and organized a bridge tournament so that members would have an opportunity to get acquainted.

Niagara Peninsula Branch

During the year eight general meetings were held.

A dinner meeting was held in Welland in January at which Hugh R. Summer of the Bell Telephone Company of Canada discussed his Company's Buffalo-Montreal micro-wave system. The following month six junior members presented papers at the Junior Speakers' Night in Thorold. C. A. McDonald won first prize; second prize was awarded to Mr. H. J. Saaltink.

In March H. C. Tucker spoke on the subject, "The English Electric Co. of Canada Ltd.", at a dinner meeting in St. Catharines.

The April meeting took the form of a dinner meeting in Niagara Falls, at which J. L. Gray of Atomic Energy of Canada, Ltd., discussed atomic energy developments.

The Annual Meeting and Ladies' Night took place in Niagara Falls in May. Douglas Walkington of Canadian Industries Limited spoke on the subject, "Chemistry and You".

The membership again toured the H.E.P.C. project at Niagara Falls in September and enjoyed a steak dinner at the commission's cafeteria. Frank Dobson discussed developments that were taking place, including the remedial works at the Falls, and the pumped storage project.

In October C. M. Stairs of Canadian General Electric Co., Ltd. spoke on the subject, "Lightning and Insulation Coordination", at a dinner meeting in St. Catharines.

During the month, also, the Association of Professional Engineers of Ontario and the Niagara Branch, E.I.C. sponsored an Engineers' Ball in Niagara Falls. The Engineers' Ball proved very successful and the members felt that it would become an annual event.

The members were conducted in November on a tour through Welland Electric Steel Foundry Ltd. After dinner the members enjoyed a talk by the chairman of the Niagara Peninsula Branch, H. D. Davison, on casting and fabricating of stainless steels.

In 1954 the Branch by-laws were amended and were approved by Council and by the Branch membership.

North Eastern Ontario Branch

Three Branch meetings were held during the year. President R. L. Dobbin spoke of an "Engineer's View of the Coronation" at the dinner meeting in Cochrane in January. The annual meeting was held in March in Kapuskasing as a prelude to a dinner dance.

Summer activities were attempted with a two-day social and sporting weekend in Kapuskasing in June. Out-of-town members and their wives from Matheson, Iroquois Falls, Cochrane and Smooth Rock Falls were billeted with Kapuskasing members for the activities which included dining, dancing, golfing, fishing and a picnic.

The Eastern Section (Cochrane, Iroquois Falls, Timmins) hampered by a now small scattered membership was inactive for the year except for branch activities.

The Western Section (Smooth Rock Falls, Kapuskasing) held six section meetings featuring local speakers in the main for their programs. Subjects ranged from grinder grit in newsprint stock, maintenance programs to man-methods. A group made a trip to Terrace Bay in November to tour the Long Lac Pulp and Paper Mill.

The Professional Development Committee of the Western Section was active during the year. Two sessions have been held on "Investment Policy for the Individual" with about eighteen in attendance. The most popular course proved to be public speaking and debating. Every Section meeting has a tyro speaker rise and summarize the last council's minutes for the group. In the fall four debating sessions were attended by eighteen members. Controversial subjects were hotly debated, followed by judges and critics who rose to constructively criticize all speakers.

The Branch's main problem—distance—remains to be overcome. Roads, however, have been improved and with better programs for meetings, attendance should steadily increase.

Northern New Brunswick Branch

The year 1954 was one of progress as well as consolidation for the Northern New Brunswick Branch. A full schedule of meetings was carried out and an average attendance of about 50 per cent of the membership was realized.

The first meeting of the year was held in Bathurst on February 4. Mr. White of Gill and Company presented the film "The Great Jib". A discussion period followed by refreshments completed the program. A welcome visitor in the person of the field secretary, Col L. F. Grant, attended this meeting.

Again in February another meeting was held, this one in Dalhousie. The program included an industrial instrument display by Honeywell followed by a dinner meeting and talk on "Steam Plant Instrumentation".

A short business meeting was held in April in Dalhousie. A film entitled "Steam Progress" was shown followed by a talk by H. M. Esdaile of Combustion Engineering Corporation. A visit to the International Paper Company steam plant rounded out the program.

The annual meeting of the Branch, a Ladies' Night, was held in Bathurst on May 29. This was a dinner meeting with a brief business session including the installation of new officers. The guest speaker, Prof. R. J. Love, head of the department of education of the University of New Brunswick, spoke on education with pertinent references to engineering. A dance followed the dinner to complete this popular annual event.

Branch activities resumed after the summer recess with a meeting in Dalhousie on October 8. Films were shown at this meeting following a business session. The final meeting of the year was held in Newcastle on December 11. Two members of the Branch presented papers at this meeting. C. K. Steeves spoke on "Centri-Cleaners" and T. W. Creaghan on "The Optimum Industrial Unit".

In addition to the general meetings of the Branch, members attended a joint meeting of the New Brunswick branches in Fredericton on the occasion of the presidential visit.

Unity was a much discussed topic at meetings throughout the year and action to further this cause has taken the form of several new joint memberships.

The Branch has established a general pattern of operation which shows indications of strong growth out of the infancy stage. The interest is high and all activities have shown keen participation. New projects this year included the presentation of papers by members which is already under way, and a program of student counselling which will become active early this year.

North Nova Scotia Branch

A very young Branch of the E.I.C., the North Nova Scotia Branch has not been too active during the year 1954. Only two meetings were held, on February 11 and November 16. On both of these occasions the Branch was honoured by the presence of Col. L. F. Grant, field secretary.

On his first visit, Col. Grant gave a very informative address on the St. Lawrence Seaway Project and during his November visit, spoke in a general way about the unity of the Professional Engineer and the Institute, and the coaching of younger engineers in their profession.

It is expected that the coming year will see more activity in this Branch.

Ottawa Branch

Seventeen programs were arranged by the Proceedings Committee as follows:

Luncheon meetings—Nine of these meetings were held in the Chateau Laurier and one in Lauder Hall of Christ Church Cathedral. Highest attendance was 140, lowest was 62, and average was 91.

Evening meetings—Four of these including the annual meeting were held, two in the National Research Council, Sussex Street, and two in the new National Research Council Radio and Electrical Engineering Building. Average attendance was 95.

Field Trips—Two field trips were held, one to the cantilever hangar at Uplands Airport and the other to the Dominion Magnesium Plant at Haley, Ontario. The former was extremely popular from an attendance point of view with approximately 140 present. Attendance of about 40 members to Haley was creditable in view of the distance from Ottawa.

Social Events—A separate evening reception on the occasion of the President's visit brought forth about 150 members and wives. A few members played golf at the Renfrew Golf Club following the dinner and plant visit to Haley, Ontario. Refreshments were served following all evening meetings and afforded those present the opportunity to become acquainted with their fellow members.

Claude Howard, a member of this committee, attended to newspaper releases of meetings and submitted reports of these meetings to the E.I.C. Journal.

Apart from the costs of printing and mailing notice cards and the issuing of complimentary tickets to guests, each program was almost financially self-supporting. More attention was given this year, however, to the subsidizing by the Branch of refreshments after evening meetings.

Providing two program events for the president's visit proved popular. A noon luncheon and evening reception afforded the members two opportunities to meet and hear our national president.

Correspondence has been sent to two members in Hawkesbury and Chalk River requesting their suggestions for a meeting to be held in each of these centres. There has been concern that members in the outlying areas are not able to take part in the activities of the Branch.

Some of the subjects on the technical program were as follows: Recent Developments of Prestressed Concrete, by Professor Gustave Magnel; Underpinning, by Edward E. White; Consulting Management Engineering, Paul Kellogg; National Parks of Canada, An Engineer's Impression, by Lt.-Col. C. G. Childe; The Place of the Trolley Coach in Urban Transit, by L. W. Birch; Dam Construction in France, Andre Coyne; Health, Happiness and Hospitals, H. Gordon Hughes; Colonel By and the Rideau Canal, R. F. Leggett; Research into Road Safety, Dr. W. H. Glanville; The Maitland Works of Dupont of Canada by R. N. Boyd; Transient Transits in the Arctic, by W. D. Forrester.

Peterborough Branch

During 1954 the Peterborough Branch held eight meetings at which the average attendance was 43.

On June 3 the Branch entertained engineering graduates of the class of 1954 at a symposium entitled "Engineering in Peterborough". This was a special program designed to give some idea of the technical operations carried on within the Peterborough area.

Field trips are always a big drawing card and the trip to the American Nepheline Mine at Nephton, Ontario, was no exception. After a tour of the mine, a softball game and a swim at Stoney Lake, the members converged on the cook house to feast on a steak dinner that will always be remembered as the best they have ever had.

Prince Edward Island Branch

During the year there were nine meetings of the Prince Edward Island Branch. These meetings for the most part were well attended and presented a good cross-section of speakers. This Branch sustained a loss in the tragic death of its immediate past president, Ron Smith. The newly-elected vice-chairman J. H. Hearn, and committee member, Reg MacLean, left the province in the early part of the year.

The first meeting of the year was held in February and was addressed by the field secretary, Col. Grant, who spoke on the Saint Lawrence Seaway's history.

The biggest event of the year was our annual summer outing which was held at Cavendish. The only absentees were those who were not in the province. This outing as usual was an outstanding success from the standpoint of the members, wives and children. It is being looked forward to more each year. The sports committee suppressed all information concerning scores, achievements, winners and losers which could only indicate shenanigans were present in the various events.

Fall sessions have been occupied mainly with discussions and considerations concerning the formation of an Association of Professional Engineers for this province. This matter was brought very much to the fore at the Maritime Professional Meeting held at Digby in September at which this Branch had two representatives present. The kindness and courtesy of our sister provinces in extending invitations to Island members is very much appreciated. Definite progress in this regard can be reported.

Saguenay Branch

The Saguenay Branch enjoyed an active year. A total of 15 meetings were held, seven technical meetings with refreshments served at the close of the meeting, a dinner-dance, the annual meeting, three Student Guidance meetings, one field trip and two technical meetings, also with refreshments after the meeting, sponsored by the Junior Section. In addition, the Junior Section organized study groups which ran from January to June and has organized similar study groups this past fall the activities of which will end in the spring of 1955.

The highlight of this year's activities was the close collaboration with the regional group of the Corporation of Professional Engineers of Quebec which was organized in the fall of 1953. Until June 1954 all general meetings were held jointly with this group, while executive meetings were held separately with the chairman and secretary-treasurer of the other group sitting in. The memberships of both organizations have many members in common and these were asked to show their support of this close collaboration and efforts to promote confederation by voting the same man to the same post in both executives. On counting the ballots it was found that only one committee member post was not held by the same man in the two executives. The executives were installed at the joint annual meeting on June 1, and since that time all executive and general meetings have been held jointly.

The Student Guidance meetings were under the auspices of the E.I.C., C.P.E.Q. and C.I.C., one man from each organization serving on the committee. The meetings consisted of talks to the graduating classes of three local high schools. The program called for ten-minute talks by each of six speakers on different branches of engineering. These were followed by a formal question period and an informal question period over refreshments.

As mentioned earlier Professional Development for the Saguenay Branch takes the form of study groups organized by the Junior Section. Normal size of a study group is eight persons and attendance is high. Meetings are held at the discretion of the group itself, usually every two weeks but dependent on the time available to finish the course by spring. Three study groups are presently running, two on the "Principles of Investment" and the third a "Refresher Course in Chemical Engineering". These groups, too, are joint undertakings with the regional group of the C.P.E.Q.

Saint John Branch

Five dinner meetings were held during the past year when members were privileged to hear a variety of most interesting talks.

On January 28, a well attended joint dinner was held with the Association of Professional Engineers of New Brunswick. The special speaker was Brig. Eric Snow who spoke on 'Camp Gagetown", Canada's largest Army camp which is at present under construction in New Brunswick. This was a subject of interest to everyone present.

Col. L. F. Grant on February 26, presented a talk on "The St. Lawrence Seaway", and on April 21, "Ladies' Night" was held when Lieutenant Governor D. L. MacLaren was the special speaker.

Mr. H. H. Smith, Industrial Commissioner for this area spoke on "The Industrial Development of Saint John", on October 14, and on November 15, Prof. G. S. MacKenzie, professor of geology at the University of New Brunswick presented a talk on "New Brunswick Mineral Resources" with particular reference to the recent very large base metals discoveries in Northern New Brunswick in the Bathurst area.

In addition, on September 13, this Branch joined with the Prince Edward

Island and Moncton Branches in welcoming the President, Dr. Stephens, at a dinner meeting in Moncton.

On May 7, Branch members attended a dinner meeting in Fredericton, where, along with engineers from other parts of the province, they heard J. H. Smith, vice-president of Canadian General Electric speak on a proposal for uniting Associations and the Institute into one national body.

No Professional Development courses were held during 1954.

St. Maurice Valley Branch

Most noteworthy in this year's activities was perhaps the fact that an arrangement was instituted which involved the suspension of the Junior Sections in Three Rivers and Shawinigan Falls, and the setting up of a Three Rivers group and a Shawinigan Falls group, whose activities were open to all members and notices sent out to all members. This new plan was started on a year's trial as of April 27, 1954, directly following the Branch's annual meeting.

Prior to the latter meeting, the two Junior Sections held three meetings each, including a speech on I.B.M. Accounting Machines, a tour of the C.I.L. Shawinigan Falls Cellophane plant and a film night featuring house construction practices. During the same period, the Seniors organized meetings during which federal taxation and executive methods were the topics. A third event took the form of a tour to Sorel Industries Ltd. in Sorel.

The program after April 27 included a dance in June and a golf tournament and buffet supper, the latter event having been held jointly with the A.I.E.E. St. Maurice Valley Section. Two meetings in Three Rivers and a dance and two meetings by the Shawinigan Falls group rounded out the program for 1954, with topics on Paper Company Woodlands Operations, Industrial Relations, Trends in Aviation and films on the Development of the Automobile.

Sarnia Branch

The program committee for 1954 was composed of five members, A. Skene, D. Livingstone, H. Page, W. Millholland, Jr., K. E. Bentley. Special committees were formed to handle the May field trip to the Kellogg Company of Canada and the dinner dance in January. The chairmen of these committees were N. Lund and F. Belshaw, respectively.

There were eleven meetings during 1954. Of these two were joint meetings with the C.I.C., one arranged by each organization.

It was attempted to meet the wishes of the general membership as expressed by the answers to a questionnaire circulated in 1951 and as evidenced by general discussion at annual meetings.

A summary of 1954 meetings is as follows:

January 13, evening meeting, with speaker S. B. Thomas, Northern Electric Company, on the subject, "Plastics in the Wire and Cable Industry"; January 28, evening meeting, H. J. Bowen, "Industrial Models"; February 22, dinner meeting, J. B. Bassett, "Application of Statistical Analysis"; March 11, evening meeting, G. H. Cash, "Study in Black"; April 21, dinner meeting, G. Temple, "Fifteen Years at the World's Largest Oil Refinery"; May 17, dinner meeting and plant visit; June 18, annual dinner dance.

September 16, evening meeting, J. Anderson, film "Man With a Thousand Hands". October 7, evening meeting, J. R. Montague, "St. Lawrence Power Project—Engineering Aspects"; November 9, dinner meeting, Dr. W. J. Dunlop, "Education"; December 7, annual business meeting.

The Junior Section managed the meeting in May, a dinner and a visit to the Kellogg Company plant in London, Ont. About 50 members attended, and observed the food processing and packaging operations. Chairman of the Junior Committee was C. N. Lund.

Saskatchewan Branch

Nine executive meetings and the annual meeting were held during the year for the transaction of Branch business.

Three Branch sections were formed during the year at Lloydminster, Swift Current, and Moose Jaw. These Branch sections have reported an active interest and support of their activities. Col. L. F. Grant, Hon. M.E.I.C., field secretary, can be given much of the credit for stimulating the interest in these areas to the point of organizing sections.

J. Herbert Smith's "Plan for Unity" was taken under consideration by the executive and approved of in principle. This plan is presently under active consideration by a committee on confederation set up at the Institute headquarters. It has been reported that there will be many details to work out, but that there is a strong feeling of support among the profession for the idea.

J. G. Schaeffer of Regina was nominated by the Saskatchewan Branch as Institute Councillor for 1955-56, and Prof. A. H. Douglas of Saskatoon was appointed by the executive to the Nominating Committee.

Junius Jonsson of Prince Albert attended the Regional Meeting of Council held in Lethbridge on November 27, 1954 as the representative from the Saskatchewan Branch.

Sault Ste. Marie Branch

As compared with 1953, the Branch has registered a small net gain of three in Institute membership, but has lost five branch affiliates.

One resident member resigned during the year, while two resident members and one resident junior were transferred to other branches. Offsetting this, three resident juniors, one resident student, two non-resident juniors and one non-resident student were transferred into the Branch as existing members.

No new Institute applications were processed through the Branch this year, and a drive for new membership remains one of the major tasks facing the Branch in 1955.

Four Branch meetings were held during the first half of the year, the programs including both local and out-of-town speakers, films and a very enjoyable mixed dinner meeting on the occasion of the president's visit to which local members of the Association of Professional Engineers of Ontario were invited. The programs were interesting and well presented in all cases, but attendance generally was disappointing due largely to unforeseen conflictions with major sporting events and other competing attractions.

In the late summer, both the Papers Committee chairman and the secretary-treasurer moved elsewhere, and other members of the executive were frequently out of town throughout the fall months. In the resultant confusion, no Branch meetings were organized during the latter half of the year, regrettably, but the situation is now in hand for 1955.

An operating surplus of $143.15 for the year 1953 was almost balanced by a deficit of $122.01 for the past year 1954. This deficit resulted principally from special expenses associated with the social phases of the year's activities.

Otherwise, there were no unusual receipts or disbursements, and the branch remains in a sound financial position.

Section de Quebec

Au cours de l'année écoulée, le Comité exécutif de la section de Québec a organisé la Convention annuelle de l'Institut à Québec, les 12, 13 et 14 mai 1954. Un comité a été formé sous la présidence de Gilles Sarault et la convention a obtenu un grand succès. Près de 1,000 personnes ont assisté aux diverses manifestations de la convention.

A sa séance du 16 février 1954, le Comité exécutif de la section de Québec a établi un comité spécial ayant mission d'étudier la proposition de J. Herbert Smith, "A Plan for Unity", sous la présidence de Jean St-Jacques. Le comité présenta un rapport au Comité exécutif, le 28 avril 1954.

Copie de ce rapport fut transmise au Conseil de l'Institut, à la Corporation des Ingénieurs professionnels de Québec et autres sections de l'Institut dans la province.

Un comité national a été établi par l'Institut pour étudier le projet d'unité et Hector Cimon en est le représentant de la section de Québec. Jean St-Jacques a été chargé de représenter la section de Québec lorsque M. Cimon ne peut le faire.

La section a obtenu encore cette année un octroi substantiel du Ministre de la Jeunesse pour la continuation des cours de structure de la Faculté des Sciences. Nous sommes très reconnaissants à l'Honorable J. P. Sauvé de sa collaboration essentielle à la réussite de ces cours de structure.

Le programme de réunions générales de l'année 1954 a été le suivant: 28 janvier, assemblée annuelle de la section; 5 février, conférence de M. Yves Guyon, ingénieur de France, "Béton Pré-Contraint"; 27 février, visite de Montmorency Distilleries à Beaupré; 27 mars, tournoi de curling au Club de Curling Jacques-Cartier; 7 avril, conférence de M. H. S. Milne, "Engineers and Atoms"; 20 avril, conférence de M. André Coyne, ingénieur de France, "25 ans consacrés à la construction de Barrages"; 26 avril, Cocktail en l'honneur de Y. R. Tassé, M.E.I.C., président de la Chambre de Commerce de Québec, organisé conjointement avec l'Association des Diplômés de Polytechnique, au Cercle Universitaire de Québec; 5 mai, conférence de A. A. Moline, "Le point de vue mécanique dans la construction électrique". En collaboration avec la section de Québec de A.I.E.E.

Six juin, les membres sont invités à un cocktail en l'honneur de monsieur Hector Cimon et monsieur Georges Demers, au Cercle Universitaire de Québec, par l'Association des Diplômés de Polytechnique; 25 août, tournoi de golf de la construction, organisé conjointement par les ingénieurs, les architectes et les constructeurs; 13 septembre, tournoi de golf annuel de la section de Québec; 4 octobre, ouverture des cours de structure à la Faculté des Sciences; 10 novembre, conférence de M. Maurice Ponte, ingénieur de France, "Apport de l'électronique à la mesure dans la

science et l'industrie"; 18 au 21 novembre, retraite fermée pour les ingénieurs professionnels, les arpenteurs et les ingénieurs forestiers, à Villa Manrèse; et 14 décembre, conférence de M. Léo Roy, "Certains aspects du développement de la Bersimis."

Le Comité exécutif déplore la perte d'un membre distingué en la personne de A. B. Normandin, décédé au cours de l'année. M. Normandin était membre à vie de l'Institut, il est un des premiers membres de notre section. Il occupa des charges importantes sur le Comité exécutif de la section et sur le conseil de l'Institut. Il fut un précieux collaborateur à la Corporation des Ingénieurs professionnels de Québec; il en fut un des co-fondateurs.

Le Comité exécutif tient à souligner la part active que plusieurs membres de l'Institut ont prise dans différentes organisations publiques ou charitables de Québec. Mentionnons particulièrement Y. R. Tassé, président de la Chambre de Commerce de Québec pour l'année 1953-1954, G. E. Sarault, président du Comité des Paroisses pour la Campagne 1954 du Conseil central des Oeuvres de Québec. M. Sarault a également été élu récemment président du Club Kiwanis de Québec. Guillaume Piette a été élu président du Comité des noms spéciaux de la campagne de la Fédération des Oeuvres pour l'année 1955, M. Sarault conservant le même poste que pour la campagne 1954. Louis Joncas a été élu récemment président du Club Kinsmen de Québec.

Plusieurs de nos membres ont obtenu des promotions au cours de l'année écoulée et nous les en félicitons chaleureusement. Soulignons tout particulièrement la promotion de Ludger Gagnon, comme ingénieur en chef de la Cité de Québec et celle de Henri F. Béique, comme gérant général adjoint de la Compagnie Quebec Power.

Le Comité exécutif se plait également à faire une mention spéciale de l'élection de Georges Demers, ancien président de la section de Québec, comme président de la Corporation des Ingénieurs Professionnels de Québec.

Un de nos membres distingués, le Docteur Hector Cimon a été honoré d'une façon toute particulière par l'Université Laval. En effet, au cours de la convention de mai 1954, l'Université Laval lui a décerné un doctorat en sciences appliquées "honoris causa". Ce geste de l'Université ne pouvait mieux reconnaître les services innombrables que M. Cimon a rendus à sa profession, tant à la Corporation qu'à l'Institut.

Sudbury Branch

Six lectures were held in the Professional Development course during 1954. The subjects included two lectures on Sudbury traffic problems, and one lecture each on Public Speaking, Banking, Life Insurance, and Automobile Insurance.

The average attendance was 16 per cent of the resident members. No enrolment was used for the series.

Toronto Branch

The activities of the year 1954 were a tribute to those members of the various committees entrusted with the organization of the program.

The previous year's executive left a well organized program for the winter and spring. One of the meetings generally considered outstanding was the first one; a joint meeting with the Royal Canadian Institute, when Robert Shama spoke on "The World's Largest Prestressed Concrete Spans".

The annual students' night held in Hart House in February was a "Quiz Night". There was a panel of seven students, and a panel of experts. W. H. M. Laughlin, consulting engineer, was the meeting chairman and quiz-master.

F. R. Whatmough of Canadian Standards Association Approvals Laboratories spoke on the laboratories and their work. This was an excellent preparation for a subsequent summer visit to the official opening of the new Laboratories. Another joint meeting, this time the C.I.M.M., proved to be very interesting. The meeting was addressed by Col. L. F. Grant, Hon. M.E.I.C., who spoke on "The St. Lawrence Seaway Project". "Mountain Climbing with Atomic Energy Engineers" was F. W. Gilbert's subject at a meeting in March. A joint meeting with the A.I.E.E., to hear A. W. Paulson on the subject of "Vertical Transportation" was very well received.

Mr. McMurray provided the branch executive with an excellent bit of curling activity at the Toronto Curling Club in the spring.

The discussion of "The Engineer in Management", by a panel of experts was very good. This type of meeting seems to be very popular, and audience participation is a feature. A visit to the Oakville assembly plant of Ford Motor Company of Canada Limited was arranged in cooperation with the Hamilton Branch.

To open the fall season a social evening was held at the Prince George Hotel. Buffet supper was served before the room was cleared for "fun and games". Stage money running into millions of dollars changed hands.

Two technical meetings were held in October. G. W. Miller spoke on "The Engineer and the Contractor", and this meeting was remarkable for a lively discussion period. At a joint meeting with the Chemical Institute of Canada H. R. Lyle Streight spoke on the subject of the "Nylon Intermediates Plant at Maitland." A panel discussion was held early in November on "The Gap between Fundamental Research and its Application".

Ladies' Night was held this year, unfortunately without the president and his lady. Dinner, dancing and entertainment were arranged by an entertainment committee under chairman C. E. Potter.

The final meeting included a talk by Dr. J. Tuso Wilson, of the University of Toronto, who spoke on the intriguing subject of "The Earth as a Machine."

The year was one showing development of much new interest in branch activities. The branch has continued its support of confederation, and has given its representatives every assurance of its willingness to cooperate.

The year 1954 marked the beginning of a third year course in the fourth successive Professional Development Program in Toronto. In an informal atmosphere, all topics are prepared by individuals as assignments, and the main theme is individual participation. Last year's second-year members selected the subjects, with emphasis on cultural subjects. The Harvard case study method of business study was introduced and will be continued.

Vancouver Branch

During the past year there were ten meetings of the executive and eight of the Branch. Technical meetings continued to be held jointly with the B.C. Engineering Society. In May a large group of the Branch's members visited Seattle as guests of the Seattle Section of the American Society of Civil Engineers.

The Branch was visited by two presidents of the E.I.C., Mr. Dobbin and Dr. Stephens. The visit by Dr. Stephens was of unusual interest in that it coincided with the annual meeting of the Association of Professional Engineers of British Columbia, and the many joint functions and other opportunities for discussion were used to forward the most vital subject of confederation.

Vancouver Island Branch

The Branch held nine meetings during the year, seven of which were joint meetings with the Victoria Branch of the B.C. Engineering Society. The two exclusively E.I.C. meetings were dinner meetings, the first to honour the president, Ross L. Dobbin accompanied by the general secretary Dr. L. Austin Wright, and the second to honour Dr. Wright who again visited the Branch on December 6.

The joint meetings with the B.C. Engineering Society were all of an instructional nature with guest speakers addressing the gatherings on wide and varied subjects.

One field trip was taken to the Crown-Zellerbach Plant at Port Angeles where guides explained the various processes in newsprint production.

The Branch executive met on five occasions during the year.

A Golf Tournament was held in the late fall at Ardmore Golf Club.

No Professional Development Course was operated by the Branch.

Winnipeg Branch

During 1954 the Branch held six general meetings, with average attendance of 60. Twenty sectional meetings were held of which seven were electrical with an average attendance of 145; seven were civil with an average attendance of 56; and six were student with an average attendance of 200.

At the meetings of the branch, the business transacted dealt mainly with the good and welfare of the Branch and of the profession. It has been the practice to present papers of general interest at the Branch meetings. Those dealing with particular technical subjects are featured at the Section meetings.

Attendance at the meetings has improved somewhat over 1953. Section executive committees hope for an even better improvement in this regard during 1955.

Most of the students in the 3rd and 4th year of the Faculty of Engineering of Manitoba University are members of the Student Section. This group, in particular shows great interest in the Engineering Institute. A membership drive is now under way and the Student Section executive anticipates, as a result, increased enrolment of students of the Junior year.

Yukon Branch

The Yukon Branch has had a very successful first year of operation. Of the eight General Meetings the Branch was fortunate in obtaining guest speakers for six. There were two field trips; one to the Yukon Hydro Company Power plant, and one to the Elsa Mine at Mayo, a distance of 260 miles from Whitehorse.

The highlight of the year was the president's visit in March when he presided over a general meeting in Whitehorse and a joint E.I.C. and C.I.M.M. meeting at Elsa Camp.

Month To Month

JAN. FEB. MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Sixty-ninth Annual General and Professional Meeting

The 1955 Annual General and Professional Meeting of the Engineering Institute will take place in the Royal York Hotel in Toronto on May 11, 12 and 13.

Transportation

As usual special reduced convention fares will be available for rail travel in Canada and the necessary certificate will be sent to all members requesting it at time of registration. Members are requested to make their own travel arrangements through their local ticket agent.

Hotel Accommodation

Ample room accommodation for all members and their wives is expected to be available at the Royal York Hotel but a few rooms will also be available at lower rates in near-by hotels.

Advance Registration

Hotel reservation and advance registration cards will be mailed with advance copies of the meeting program, early in April. Room allotments will be made in the order of the receipt of reservation cards at Institute Headquarters. It is expected that all social functions will be fully attended, therefore members are urged to order tickets for dinners, etc., on their advance registration cards. Otherwise reservations cannot be guaranteed.

Annual Banquet and Ball

The final event of the meeting will be the Annual Banquet and Ball to be held on Friday evening, May 13.

Ladies' Events

All events such as dinners and technical meetings will be open to the ladies. In addition, a number of special social events will be provided.

General

A full program of technical papers covering a wide variety of topics has been arranged. It is planned also that plant visits of unusual interest will be available. In addition some further entertainment is expected to be available concerning which particulars will be found in the advance program.

Muriel's Room

Our hostess, Muriel, will be on hand to dispense her usual hospitality on those occasions for which this would be appropriate.

Consulting Engineers Association

The annual meeting and banquet of the Association of Consulting Engineers will be held in the Royal York Hotel on Thursday evening, May 12 at 6.30 p.m. Full particulars will be found in a separate notice in "News of Other Societies" (page 297).

The First Hundred Years

On February 15, 1854, the University of New Brunswick began giving some instruction in engineering, the first Canadian university to do so. A hundred years later, on February 15, 1954, it celebrated the anniversary of this event by inviting Dr. J. B. Stirling, M.E.I.C., to deliver its Founders' Day address, also commemorating 154 years of its existence. Dr. Stirling chose to review the history of engineering education in Canada; the following summary of his remarks will be interesting to our readers.

It was eight years after the inauguration of its courses in some engineering subjects that the University awarded its first "diploma of Civil Engineer" in 1862 to Henry George Clopper Ketchum. There were 15 graduates by 1865, when engineering instruction lapsed. Formal engineering teaching began at McGill University apparently in the session of 1856-57—the date is uncertain—and the first diploma was awarded to Oliver Gooding in 1858, who thus had the distinction of being the first engineer to graduate in Canada.

It must have taken much courage and strong faith in the future of this country for the educators of those bygone days to venture into this, to them, unknown field of training. The population of Canada was small and there was not much to attract

Cover Picture

The cover picture shows one of the first Canadian industrial applications of non-destructive inspection and testing by ultrasonic devices. By such means, minute flaws or variations in thickness can be detected in metals or alloys up to 17 feet from the surface, without recourse to drilling or other laborious methods formerly employed.

Photo courtesy of The Warnock Hersey Company Ltd.

a young man to the profession beyond a limited public works program and some activity in railway construction. In the much more heavily populated United States, with its greater industrial activity, there were then only four colleges with engineering courses; Renssalaer Polytechnic Institute (1824), Union College (1845), Dartmouth College (1851) and the University of Michigan (1852). Perhaps we should include the United States Military Academy at West Point (1802), which included some engineering subjects in its curriculum; the Lawrence Scientific School at Harvard University and the Department of Philosophy and Arts at Yale University, later the Sheffield Scientific School. Both the latter were functioning in 1854, but neither could well be called an engineering school.

In fact, there were few engineering schools anywhere then. France was the world's leader in engineering education; its oldest school was founded in 1750. There were three struggling schools in Great Britain, but only one chair of engineering. Germany had eight first-class engineering schools, three mining academies and a number of institutions of lower grade. The Swiss had not founded their federal polytechnic as yet.

L'Ecole Polytechnique of Montreal is the third of our engineering schools, founded in 1873. Then follow the University of Toronto (1878), Queen's University (1893), the University of Manitoba (1907), the Nova Scotia Technical College (1908), the University of Alberta (1909), the University of Saskatchewan (1912), the University of British Columbia (1915) and Laval University (1937). Finally one should include the new University of Sherbrooke, where courses were commenced last year. Today the enrolment of engineering degree students in Canada is about ten thousand, with an additional four or five hundred in certificate courses. Most of the latter will proceed to degrees in schools other than those they are now attending.

We are wont to compare conditions in Canada with those in the United States, naturally enough. About 30 per cent of all persons between the ages of 18 and 21 are enroled in the colleges and universities there, not all in engineering, of course. The comparable figure in Canada is only about six per cent. But more and more of our boys and girls are going to college. Since 1919 college attendance in the 18-22 year age group has risen by 175 per cent, while the group itself has grown by only 45 per cent.

If the engineering schools get their share of the anticipated increase in our university enrolment—they seem to be getting it, as engineering registration is up right across the country—there should be enough Canadian engineering graduates available when wanted to satisfy the demands of industry and of the public service. And it also looks as though this increase will pose some problems, physical and financial, for our universities. The universities seem to be quite aware of these problems, which may become acute by 1960, and are taking steps to solve them as they arise.

Growth in the Maritimes

Recently our attention was called to the fact that at the University of New Brunswick in Fredericton their engineering enrolment has now reached the figure of four hundred. This does not rank it at the top of the list of Canadian universities, but it is a definite and substantial increase over recent years.

Another interesting feature is that in the branch of civil engineering, U.N.B. is exceeded only by the University of Toronto. At Fredericton they have an enrolment of two hundred and nine in civil engineering, and in Toronto they have three hundred and twenty-six. But the next nearest figure is one hundred and sixty seven, at the University of Alberta.

It is very encouraging to see this steady progress in New Brunswick. It is a clear indication that the university there is continuing to render a service that meets the increasing needs of the provinces.

Sixty-Ninth Annual General Meeting

Notice is hereby given, in accordance with the by-laws, that the annual general meeting of The Engineering Institute of Canada for 1955 will be convened at the Royal York Hotel, Toronto, Ontario, at ten o'clock a.m. on Wednesday, May 11, 1955.

Correction

The item "Art and the Engineer", concerning Mr. J. S. Walsh, appearing on page 134 of the February issue of the Journal, contained a statement which is incorrect.

It is stated in the second paragraph that "Mr. Walsh joined the staff of Dominion Engineering in 1946". The correct term is "Dominion Bridge Company".

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

Employment on the Seaway

Numerous inquiries are received from persons seeking employment on the St. Lawrence Seaway project by the president of The St. Lawrence Seaway Authority, the Honourable Lionel Chevrier, and other members of the Authority. Many of these inquiries are for information as to how employment may be obtained and particularly whether any private agency has been designated as an official agency for this purpose.

Mr. Chevrier has advised that no outside organization had been hired for this purpose nor was any organization authorized to indicate that they were acting as an agent for the Seaway.

The major construction work on the St. Lawrence Seaway is being done by contracts and the contractors hire their own staff. However, Mr. Chevrier indicated that the National Employment Service of the Federal Government has set up a special organization to assist in placing and hiring people wanting to work on the St. Lawrence Seaway project. These facilities included the formation of a central office in the Seaway area to process requests for particular trades and technical skills required by the contractors to do the work. In this respect Mr. Chevrier stated that he understood the National Employment Service was going to advise all persons interested in employment to register their names with their nearest Employment Service office. All such persons were also being advised not to proceed to the area where the work was being undertaken unless they were advised to do so by the National Employment Service.

Tenders for Canal and Lock Construction

The Honourable Lionel Chevrier, president of the St. Lawrence Seaway Authority, announced on January 26 that eleven bids had been received for the "Construction of a Canal and Lock at Iroquois" in the International Rapids Section. It will be recalled that following the exchange of notes of August 17, 1954, between the United States and Canadian Governments a statement was made by the Minister of External Affairs to the effect that the Canadian Government would construct forthwith, a canal and lock at Iroquois.

On the basis of unit prices tendered, the lowest bid was that submitted jointly by Pentagon Construction Company, Limited and Iroquois Constructors Limited amounting to $6,470,000.00. The second lowest tender was submitted by Northern Construction Company and J. W. Stewart Limited in the amount of $6,543,373.00. The third lowest tender amounted to $6,731,200.00 and was submitted by Canit Construction Limited. The fourth lowest bid was submitted by Deschamps & Bélanger Ltée, in a joint venture with Dufresne Engineering Co. Limited, A. Janin & Cie Limitée and The Key Construction Ltd. in the amount of $6,899,000.00. The bid received from McNamara, Piggott and Peacock in the amount of $6,975,600.00 was the fifth lowest.

Seaway Authority engineers being satisfied that the company had submitted an acceptable construction program showing the order of procedure, time schedule, construction plant to be used, details of organization to be placed on the work, and method by which the contractor proposes to carry out the works, authority was sought from Treasury Board to enter into an agreement with the lowest bidder, Pentagon Construction Company and Iroquois Constructors Limited.

The work to be carried out under this contract consists of the construction of the canal and lock at Iroquois in the International Rapids Section of the St. Lawrence Seaway. The proposed lock will be of the Welland Ship Canal dimensions. It will be 768 feet in length and 80 feet in width, have a depth of 30 feet over the sills and an approach channel depth of 27 feet at all river stages. The work is to start immediately and to be completed not later than November 30, 1957.

It was subsequently confirmed that the contract was awarded to Pentagon Construction Co. Ltd., jointly with Iroquois Constructors Ltd., at the figure of $6,470,000.00.

The following companies also tendered on the Iroquois project: C. A. Pitts General Contractor Limited; Arthur A. Johnson Ltd. and Peter Kiewit Sons' Company of Canada Ltd.; Walsh Canadian Construction Company Limited; Bran Limited, Ekard Construction Company, S. J. Groves & Son & C. F. Lytle Company; E. G. M. Cape & Company; Utah Co. of the Americas.

Contracts Awarded

Generators

Ontario Hydro announced on February 7 the awarding of contracts to two Canadian firms for the manufacture and installation of 16 generators in the Canadian Section of the St. Lawrence powerhouse. At the same time, the Commission awarded a contract for the production of crushed rock and manufactured sand to be used as concrete aggregate in the building of Hydro's portion of the international powerhouse.

The generator contracts involve the purchase of 8 units from Canadian General Electric Company Limited, Toronto and 8 units from Canadian Westinghouse Company Limited, Hamilton at a total cost of approximately 13½ million dollars. Both firms have promised to meet the delivery date schedule which calls for the commencement of erection of the first unit on August 1, 1957. Subsequent units will be erected at intervals of one and a half to two months.

A total of ten companies in Canada, England, and Europe submitted generator bids.

Rock and Sand

The contract for the production of crushed rock and manufactured sand from the Commission's quarry near Cornwall was awarded to C. A. Pitts General Contractor Limited, Toronto. A total of 16 bids was received from both United States and Canadian sources. The contract involves an anticipated 1,942,000 tons of rock and sand, at an approximate price of $2,486,000.

Turbines and Governors

A contract for sixteen turbines and governors to be installed in the Canadian section of the St. Lawrence powerhouse has been awarded by Ontario Hydro to the English Electric Company of Canada, Toronto. Hydro officials stated that the contract, for approximately $7½ million, calls for deliveries to commence in March, 1956. It was one of

seven bids received from Canadian and European companies.

The turbines, together with sixteen generators to be erected in Hydro's portion of the international powerhouse, form the unit which transforms the power of water into electrical energy. The Canadian half of the St. Lawrence Power Project, scheduled for initial service in the fall of 1958, will have an installed capacity of 1,100,000 horsepower.

CCA Meets at Quebec

The Canadian Construction Association's 37th annual convention was held at the Chateau Frontenac in Quebec City, January 16-19, 1955, with more than 860 delegates in attendance. Here the spacious accommodation at the Chateau, French Canadian gaiety and hospitality and the winter carnival setting, all combine to make Quebec the CCA's favourite meeting place. As is customary, the opening day was taken up with a luncheon for Builder's Exchange Secretaries, registration and a management committee meeting.

Committee Reports

The Monday morning session was devoted to hearing CCA committee reports. Chairman Lorne Bain announced that the Association membership now exceeded the 1,000 mark. Speaking for Chairman J. M. Pigott of the apprenticeship committee, H. C. Nicholls reported 14,771 apprenticed in Quebec, vs. 13,272 last year, and 6,479 in nine other provinces vs. 6,169 a year ago. Notwithstanding this growth, apprenticeship falls far short of the needs of the industry, and calls for sustained help and co-operation from the Association, he declared. Employers must be encouraged to take more interest, and a solution to this serious problem would never be resolved until employers recognized their responsibilities and attacked the problem with energy and enthusiasm.

CCA Building Committee

Chairman Bob Drummond reported that $67,400 had been spent on construction last year on a contract awarded to Ross-Meagher Ltd. at a price of $260,762. Expenditure of $175,000 from association reserves had been authorized and the balance of some $100,000 needed would be financed by sale to members of 4½ per cent first mortgage sinking fund bonds. The project, he said, had been a good investment from the start and its completion will mark one of the most important milestones in CCA history.

Contractor Relations Committee

R. F. Legget, chairman, explained that a threat to CCA unity due to misunderstandings developing between two of the four sections through which the association operates, had led to the setting up of this committee, composed of four members each from the general and trade contractors sections, with an independent chairman. The two main issues were the alleged "bid shopping and peddling" and the alleged promotion by trade contractors of the idea of carrying out work without the services of general contractors.

The committee presented a set of 10 rules for procedure in competitive building practice as a proposed "Code of good practice for the Construction Industry in Canada". Warning that it cannot be made fully effective until its philosophy is accepted also by engineers and architects, the committee recommended that, if and when adopted, it must be immediately discussed with national bodies representing

The newly elected officers for 1955 of the Canadian Construction Association are shown after their election at the annual meeting in Quebec City. Back row, left to right: R. A. Seasons, vice-chairman, Trade Contractors' Section; F. R. Murray, honorary secretary; Felix Guibert, chairman, Trade Contractors' Section; G. D. Schroeder, chairman, Manufacturers' and Suppliers' Section; J. E. Harrington, chairman, General Contractors' Section; J. P. Kennedy, chairman, Road Builders' Section; S. G. Quinn, vice-chairman, Manufacturers' and Suppliers' Section; D. L. Donaldson, honorary treasurer.

Front row, left to right: Col. E. J. W. Akins, Manitoba vice-president; Allan Tubby, Saskatchewan vice-president; S. W. Kenney, vice-president for Newfoundland and Nova Scotia; A. Turner Bone, national vice-president; W. G. Malcom, president; Raymond Brunet, immediate past president; Tullis N. Carter, national vice-president; W. A. Marshall, Quebec vice-president; L. J. B. Forbes, Ontario vice-president; R. L. Parsons, vice-president for New Brunswick and Prince Edward Island.

Not present for the picture were Charles A. Stollery, Alberta vice-president; M. L. Barr, British Columbia vice-president; N. A. Putherbough, vice-chairman, General Contractors' Section; George Poole, vice-chairman, Road Builders' Section.

these professions in the hope of obtaining full agreement.

Housing Committee

V. L. Leigh, housing committee chairman, told delegates 1955 had commenced with a large carryover of some 60,000 dwellings under construction, he stated, with prospects good for increased "starts," representing a value of well over a billion dollars. Nevertheless, much housing was substandard and overcrowded, while the housebuilding section was working at less than capacity and had yet to attain the Association's target of 125,000 units yearly. The Committee urged members to encourage local groups to sponsor long-term limited-dividend low-rental housing, slum clearance and other such projects dealt with in Section 36 of the 1954 N.H.A. The volume of housing starts in the last half of 1954 reflect the predicted rise due to charter banks entering the direct residential mortgage field and provisions for lower down payments and longer amortization. The Home Improvement Loan section of N.H.A. would be proclaimed to apply to the whole of Canada on February 1st, 1955. These changes had been advocated by the CCA.

Pointing to the difficulties mainly responsible for lack of down payments discouraging the effort to accumulate the required cash, the committee advocated amendment of the Act to allow purchase with no down payment. It was suggested that a solution would be to issue "Home Purchase Savings Bonds" carrying the same rate of interest as Canada Savings Bonds, purchasable under a payroll deduction plan.

Labour Relations Committee

Chairman A. C. Ross told the membership comparative stability in construction trade wages during 1954 had been due to leveling off of living costs, and to the effects of the two-year agreements signed in 1953. Yet there had been a cloudy background of 190,000 man-days of work stoppages, sharply up over the previous year. He urged that formation of a Canadian board for settling jurisdictional disputes should be discussed further with the Trades and Labour Congress, whose past president had expressed sympathy with the proposal before his retirement.

American refinery contractors operating in Canada had signed agreements with boilermakers, plumbers and steamfitters for rates considerably in excess of those negotiated locally, disrupting relations in several areas. The prolonged Montreal plumbers' strike had its roots in premium agreements signed on Montreal refinery projects. The CCA contended that when working here, American firms should abide by the usual local collective agreements.

Reviewing CCA discussions with U.I.C. officials about forthcoming changes in the Unemployment Insurance Act, he observed one proposal was of particular interest to employers, namely, that of amending the act to replace present stamp methods of contributions with a payroll deduction system.

Referring to recent rulings by the unemployment insurance umpire allowing benefits to workers who refused to cross picket lines, he pointed out that picketing employing force is quite illegal, and payment of benefits to workers was very unwise because fellow workers were allowed to indulge in illegal acts.

Legislation Committee

Chairman R. A. Seasons, describing the functions and recent activities of his committee, emphasized the advantages of representations in person to those responsible for legislation affecting the industry. Referring to pending changes in the Unemployment Insurance Act, assurances had been received that there will be ample opportunity for representations when the bill is considered in Committee. The Association had been fully informed, he said, regarding the emergency bill to liberalize benefits, prior to main amendments.

The chairman commended Quebec's action in introducing legislation to eliminate payment by employers of double Workmen's Compensation assessments for employees working temporarily outside their home province. Since Ontario had already passed similar legislation, reciprocal agreements would now be possible.

Concluding, Mr. Seasons referred to enquiries from members going into new areas about local provincial and municipal laws and regulations. Though most Builders Exchanges were good sources for such information, he suggested the association might explore the need for comprehensive data on municipal business taxes, compensation rates, provincial sales taxes, etc., as they affect construction operations.

Provincial Activities Committee

Committee chairman, J. M. Soules, reviewing the four point recommendation approved at the 1954 Vancouver convention, reported progress had been made in locating meetings more equitably throughout the country, while presidential parties had visited Lakehead, Sudbury, Val d'Or, and had met with directors of the O.R.B.A. following its affiliation with CCA.

While Builders Exchanges and provincial organizations are now confident of wholehearted CCA support, and while the exchanges hold the respect of and gain cooperation from municipal governments, the industry lacked the effective voice it should have in regard to provincial policies. This, he said, was particularly true of Ontario, where 35 per cent of the total volume of construction was carried out.

Such discrepancies, he predicted, would in time disappear with dissemination of information to local and provincial associations, with decentralized management committee meetings and regional conferences, and through close attention to regional problems and continuing efforts of vice-presidents to seek out industry problems and provide liaison to local organizations.

CCA Publicity Committee

Chairman E. R. Smallhorn reported that the mechanics of issuing press releases, etc., was now left entirely in the hands of the Executive Committee and the headquarters staff. A number of articles on industry matters had been prepared for a variety of journals, and increasing requests of this nature indicated growing recognition that the CCA is the "voice of the industry". Publicity arrangements, he stated, were also being looked after by the association itself rather than through outside agents.

A brochure concerning the CCA is under preparation and it has been suggested that another should be prepared showing outstanding examples of projects designed and built by Canadian firms. His committee advocated, in addition to an increase in publicity material from the national Association, that Builders Exchanges should also expand their publicity programs, and have their members address service clubs and other bodies on the industry's activities and achievements.

Research and Education Committee

Enumerating the various assistance, donations and the prizes now being provided by the CCA to university students for theses on construction subjects, Chairman J. F. Parsons recalled that his committee had discussed with univer-

sity authorities the possibility of establishing a construction engineering course. It was believed in general that special postgraduate courses were preferable to specialized courses at the undergraduate level.

A Maritime university, he reported, had shown special interest in such a course, and one of our larger universities was actively considering a course dealing with construction management subjects. He called attention to the night lectures on construction management currently under way at the University of Toronto, sponsored by the Toronto Builders Exchange, and recommended that other exchanges should follow suit.

In conclusion, the chairman urged that the award of the four annual fellowships for financing postgraduate study in construction, already approved in principle, be acted on by the 1955 executive committee. He also advocated members taking the lead in their home cities in urging the adoption of the National Building Code provisions where local codes are out of date or incomplete.

Sales Tax Committee

Expressing the committee's feeling that a former committee's recommendation to engage an expert to sort out evidence respecting the federal sales tax question, for presenting to the government to supplement previous briefs, chairman D. K. Edwards stated his committee's belief that the time was now ripe for action. Administration of the act, he said, was difficult and costly compared to the revenue received, and because of unsatisfactory interpretation there had arisen an unsatisfactory tendering practice of suppliers absorbing the tax themselves. A meeting had been held with the cabinet last February and further representations had been made to the new minister of finance, Mr. Walter Harris. W. A. Marshall, Quebec vice-president, had presented a brief before the Canadian Tax Foundation in November.

Standard Practices Committee

Chairman A. Turner-Bone reported completion of revisions to the standard form of cost-plus-fee contracts was almost attained, following meetings with the E.I.C. and R.A.I.C. and by correspondence. Pending completion, work on the proposed "Guide to Better Bidding" was left in abeyance. Consideration of a standard specification awaited observation of results from the work of the newly formed Specification Writers Association of Toronto — the E.I.C., he stated, had approved the revised form of lump-sum contracts. Two small changes thereto had been made and others had been suggested, and revisions would probably be made in 1955. The Committee had had a very active year, including discussions with government agents, architects and municipal authorities. In addition, standard documents covering U.S.A. and U.K. tendering practices and contracts had been reviewed.

Defence Construction Program

R. G. Johnson, president of Defence Construction (1951) Ltd., told delegates that four years ago he had announced to CCA delegates a three year program of defence construction costing $100 million. In the past four years DCL had spent $600 million on behalf of the Department of National Defence, involving over 3,000 contracts with a total value close to $700 million, nearly 90 per cent of which had been put in place, leaving some $75 million still to be spent on existing contracts. Expectations were that current volume of $100 million yearly will be maintained in 1955.

The earlier programs of projects most urgently needed, such as airfields, radar stations and coastal defence, had been completed, he said. Needs of the R.C.A.F. had top priority, and in the fiscal year 1952-53, 78 per cent of all awards was on behalf of the R.C.A.F., the largest project being the chain of radar stations known as the *Pinetree* project. Another large project now almost complete was the Cold Lake Air Weapons Range, where the airbase is now in operation. The last of several large cantilever hangars should be finished by midsummer.

As a result of Korea and NATO the Canadian Army had been greatly expanded, Mr. Johnson continued, creating the problem of increased accommodation and training facilities. As a result the Army home-station development program was the principal DCL item presently in hand. Camp Gagetown is the largest home station, designed for training a brigade or even larger formations, with climate at the site in New Brunswick permitting all-year-round training, covering an area of 400 square miles and costing some $45 millions.

The next in size will be Petawawa, followed by others at Edmonton, Calgary, Winnipeg, London and Valcartier. Another major project assigned to DCL for its construction phase was the mid-Canada line of radar warning stations running roughly along the 55th parallel while the northernmost or *Dew* Line will be built by the U.S. government.

Calling attention to the time taken in the final stage of many projects to clear up minor deficiencies, thus retarding the release of holdbacks and security deposits to contractors, Mr. Johnson called for their co-operation in developing a solution. In conclusion, he quoted from the White Paper on "Canada's Defence Program" of May 1954, as follows:—

> "The apparent improvement in the international situation is related to the growing ability of free nations to speak from a position of strength . . . if we are to maintain and improve our prospect for peace NATO countries must continue, perhaps for a lengthening period, to devote a substantial part of their resources to the common defence effort."

President's Address

At the opening luncheon on Monday, delegates were welcomed to the city by His Worship Mayor Wilfrid Hamel. Following this, CCA President Raymond Brunet, O.B.E. of Hull, Que., in his presidential address, made the prediction that, "If the trend in the volume of construction continues at its present rate, it is possible that a record value of $5 billion of construction will be put in place in Canada this year."

Mr. Brunet noted that the construction industry had had a greater volume of work in each successive post-war year, and that the 1954 total was estimated to be some $4\frac{3}{4}$ billion. "This record volume would have been even greater had it not been for the especially bad weather conditions that hampered construction operations", he stated. However, as a result, this had left a bigger than average carryover. Providing costs remain at levels that will continue to attract investors, an even greater volume this year than in 1954 could be expected."

Another reason why the value of construction carried out in 1954 was below that predicted in the investment forecast based on owners' reports, he said, was that many projects were being built at below the estimated cost. "The improved supply situation and increased industry efficiency and capacity have resulted in tenders considerably below the expected price. Competition is extremely keen and contracts are

being signed at 'bargain basement' prices."

Mr. Brunet believed the increasing volumes of construction reflected (1) the large backlog of projects deferred because of the depression and the war and (2) the steady economic growth in Canada, rather than "boom" conditions. The industry was actually operating below capacity levels in the building of houses, roads and other types of construction. "In Canada's expanding economy it is only natural that our construction programs will also become larger over the years ahead. This factor has encouraged not only the establishment or expansion of many Canadian construction companies but also the entry to Canada of a fair number of large firms from other countries. The industry now employs upwards of 500,000 in actual construction operations.

Improved Credit Terms for Both New and Existing Houses

"Stability of prices and the easier financing terms available under the 1954 National Housing Act have been principal factors in the present increased housebuilding program", said Mr. Brunet, "and the general proclamation of the N.H.A. Home Improvement Loan Section, as advocated by the CCA, will also help considerably to raise the standards of existing houses when it takes place next month. However, down payments and carrying charges under our housing legislation are still less liberal than in such countries as the United States."

Highways Backlog Continues to Grow

Mr. Brunet said that Canadian roadbuilders had long been impressed with the high degree of federal-state co-operation on highway matters in the United States, and the recognition by the U.S. federal government of the national importance of roads. Federal aid had been available to the states for road construction for many years.

"In Canada, the Trans-Canada highway is being built on a joint-financing basis", he said, "but there has been no federal commitment that funds will be granted for this vital project after the present agreements expire in 1956. It is sincerely hoped, therefore, that steps will be taken to extend the agreements, and that federal investment in other roads of national importance will be placed on a continuing basis. The expenditure on roads per motor vehicle registration is less today than it was before the war, and the backlog of badly-needed roads is steadily growing."

Seasonal Unemployment — Winter Construction Work

The CCA president noted with pleasure the growing support to the industry's efforts to increase the volume of winter work, and thereby reduce the seasonal unemployment in construction operations. "While great strides have been made in extending construction work through the winter months, upwards of 25 per cent of our summertime labour force are on average unemployed in construction during the middle of the winter. The interest of government agencies and industrialists in timing their projects so as to provide more winter work is most encouraging and reflects the benefits to all interested parties."

World Wide Standard on American Scale Impossible

The guest speaker for the first dinner meeting was Dr. G. H. T. Kimble, research director, Twentieth Century Fund, New York City. As one of the world's most eminent geographers, he observed that geographers were most concerned with the relationships between men and the environments they inhabit, and with the cultural consequences of the way they have fashioned these environments.

Tracing the patterns of development for the various continents and peoples over the past six thousand years, he reminded his audience that on this continent we had been on a vast spending spree for the past 250 years, not merely with money but with resources. We had built ourselves the most advanced culture, technically speaking, the world had ever known, but we had come perilously near to breaking the bank, as shown by the findings of the 1953 Washington conference on "Resources for the Future".

The idea of containment, of limited opportunity, was something we were very loath to accept. "Why not take our bulldozers and pulpmills and engineering 'know-how' to Africa, India, Indonesia, Brazil", he asked, "and keep the frontier rolling? There is merit in the argument for we cannot much longer continue being an island of prosperity in a sea of poverty." But there was heresy in this argument too, he warned, for the known world resources would not long support our scale of living on a worldwide basis. And even were the resources adequate, who would foot the bill?

"Would it not be just as well for us", he asked, "to spend part of our time schooling ourselves in the art of going without, or at least living gratefully with what we have?" There was enough of every ingredient of the good life for everybody, but not enough to give everybody a seven room ranch house on an acre lot with two cars, a kitchen full of electrical equipment and a change of wardrobe twice a year, he warned. Such a doctrine was not half so unpalatable as living in torment the rest of our lives, and under the shadow of a mushroom-shaped cloud.

In conclusion the speaker expressed the view that we have much to learn about the art of living in today's world with its fluctuating wealth and poverty, its changing moods, and of living with its unruly inhabitants. To address ourselves to this task of humility was not only the beginning of wisdom but also the condition of survival.

Panel Discussion on Standards

A feature of the third day's sessions was a panel discussion on "Standards for Construction Materials by National Agencies in Ottawa". F. A. Sweet of the Canadian Standards Association, R. F. Legget of the Canadian Government Specifications Board and O'Neill Higgins, commodity standards director of the Department of Trade and Commerce, in turn described the functions of their respective agencies, explaining how these were complementary and how overlapping was avoided.

Guest Speakers

Guest speaker at the second luncheon was Lt-Col. R. A. Sharood, chief engineer, Quebec North Shore and Labrador Railway Company, who gave the history of early surveys and discoveries in Ungava. He then presented a graphic description of the obstacles and problems confronting the builders of the 360 mile railway from Sept Isles to Knob Lake, and how these were overcome, permitting the first shipments of iron ore last August.

Guest speaker at the annual banquet was The Hon. Maurice Duplessis, Premier of Quebec, who told the Association that the work done by its members brought to mind the fundamental truth that "you can't build unless you establish sound foundations". Another fundamental truth often forgotten today was that real progress and security was based on real work. "There were those", he said, "who believed you could reduce working hours and increase production at the same time. But we know and you know such a system cannot

exist . . . " "Private enterprise was the system under which Canada had become great", he continued, "and if Canada is to continue to grow and prosper these principles must be safeguarded. Capital is the real backbone of any progress, but unfortunately today the trend was to expect the state to do everything."

In conclusion, the premier reminded his audience that two great races had learned to live together in harmony and co-operation. The loyalty of Quebec to the institutions we all held dear could not be doubted, and this was why here in Quebec we are opposed to Communism. Quebec was always willing and anxious to co-operate with the rest of Canada and with other governments, he said, not forgetting there can be no co-operation and no real progress if the basic fundamentals of confederation are not respected.

'New Look' for Public Works

Describing recent developments in policy and procedure in the federal Department of Public Works, Deputy Minister Major General H. A. Young, guest speaker at the third luncheon, told members its main functions now fall into four main categories: construction of public buildings comes under the Building Construction Branch; operation and maintenance of government-owned and rented buildings is the duty of the Property and Building Management Branch; projects related to the maintenance and improvement of navigation is the concern of the Harbours and Rivers Engineering Branch, while the Development Engineering Branch is responsible for the Trans-Canada Highway, bridges and structural engineering, testing laboratory and all special projects not related to marine works.

In addition to these four main branches were the Purchasing and Stores Branch, the Fire Prevention Branch, the Information Service and the Economic Studies Division. Duties of the latter include examination of the short and long term aspects of proposed projects from both local and national viewpoints.

Outlays by the department including those for the T.C.H., will amount this present fiscal year to some $100 million, only a small part of Canada's construction volume. Compared with this national defence and transport carry out more than half the federal construction program. Nevertheless, "public works" plays a not insignificant part in relieving current unemployment, he pointed out, creating as it does this year some 300,000 man months of work on site and off-site, including indirect affects on the economy.

There were, the speaker pointed out, localities where the unemployed can be usefully absorbed by public projects, especially where projects can stimulate private industry and help create permanent jobs. On the other hand there were cases where projects were essential to meet immediate area requirements, but where unemployed workers do not come from construction or related trades. In such cases, the contribution of such projects to the direct relief of unemployment must be relatively small. Measures to ease seasonal unemployment had been receiving careful attention, he said, and all branches had been seeking ways and means to encourage more winter work.

The convention concluded with reports from section chairmen, report of the resolutions committee, election and installation of officers, followed by a dinner-dance and entertainment. W. G. Malcom of Winnipeg was elected president for the coming year, with A. Turner-Bone of Montreal and Tullis N. Carter of Toronto as national vice-presidents.

Elections and Transfers

At the meeting of Council held at Hamilton, Ont. on Saturday, February 26th, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

J. H. Archer, *Arvida*
A. A. Baker, *Montreal*
J. M. Bedington, *Toronto*
A. G. Bennett, *Toronto*
E. Blair, *Ottawa*
J. H. Fee, *Montreal*
P. A. Gagnon, *Montreal*
L. L. Goddard, *Montreal*
J. B. Gordon, *Sarnia*
F. W. Hill, *Sarnia*
R. H. Hogue, *North Bay*
L. P. Hynes, *Haddon'fd, N.J.*
E. G. Kimsey, *London, Eng.*
A. G. Osborne, *Montreal*
W. Peplowski, *Sherbrooke*
A. B. Sanderson, *Victoria*

Juniors

G. Brynildsen, *Shawinigan Falls*
M. A. Buchanan, *Toronto*
M. T. Devine, *Iroquois Falls*
L. J. Ingolfsrud, *Montreal*
H. Kierulf, *London, Eng.*
S. M. Lipkovsky, *Forestville*
S. T. Meissner, *Sherbrooke*
G. C. Oates, *Derby, Eng.*
T. M. Wardle, *Toronto*
P. J. Wooding, *Asbestos, Que.*

Transferred from the class of Junior to that of Member:

L. J. Bayly, *Vancouver*
C. G. W. Bird, *Ottawa*
L. S. Breen, *Toronto*
S. Brodylo, *Calgary*
A. F. Brooks, *Trail*
K. A. Brown, *Toronto*
A. K. Bunnell, *Toronto*
N. B. Cameron, *Winnipeg*
E. R. Carpenter, *Windsor*
O. M. Cepella, *Leaside*
J. Y. Chabot, *Victoriaville*
A. Chiperzak, *Montreal*
H. G. Clark, *Calgary*
E. J. Colas, *Montreal*
L. B. Davies, *Ottawa*
W. E. Davies, *Montreal*
B. P. Dolmont, *Toronto*
R. D. Donnelly, *Charlottetown*
J. H. Douglas, *Sarnia*
J. R. Eason, *Arvida*
N. L. Eldridge, *Halifax*
A. L. Ellis, *Vancouver*
H. Fealdman, *Toronto*
R. M. Ferguson, *Calgary*
R. N. Flaherty, *Toronto*
S. W. Forstrom, *Ocean Falls*
E. L. Fulcher, *Toronto*
J. P. Gelinas, *Montreal*
R. T. Gibson, *Winnipeg*
J. P. Gignac, *Shawinigan Falls*
H. Gordon, *Trail*
G. Gourdeau, *Rouyn, Que.*
G. J. Griffin, *Montreal*
R. J. Hallawell, *Cleveland, O.*
J. R. Harris, *Toronto*
R. G. Harris, *Kelowna, B.C.*
A. F. Hayeraft, *Kapuskasing*
C. W. Henry, *St. John's*
J. L. Hope, *St. Catharines*
R. R. Houde, *Sorel, Que.*
T. H. Ivory, *Toronto*
R. E. Johnson, *Toronto*
R. D. Litchfield, *Smooth Rock Falls*
E. A. W. Lundman, *Winnipeg*
C. H. B. Lytle, *Calgary*
P. G. McConnell, *Calgary*
D. J. McIntyre, *Montreal*
R. MacLellan, *Montreal*
A. S. Millar, *Iroquois Falls*
H. F. Morriss, *Montreal*
F. Nunes, *Montreal*
E. B. Pearson, *Windsor*
R. E. Phaneuf, *Montreal*
J. L. E. Pontbriand, *Quebec*
R. W. Potts, *Welder Crossing*
J. T. Proyan, *Kingston*
H. C. Purdy, *Montreal*
R. B. Purser, *Montreal*
G. L. Rainville, *Montreal*
W. W. Robertson, *Arvida*
P. E. Rochon, *Quebec*
G. M. Rose, *Toronto*
J. Roy, *Quebec*
L. Scharry, *Montreal*
J. H. Scovil, *Montreal*
J. W. Shears, *Owen Sound*
G. W. Shorter, *Ottawa*
J. L. Stober, *Montreal*
J. Stonehewer, *Montreal*
D. H. Stonehouse, *Stellarton*
R. G. Stuart, *Fredericton*
R. C. Surtees, *Montreal*
J. P. Tessier, *Alma, Que.*
P. Tourigny, *Montreal*
W. A. Traill, *Niagara Falls*
H. K. Walter, *Kitchener*
L. W. Ward, *Toronto*
J. M. Weintraub, *Montreal*
R. A. Weir, *Toronto*
J. S. Whyte, *Kapuskasing*
A. W. Wirth, *Sarnia*

Transferred from the class of Student to that of Member
W. A. Mildren, *Winnipeg*

Transferred from the class of Student to that of Junior
R. O. Costar, *Halifax, N.S.*

The following Students were admitted:

Queen's University

D. E. Allen
G. P. Andrinovich
J. J. Bawden
D. M. Bews
D. W. Blair
D. W. Brooks
B. R. Camire
J. Choquette
K. L. Currie
R. M. de Goumois
S. Dozzi
G. F. Felgate
J. J. Godawa
R. W. Harmer
J. E. Henderson
F. N. Hoag
L. H. Jempson
T. C. R. Joyce
P. J. Kenny
V. Loit
F. C. Lockwood
E. J. McCabe
D. E. McFarlane
T. A. Mair
D. D. Marston
D. C. Martin
G. I. Martin
R. A. Martindale
D. R. Moorhouse
J. P. Morton
W. E. J. Moss
R. T. Nishikawa
D. M. Nowlan
L. E. G. Parker
J. D. Pinchin
J. R. Plummer
F. J. Progar
D. H. Quinsey
A. S. Romaniuk
W. J. Setterington
B. F. Smith
K. A. R. Smith
M. S. Smith
T. G. Smith
R. M. Sowden
I. W. Sutherland
J. P. Sutherland
W. D. Syniuta
J. G. R. Tardif
D. R. P. Thomson
D. H. C. Thwaites
J. P. Turcotte
L. L. Vidal
M. G. Wade
F. J. Walsh
P. H. Weiland
H. J. Wilkinson
W. D. Wright
U. M. Zommers
J. M. Zwirewich

University of Toronto

R. J. Armstrong
D. B. Bastedo
S. P. Godwin
T. W. Grayson
W. R. Hamilton
D. J. Kec
W. H. Sharpless
W. Springle
R. G. Taylor
J. E. Thomlinson
P. J. Troyer
W. A. West

Nova Scotia Technical College

C. P. Brennan
H. F. Mattinson
J. P. Mooney
E. G. Nicolle
L. T. Russell

Royal Military College

I. R. Atkins
C. H. Campbell
R. J. Fulton
P. C. Gunyon
J. D. Pearce
R. G. Thompson
R. S. Wallace

McGill University

D. E. Greenwood
G. B. Payne
N. D. Sim
A. G. Stauble

University of New Brunswick

T. F. Gorman
C. A. Ponder
R. A. Rhind

University of Alberta

H. D. Atkins
A. R. Pasini
E. W. A. Schaefer

University of Manitoba

L. Morhalo
W. M. Shaw

Ecole Polytechnique

J. L. M. Marcoux

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members:
A. D. S. MacDonald
A. P. Robinson

Junior:
F. G. LeDez

Student:
P. R. C. Collings

Junior to Member:
G. W. Glaholt
S. P. Slinn

SASKATCHEWAN

Members:
D. W. Asbury
W. A. Flegel
A. F. Gregory
F. Hollingworth
W. A. McLaughlin
C. Wong
D. D. Wright

Junior:
D. S. Champ

Students:
G. E. Baldwin
E. J. Beauchamp
L. C. Cameron
D. E. Fidlar
W. H. Fisher
A. C. Floyd
C. M. Goodrich
J. A. Haynes
F. H. Lepine
C. R. MacFadyen
E. M. Misfeldt
D. H. Olson
G. M. Pearson
J. G. Rogers
J. C. Sands
H. Skogland

I. S. Howrie
R. J. Jacobson
S. D. Jaycock
E. S. Jonasson
J. J. Sled
J. R. Sparrow
A. A. G. Swanson

Junior to Member:
H. G. Bird
L. E. Burford
M. J. Gavel
R. C. Hovdebo
J. A. Marshall
R. B. N. McBurney
R. Oancia
L. E. Toth
W. R. Wiggins

Student to Junior:
D. L. Gingerick

MANITOBA

Junior to Member:
W. J. Patton

NOVA SCOTIA

Members:
A. W. Evans
A. H. MacKinnon

Thirty-five Years Ago

Comment on the *JOURNAL* of March 1920

The Institute's financial statement for 1919 showed a deficit of about $6,500 on the year's operations. Naturally, it could not continue to run into the red, so one of the tasks of the annual meeting, reported in the March, 1920, *Journal*, was to devise means of getting — and staying — solvent. This was done by resolving, in effect, to raise fees by two dollars, thus restoring the amount available for general purposes to what it had been before two dollars per member was allotted to the *Journal*. Because it would take some months to make this change legally, it was decided to ask members to contribute the extra two dollars voluntarily when they paid their fees. It will be interesting to see whether there is any note in later issues of the *Journal* of the success or failure of this appeal.

Legislation was marking time, the annual meeting was told that licensing bills had been submitted to the provincial legislatures of British Columbia and New Brunswick and would shortly be submitted in Alberta and Saskatchewan. The Ontario Provincial Division was in a fair way to settle its differences in legislative outlook with the Joint Committee of Technical Organizations of that province. It may be remembered that, while the Provincial Division supported the Institute's idea of the registration of all engineers by one authority, the J.C.T.O. wanted each specialty group separately registered, and, incidentally, wanted this scheme of registration ultimately extended to cover all professional people — lawyers, doctors, dentists, nurses, accountants and so forth.

A good deal of this *Journal* was filled by the professional papers read at the annual meeting, beginning with one on The Training of the Chemical Engineer, by R. F. Ruttan, director of the department of chemistry of McGill University. Chemical engineers seem to have been a new breed in 1920, rather looked down upon as sterile hybrids by both engineers and chemists. Admitting that the attempts at training them had not been too successful in the past, Dr. Ruttan nevertheless thought the case far from hopeless and advanced some ideas of his own for turning out graduates in this specialty as competent in their own way as those in other fields of engineering. The heart of his scheme was a year to be spent, six weeks at a time, in selected chemical industries, but under university discipline and control. Quite apparently, the scheme died a-borning.

Another speaker was A. S. Eve, Macdonald professor of physics at McGill University, who told the meeting the old story that our preparatory schools were not doing too well in teaching their students, notably in mathematics. His Importance of Physics in Engineering Education could not have attracted much attention; nobody at all bothered to discuss it. If Dr. Eve were alive in this atomic age, he would, we fancy, find a more interested and sympathetic audience than he did in 1920.

The Water Power Policy of the

Province of Quebec and the Work of the Quebec Streams Commission was explained by Olivier Lefebvre, M.E.I.C., the Commission's chief engineer. The Commission had just completed the Gouin storage dam on the St. Maurice River, impounding 160 billion cubic feet and exceeded in capacity only by the Gatun Dam in the Panama Canal Zone, and was busy with plans for others. It was guessed that about 5 million horse power might be available in the province south of Latitude 50° North, of which about 875,000 horse power was developed; today the estimated minimum-flow power, location not stated, is given as nearly 11 million horse power, of which 7,263,621 horse power was developed in 1953. How far we have come in things material since 1920!

Alexander Fraser, A.M.E.I.C., chief engineer of the Quebec Ministry of Highways, read a paper, short but interesting, on the history of Quebec's road system since the earliest days of the colony. It contained no technical matter.

In 1920 the Institute was perhaps more modest than we are today. The leading editorial, *As Others See Us*, begins, "Adherence to the strict traditions of the profession in Canada would prevent repeating any comment of a favourable nature made regarding the Institute. But, inasmuch as modesty of an extreme variety has been a curse to the profession, it seems high time that we should . . . do a little blowing on our own account", and then proceeds for a column or so to reprint all the nice things the *Engineering News Record* had to say about the annual meeting. The *ENR* visitor was impressed by the smoker: "The room was . . . large and . . . chairs were . . . gathered suggestively around tables . . . And on the tables were bottled goods that cheered, now banished from these arid states . . . We are sure that everyone went away feeling that the Institute was a very real thing, something that helped him to come close to his brother engineer and to work with him for common objects."

Professor Peter Gillespie, M.E.I.C., of the University of Toronto, entered a plea for some competent writer to prepare a series of short biographies of Canadian engineers who had made their mark, something like Smiles' classic Lives of the Engineers. Nobody ever came forward to do the job, though some biographical material of this sort has appeared since 1920. Probably nobody could have written these booklets better than Professor Gillespie himself; the writer has reason to believe he was thinking about the project at the time of his death.

1920 was U. of T's year, the president of the Institute, all four of the vice-presidents and the two newly elected councillors from Ontario were all graduates of that university.

Three council meetings were reported in this *Journal*. Other than routine business and the admission of applicants to various grades of membership, not much happened at these meetings. The names of most of the new members mean little to us today, but there are a few still with us — C. M. Crooks of Halifax, W. A. Gilmour of Montreal, P. S. Gregory of Montreal, H. W. Harkness of Kingston, C. E. Herd of Ventnor, Ont., E. H. Jupp of Vancouver, L. B. McCurdy of Montreal, W. B. Redfern of Toronto, J. J. Traill of Toronto and J. E. A. Weaver of New York — to mention only those who were granted "M's" or "A.M.'s".

Among the personals we see the name of J. N. Aggiman, who had just departed for Turkey, the land of his birth. This writer remembers him well, though he is no longer a member of the Institute. A bundle of energy and full of ideas, he set up a contracting business in Ankara and prospered exceedingly, being a strong supporter of the Turkish government, from which he received many contracts. For years he visited Montreal at fairly regular intervals, bringing with him his family and a retinue of servants and installing them in a suite at the Ritz Carlton Hotel, while he shot back and forth across eastern Canada and the United States, buying construction machinery and drumming up business. No hustling Yankee ever had anything on Aggiman.

Engineers were still in "brisk demand". There were 14 posts open, some for more than one employee, as against only five who were looking for jobs. Civil Service had two vacancies to fill, one for a highway engineer in the Department of Railways and Canals and one in the intelligence service of the Air Board. The salaries offered seemed to show that the new Civil Service scale was beginning to work.

One has only to look at a copy of the *Journal* of the period under review to realize how much it has improved in appearance since then. The 1920 *Journal* is not very inspiring, but what technical periodical was then ? One read them from a sense of duty or for information and not because they had the slightest aesthetic appeal. How different today! The writer's wife regularly ploughs through the advertising pages of the *Journal* not because she has any interest in what is offered there, but because the "pictures look nice". More power to the man who produces attractive books and magazines!

Correspondence

Criticism of Engineering Writing

Mr. Editor:

Mr. F. G. Carson's paper in the October issue of the *Journal* describing a new instrument-controlled chemical factory must have been of interest to many engineers. Unfortunately the article was spoiled for me by the language in which it was written, and it is because this strange tongue is becoming increasingly common in engineering writing that I venture to draw attention to it and to deplore it. It may be good Scientific American, but it most certainly is not good English as I know it. I admit that by a process of mental translation it is possible for an English-speaking reader to understand the paper though there are a few sentences which defied my efforts.

I have given close attention to the language of this paper and others like it, to determine what are the features which distinguish it from English. One is the invention of clumsy words like "instrumentation" and "roughing-in" and of terms like "production throughput", "prestartup calibration" and "program scheduling", for quite simple ideas which are easily expressed in good Anglo Saxon words. Another is the excessive use of vaguely scientific words like "technique" and "planning", and the unnecessary creation of verbs like "sizing", "averaging", and "paralleling". Less obvious is the woolly use of words like "field" and "potential" which have exact scientific meanings.

I note that the E.I.C. Student Conference wants more French language papers in the *Journal*. I think that is a very good idea. French is not so easily murdered as our poor English tongue.

Charles R. Neill, M.E.I.C.,
Perthshire, Scotland.
December, 1954.

The ASME Boiler Code

Correction

Interpretations of the ASME Boiler Code, as printed in the February *Journal* (page 145) were said to have been formulated at a committee meeting of June 11, 1954. This statement is corrected as follows: "The following Case Interpretations (as printed in the February issue of *The Engineering Journal*) were formulated at the Committee meeting of October 29, 1954, and approved by the Board on December 30, 1954.

The *Journal's* February section also omitted the following Case Intrepretation, also approved by ASME Council, December 30:

Case No. 1195

Special Ruling

Inquiry: May Fig. UNF-28.10-1, covering copper-silicon alloys A and C and extending the range to 350 F, be used in place of Fig. UNF-28.10?

Reply: It is the opinion of the Committee that Fig. UNF-28.10-1, covering copper-silicon alloys A and C, is to replace the present Fig. UNF-28.10 printed in the 1954 Addenda to Section VIII.

Note: Fig. UNF-28.10-1, Chart for Determining Shell Thickness of Cylindrical and Spherical Vessels Under External Pressure When Constructed of Copper-Silicon Alloys A and C, is available from the Secretary of the Boiler and Pressure Vessel Committee and will be included in the printed Case Interpretations.

Interpretations

The Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

The following Case Intrepretations were formulated at the Committee meeting December 10, 1954, and previously.

Case No. 1196

Special Ruling

Inquiry: May aluminum bronze alloy 9A of ASTM Specification B-148-52 be used in the construction of vessels under the requirements of Section VIII of the Code, when it is centrifugally cast in accordance with ASTM Specification B-271-52T and meets the following requirements for mechanical properties.

The minimum tensile requirements conform to the following:

Tensile Strength	80,000 psi
Yield Strength at 0.5 percent elongation under load	29,000 psi
Elongation in 2 inches	30%

Reply: It is the opinion of the Committee that the material specified in the Inquiry may be used in the construction of unfired pressure vessels under the rules of Section VIII provided the following additional requirements are complied with.

(1) The maximum allowable stress values shall be those given in Table I.

(2) Welding procedures and welders shall be qualified in accordance with Section IX, Part B. Separate qualifications are required for this material since it is not listed in Table QN-11.1.

(3) The requirements in Par. UNF-65 shall apply to low-temperature operation.

Table I — Case 1196

Maximum Allowable Stress Values

Metal Temperatures not Exceeding Degrees F.	Allowable Stress Value in psi
150	17,000
250	14,300
300	14,000
350	13,700
400	13,600
450	13,500
500	13,000

The allowable design stresses are subject to a casting factor as per Pars. UNF-8 and UG-24.

Nonmandatory Appendix

(1) Since this alloy will be employed in the processing or storage of corrosive liquids or gases, care should be exercised that the design considers the corrosion possibilities. All crevices where accelerated local attach may occur should be filled or sealed by fusion welding. These crevices usually are found behind backing strips, lap joints or riveted joints.

(2) It is expected that vessels or parts thereof constructed from the above cast materials will be employed in the processing or storage of corrosive liquids or gases. The selection of materials as being suitable in a specific application shall be the responsibility of the user.

(3) The determination of corrosion allowances is not covered by these rules. It is recommended that users assure themselves by appropriate tests or otherwise, that the alloy is suitable for the service intended.

(4) The acceleration of corrosion by the presence of internal stresses or failure by stress corrosion should be considered by the user. Where service data are not available it is recommended that a suitable thermal treatment be employed after fabrication has been completed. This treatment includes a furnace anneal, when practical, at a temperature of 1150°F. for a period of 1 to $1\frac{1}{2}$ hours at temperature. Air cooling from the furnace temperature is completely satisfactory.

Case No. 1197

Special Ruling

Inquiry: In view of the recent change in Appendix Q which permits the same policy for determining bolting stresses for nonferrous materials as is now in effect for ferrous materials, what design stresses may be used in place of those now appearing in Table UNF-23?

Reply: It is the opinion of the Code Committee that the bolting stresses shown in Table 1 — Case 1197 may be used in place of those now in Table UNF-23.

(***Note.*** *Due to printing difficulties, Table 1 —Case 1197 cannot be printed in this issue. It will appear in the April issue.*)

Case No. 1200

Special Ruling

Inquiry: May wrought iron plates meeting the requirements of ASTM Specification A-42-52T be used in the construction of unfired pressure vessels under the rules of the 1952 Edition of Section VIII of the ASME Boiler and Pressure Vessel Code.

Reply: It is the opinion of the Committee that this material may be used for unfired pressure vessels under the provisions of the 1952 edition of Section VIII with the following limitations and additional requirements:

(1) Each plate shall be stamped with the maker's brand or name, the ASTM specification, the minimum specified tensile strength of 39,000 psi, the minimum elongation in 8 in. and the lot number or test identification number.

(2) The maximum allowable stress value shall be 9,750 psi.

(3) The maximum metal temperature in vessel operation shall be 650°F.

(4) The mill test reports shall show the tensile strength and elongation both longitudinally and transversely.

(5) (a) Special forming plate shall meet the requirements of Section IX of the Code except that the guided bend test specimen shall be machined on the compression side to a thickness of 3/16 in. but shall be bent in the standard guided bend test jig for specimens $\frac{3}{8}$ in. thick.

(b) Standard plate shall meet the requirements of Section IX of the Code except that the guided bend test specimens shall be made with the welds perpendicular to, and the direction of bending parallel to the direction of rolling of the plate. The standard $\frac{3}{8}$-in.-thick specimen shall be used.

Case No. 1173

Special Ruling
(Reopened)

Reply, Par. (*9*), revise the bolting stresses as follows:

100	200	300	400	500	600	650
11200	10000	9800	9100	8800	8300	8300

Annulment of Cases

Case Nos.	*Reason for Annulment*
973	Pars. P-186(h) and UW-27(2) permit the usage of oxy-acetylene pressure welding.
1116	It is not practicable.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.

Power Boilers, 1952

Par. P-102(h) (2) (a) — revise table to read:

Plate Thickness Inches	Thickness of Reinforcement, Inches
Up to ½ incl.	1/16 max.
Over ½ to 1, incl.	3/32 max.
Over 1 to 2, incl.	1/8 max.
Over 2	5/32 max.

Par. P-102(h) (9), revise this paragraph to read:

When radiographing a circumferential joint by placing the radiation source inside the vessel or pipe . . . etc.

Par. P-102(h) (9), revise footnote to read:

A suggested method for proving the adequacy of the radiographic method is as follows: A preliminary radiograph should be made with a piece of pipe . . . etc. The radiation source employed in making this proof radiograph together with all other items of technique such as the location of the source of radiation and time of exposure . . . etc.

Par. P-102(h) (10), revise the first line to read:

When the radiation source is placed on the axis . . . etc.

Par. P-258, third paragraph, revise size of handhole opening to read: 2¾″ x 3½″.

Par. P-270, revise the last line to read:

The safety valve capacity of new units shall be in compliance with Par. P-274 but shall not be less than the maximum designed steaming capacity as determined by the manufacturer.

Par. P-273(d), first line, delete the words: After obtaining the Code stamp . . .".

Material Specifications, 1952

The Boiler Code Committee has approved adding to Section II the following new specifications:

Plates

SA-6-54T—General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.

SA 20-54T—General Requirements for Delivery of Rolled Steel Plates of Flange and Firebox Qualities.

SA-30-54T—Boiler and Firebox Steel for Locomotives.

SA-129-54T—Open-Hearth Iron Plates of Flange Quality.

SA-167-54—Corrosion-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

SA-201-54T—Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels.

SA-202-54T—Chromium-Manganese-Silicon Alloy-Steel Plates for Boilers and Other Pressure Vessels.

SA-203-54T—Nickel-Steel Plates for Boilers and Other Pressure Vessels.

SA-204-54T—Molybdenum-Steel Plates for Boilers and Other Pressure Vessels.

SA-212-54aT—High Tensile Strength Carbon-Silicon Steel Plates for Boilers and Other Pressure Vessels.

SA-225-54T—Manganese-Vanadium Steel Plates for Boilers and Other Pressure Vessels.

SA-285-54T—Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (Plates 2 in. and Under in Thickness).

SA-299-54T—High Tensile Strength Carbon-Manganese-Silicon Steel Plates for Boilers and Other Pressure Vessels.

SA-300-54aT—Steel Plates for Pressure Vessels for Service at Low Temperatures.

SA-301-54aT—Chromium-Molybdenum Steel Plates for Boilers and Other Pressure Vessels.

SA-302-54T—Manganese-Molybdenum Steel Plates for Boilers and Other Pressure Vessels.

SA-353-54T—Low-Carbon High-Nickel Steel Plate for Pressure Vessels.

SA-357-54T—Five Per Cent Chromium, 0.5 Per cent Molybdenum Steel Plates for Boilers and Other Pressure Vessels.

Tubular Products

SA-53-54T—Welded and Seamless Steel Pipe.

SA-83-54T—Seamless Steel Boiler Tubes.

SA-135-54T—Electric-Resistance-Welded Steel Pipe.

SA-178-54T—Electric-Resistance-Welded Steel and Open-Hearth Iron Boiler Tubes.

SA-192-54T—Seamless Steel Boiler Tubes for High-Pressure Service.

SA-209-54T—Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes.

SA-210-54T—Medium-Carbon Seamless Steel Boiler and Superheater Tubes.

SA-213-54T—Seamless Alloy Steel Boiler, Superheater and Heat Exchanger Tubes.

SA-226-54T—Electric-Resistance-Welded Steel Boiler and Superheater Tubes for High-Pressure Service.

SA-249-54T—Welded Austenitic Stainless Steel Boiler, Superheater, Heat Exchanger and Condenser Tubes.

SA-250-54T—Electric-Resistance-Welded Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes.

SA-268-54—Seamless and Welded Ferritic Stainless Steel Tubing for General Service.

SA-271-54—Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service.

SA-312-54T—Seamless and Welded Austenitic Stainless Steel Pipe.

SA-333-54T—Seamless and Welded Steel Pipe for Low-Temperature Service.

SA-334-54T—Seamless and Welded Steel Tubes for Low-Temperature Service.

SA-376-54T—New Specification, Seamless Austenitic Steel Pipe for High-Temperature Central Station Service.

Stainless Steel

SA-167-54—Corrosion-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

SA-240-54—Corrosion-Resisting Chromium and Chromium-Nickel Steel Plate, Sheet and Strip for Fusion-Welded Unfired Pressure Vessels.

SA-249-54T—Welded Austenitic Stainless Steel Boiler, Superheater, Heat Exchanger and Condenser Tubes.

SA-268-54—Seamless and Welded Ferritic Stainless Steel Tubing for General Service.

SA-271-54—Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service.

SA-312-54T—Seamless and Welded Austenitic Stainless Steel Pipe.

Non-ferrous Materials

SB-11-54—Copper Plates for Locomotive Fireboxes — approved.

SB-12-54—Copper Rods for Locomotive Staybolts — approved.

SB-26-54T—Aluminum-Base Alloy Sand Castings — ***Drop*** this Specification.

SB-42-54—Seamless Copper Pipe, Standard Sizes — approved.

SB-43-54—Seamless Rod Brass Pipe, Standard Sizes — approved.

SB-75-54—Seamless Copper Tube — approved.

SB-96-54—Copper-Silicon Alloy Plate and Sheet for Pressure Vessels — approved.

SB-98-54—Copper-Silicon Alloy Rod, Bar and Shapes — approved.

SB-108-54T—Aluminum-Base Alloy Permanent Mold Castings — ***Drop*** this Specification.

SB-111-54—Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock — approved.

SB-152-54—Copper Sheet, Strip, Plate and Rolled Bar — approved.

SB-171-54—Copper-Alloy Condenser Tube Plates — approved.

SB-178-54T—Aluminum and Aluminum-Alloy Sheet and Plate for Pressure Vessel Applications — approved except delete alloy GM40A.

SB-225-53T—Copper and Copper-Alloy Welding Electrodes — approved.

SB-247-54T—Aluminum-Alloy Die Forgings — approved except delete alloys CN42C, CN42D, SG121A, SG11A, ZG62A, 990A.

SB-273-54T—Aluminum and Aluminum-Alloy Bars, Rods and Shapes for Pressure Vessel applications — approved, for alloys GS11A and CG42A only, deleting all others.

SB-274-54T—Aluminum and Aluminum-Alloy Pipe and Tubes for Pressure Vessel applications — approved for alloys M1A, Clad M1A, GS10A and GS11A only, deleting all others.

SB-285-54T—New Specification — Aluminum and Aluminum-Alloy Welding Rods and Bars Electrodes — approved except delete alloys, R-C4A, R-CN42A, R-CS41A, E-CS41A, R-ZG61A.

SB-295-54T—New Specification — Nickel and Nickel-Base Alloy Covered Welding Electrodes — approved except delete alloys, E-3N14, E-3N19.

SB-211-54T—Aluminum and Aluminum-Alloy Bars, Rods and Wire.

Low-Pressure Heating Boilers, 1952

H-44(a) and H-97(a) Relief Valves — (rewrite as follows):

Each hot water heating boiler shall have at least one officially rated pressure Relief Valve set to relieve at or below the maximum allowable working pressure of the boiler. Each hot water supply boiler shall have at least one officially rated Relief Valve or at least one officially rated pressure-temperature Relief Valve of the automatic reseating type set to relieve at or below the maximum allowable working pressure of the boiler. When more than one Relief Valve is used on either hot water heating or hot water supply boilers, the additional valve or valves shall be officially rated and may be set within a range not to exceed 20% of the lowest pressure to which any valve is set. Relief Valves shall be spring loaded without disc guides on the pressure side of the valve. Relief Valves shall be so arranged that they cannot be reset to reneve at a higher pressure than the maximum permitted by this paragraph.

H-44(c) and H-97(c) Rewritten as follows:

Seats and disc of Relief Valves shall be of material suitable to resist corrosion. No materials liable to fail due to deterioration or vulcanization when subject to saturated steam temperature corresponding to capacity test pressure shall be used for any part.

H-44(e) Rewritten.

The required steam relieving capacity, in pounds per hour of the pressure relieving device or devices on a boiler shall be determined by dividing the maximum Btu output at the boiler nozzle obtained by the firing of any fuel for which the unit is designed by 1000 or by multiplying the square feet of heating surface by 5. In many cases a greater relieving capacity of valves will have to be provided than the minimum specified by these rules. In every case, the requirements of (g) shall be met.

Par. H-51(a) (4) Add the following words "in accordance with Par. H-51(d)."

Par. H-104(a) (4) Add the following words "in accordance with Par. H-104(d)."

Par. H-104(d) Rewrite as follows:

The manufacturer of the valves that are to be stamped with the Code symbol shall submit valves for testing to a place where adequate equipment and personnel are available to conduct pressure and relieving capacity tests which shall be made in the presence of and certified by an authorized observer. The place, personnel and authorized observer shall be approved by the Boiler Code Committee. The valves shall be tested in one of the following three methods:

(1) *Coefficient Method* Tests shall be made to determine the lift, popping and blowdown pressures, and the capacity of at least three valves each of three representative sizes (a total of nine valves). Each valve of a given size shall be set at a different pressure. A coefficient shall be established for each test as follows:

$$K_d = \frac{\text{Actual steam flow}}{\text{Theoretical steam flow}} = \text{Coefficient of discharge}$$

The average coefficient of the tests required shall be taken as the coefficient (K) of the design and shall be used for determining the relieving capacity of all sizes and pressures of the design in the following formulas:

For 45 deg. seat $W = (51.45 \times \pi \text{ DLP} \times 0.707 \times K)\ 0.90$.

For flat seat $W = (51.45 \times \pi \text{ DLP} \times K)\ 0.90$.

For nozzle $W = (51.45 \times AP \times K)\ 0.90$.

Where W = Weight of steam per hours, pounds.

D = seat diameter, inches.

L = lift, inches.

P = absolute pressure, pounds per square inch, (accumulated).

K_d = coefficient of discharge for a single test.

K = average coefficient of discharge.

A = nozzle throat area, square inches.

Note: The maximum and minimum coefficient determined by the tests of a valve design shall not vary more than plus or minus 10 percent from the average.

(2) *Curved Method.* If a manufacturer wishes to apply the Code symbol to a design of Relief Valves or Steam Safety Valves, four valves of each pipe size and/or orifice size shall be tested. These four valves shall be set at pressures that will cover the approximate range of pressure for which the valves will be used. The capacities as determined by these four tests shall be plotted against the absolute accumulation test pressure and a curve drawn through these four points. If the four points do not establish a reasonable curve the authorized observer shall require additional valves tested. From this curve the relieving capacities shall be obtained. The stamped capacity shall be 90 per cent of the capacity taken from the curve.

(3) If a manufacturer wishes to apply the Code symbol to Pressure Relief Valves, Steam Safety Valves of one or more sizes of a design set at one pressure, he shall submit three valves of each size of each design set at one pressure for testing and the stamped capacity of each size shall be 90% of the average capacity of the three valves tested.

H-51(e) and H-104(e) Rewritten as follows:

Safety Valves for steam boilers shall be tested for capacity at 33⅓ per cent over the 15 psi required set pressure. Capacity certification tests of Relief Valves for hot water heating and hot water supply boilers shall be conducted at 110 per cent of the pressure for which the valve is set to operate.

For the purpose of determining the capacity of Pressure-Temperature Relief Valves, dummy elements of the same size and shape as the regularly applied thermal element shall be substituted and the Relieving capacity shall be based on the Pressure element only. The thermal element for a Pressure-Temperature Relief Valve shall be so designed and constructed that when subjected to steam temperature at test pressure, it will not fail in any manner which could obstruct flow passages or reduce capacity.

For determining the Btu discharge of Relief Valves the relieving capacity in pounds per hour (W) is multiplied by 1000.

H-51(f)

The tests shall be made with steam in a manner closely approximating actual operating conditions of steam boilers. The relieving capacity shall be measured by condensing the steam or with a calibrated steam flowmeter. (Delete second paragraph.)

H-51(h) Delete.

Par. H-51(d), first line, delete the words:

After obtaining the Code stamp . . .

Par. H-104(d), first line, delete the words:

After obtaining the Code stamp . . .

Unfired Pressure Vessels, 1952

Par. UG-131(a), delete the words:

After obtaining the Code symbol stamp, as outlined in Par. UG-130, but

Par. UG-47, Insert a new subparagraph (e) to read as follows: (relettering the present (e) and subsequent subparagraphs)

(e) If a stayed jacket extends completely around a cylindrical or spherical vessel, or completely covers a formed head, it shall meet the requirements given above in (a), and shall also meet the applicable requirements for shells or heads in Pars. UG-27(c) and (d) and UG-32.

Par. UG-27, add the following paragraph:

(f) A stayed jacket shell that extends completely around a cylindrical or spherical vessel shall also meet the requirements of Par. UG-47(c).

Par. UG-32, add the following paragraph:

(r) A stayed jacket that completely covers a formed inner head of any of the types included in this paragraph shall also meet the requirements of Par. UG-47(c).

Par. UW-11(c), add the following new subparagraph UW-11 c) (2) (c).

(c) Circumferential welded butt joints between a radiographed shell-section and a non-radiographed head the design thickness of which is less than that of the shell-section except as required in Par. UW-11(a).

Welding Qualifications, 1953

Pars. Q-20(b) and QN-20(b), add as follows:

The welder performance test may be terminated at any stage of the testing procedure whenever it becomes apparent to the supervisor conducting the tests that the welder does not have the required skill to produce satisfactory results.

In this event, the welder may be tested at the discretion of the manufacturer in accordance with Paragraphs Q-21 and QN-21.

Reletter present Pars. Q-20(b) and QN-20(b) as Q-20(c) and QN-20(c), respectively.

News of Other Societies

The annual banquet of the **Association of Consulting Engineers of Canada** (Room 604, 620 Cathcart St., Montreal), will be held in the Royal York Hotel on Thursday evening, May 12. The dinner and annual meeting is being held coincidentally with the annual meeting of the Engineering Institute of Canada.

The guest of honour and chief speaker at the annual dinner will be Rt. Hon. C. D. Howe, Minister of Defence Production. He has accepted the invitation of the president, A. T. Hurter, and on this occasion will be made a life honorary member of the Association. Members are permitted to have their ladies and friends as guests.

The annual business meeting of the Association will be held on the afternoon of the same day. A. T. Hurter will be the retiring president, while the president-elect is Edgar A. Cross of Toronto, who will preside at the dinner meeting.

The **American Society of Mechanical Engineers** (29, West thirty-ninth St., New York 18), held in February the first of a series of five national meetings to celebrate the 75th anniversary of the Society this year. Some details of the complete program developing the theme "The Engineer in Our World", are as follows:

The founding anniversary meeting, studying The Engineer and the World of Communications, February 16, New York; the organization anniversary meeting, The Engineer and the World of Education, April 16, Hoboken and New York; diamond jubilee spring meeting, The Engineer and the World of Government, April 18-22, Baltimore; the diamond jubilee semi-annual meeting, The Engineer and the World of Science, June 19-23, Boston; the diamond jubilee annual meeting, The Engineer and the World of Commerce and Industry, November 13-18, Chicago.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Nova Scotia

New Officers

Professor M. L. Baker, associate professor of mechanical engineering of the Nova Scotia Technical College, was elected president of the Association of Professional Engineers of Nova Scotia at the joint annual banquet of the Association and the Halifax Branch of the Engineering Institute, held in the Nova Scotian Hotel on January 27. He succeeds John Clarke of Middleton.

A native of Pinehurst, N.S., Professor Baker received his general education at Pinehurst and Bridgewater, and upon graduation from high school, joined Acadia Gas Engines Limited in Bridgewater as machinist apprentice, subsequently becoming a qualified journeyman machinist.

He then went to western Canada, and after completing a course at Camrose, Alberta Normal School, taught in the public schools in Camrose and Edmonton, and upon his return to Halifax, undertook engineering studies at Dalhousie University and the Nova Scotia Technical College. He graduated from the latter with a B.Sc. degree in mechanical engineering in 1932, and a year later joined the teaching staff of the Nova Scotia Technical College.

Professor Baker, who is a past councillor of the Association of Professional Engineers of Nova Scotia, is also a past chairman of the Halifax Branch of the Engineering Institute and a past councillor of the Institute representing that Branch. He has served as chairman of the Board of School Trustees in Bedford, N.S., for the past six years, and as chairman of the Nova Scotia Provincial Apprenticeship Committee for the past seven years. He is a past president of the Nova Scotia Technical College Alumni Association, a member of the American Society for Metals, and has been a member of the Sponsoring Committee, Bedford Air Cadet Squadron for the past nine years.

Other officers elected were vice-president, C. H. Murray, Sydney; councillors, R. F. Titus and G. F. Bennett, Halifax; D. A. Eisenhauer, Lunenburg and W. R. Lewis, Kentville; secretary-treasurer, Professor Lee Cameron. Councillors continuing in office for another year are G. R. Burchell, Halifax; J. W. MacDonald, Dartmouth; J. R. MacQuarrie, Malagash; and L. F. Kirkpatrick, Amherst.

Life Membership Awards

A highlight of the banquet proceedings was the award of life memberships in the Association of Professional Engineers to S. L. Henley, veteran Halifax engineer associated with the Department of Public Works, and to D. S. Wickwire of Yarmouth.

Special honour was also paid to seven members of the Halifax Branch of the Engineering Institute who recently were made life members of the Institute. They were Dr. Ira P. Macnab, H. W. L. Doane, William C. MacDonald, Alex Scott, Karl E. Whitman, Clifford S. Wilson and R. L. Seaborne.

J. D. Kline, secretary-treasurer and registrar of the Association of Professional Engineers of Nova Scotia for the past nine years, was presented with a gift of appreciation of his services in the three posts. The presentation was made by Professor A. E. Flynn, a former president of the Association. Mr. Kline will be succeeded by Professor Lee Cameron of the Nova Scotia Technical College.

Hon. H. H. Winters Guest Speaker

Hon. R. H. Winters, federal minister of public works was the special speaker at the banquet. His subject was "The Role of Public Works in Canada's Economy".

Mr. Winters said the federal government last year spent more than $300,000,000 on public works, but as in previous years less money was spent than was voted. Under a new policy he said "we will come closer this year to spending our allotments than ever before."

He urged greater participation in the trans-Canada highway before the federal offer to pay 50 per cent lapsed in December, 1956. In Nova Scotia he said more projects would be undertaken under the marshlands reclamation scheme, the Canada Water Conservative Act, Elimination of Grade Crossing and the Forestry Act.

He said also that engineers should broaden their activities in the fields of conservation, management and politics.

W. A. Devereaux, chairman of the Halifax branch of the Engineering Institute presided jointly over the annual meeting banquet with Professor M. L. Baker.

Alex MacKinnon was master of ceremonies for the entertainment program.

Ontario

More than 1,000 professional engineers representing all branches of the profession attended the annual meeting of the 13,000-member Association of Professional Engineers of Ontario in Toronto on January 29. The delegates were from all parts of the province as well as some from Quebec, and observers from the other provincial associations throughout Canada.

Members heard reports from the various association committees dealing with such items as ethics, registration, professional status, scholarships and board of examiners.

During 1954, scholarships totalling 1,800 were awarded by the Association to engineering undergraduates at Queen's University, Kingston, and the University of Toronto. The Association also makes available loans up to $200 to secondary school students entering first year engineering at Queen's and the U. of T. During 1954, only two loans were made, although others were available, it was reported.

It was also reported at the meeting by the legislation committee that Prince Edward Island which is the only Canadian province which has no Professional Engineers' Act is currently taking steps to secure such legislation.

During 1954, more than 200 applicants from non-English speaking countries applied for membership in the A.P.E.O. Nineteen foreign countries of origin were represented by the applicants. Among the 200 were two women, it was noted.

The year also saw a total of 800 applications considered by the board of examiners. Some 80 per cent of the applicants were required to write the Association's special examinations. During the annual examinations conducted in March, 178 candidates were examined

on 62 different papers. Of the 463 papers turned in, a pass standing of 65 per cent was obtained.

These examinations are in accordance with a uniform syllabus which has been adopted by Ontario, Quebec, British Columbia, Manitoba and Saskatchewan associations.

It was pointed out in the report that it was likely that Nova Scotia, New Brunswick and Newfoundland will adopt the uniform syllabus this year.

Paul H. Robbins Guest Speaker

The successful defence of Canada and the United States in the event of a third world war depends upon the continued high technological development of the two nations, Paul H. Robbins, Washington, D.C., told members of the Association of Professional Engineers of Ontario at its annual meeting. Mr. Robbins is executive director of the National Society of Professional Engineers, the policy-making body for 34,000 U.S. engineers in 39 states.

Paul H. Robbins

In addition to its important role in national defence, technology was also responsible for maintaining the present high level of economy enjoyed by Canada and the U.S.

Praising the strides being made by Canadian engineering in this country, he noted that the performance of the profession was being watched not only by the public-at-large, but also by all levels of government.

This latter interest ran the gamut from such purely local problems such as water supply, traffic, housing, schools and building codes through provincial levels such as public works, highways, decentralization of industry, to the federal level and such projects as the St. Lawrence Seaway, oil and mineral development, and defensive measures.

He said the governments of Canada and the U.S. have been "working closely in correlating the technical assistance we can develop for the free nations of the world."

Mr. Robbins called upon the engineering profession to guard jealously its professional status and continue its high standards of performance, ethical conduct and civic responsibilities. All of these elements were indicative of the progress the profession has made to improve the appearance of "the 1955 model of engineering", he said.

He pointed to the vast developments which had occured in the last 15 years when "electronics was a fantasy in the Buck Rogers comics; atomic engineering was a series of symbols on the physicists' blackboard; travel faster than the speed of sound was considered an impossibility".

"And yet, in 1955, engineering has made all these possible."

Mr. Robbins referred to the attitude of the engineering profession concerning "certain trade union activities", and pointed out that although there appeared to be a certain degree of this evident in Canada, it was much more of a problem in the U.S.

"Because so much depends upon the engineer's judgment, it is the opinion of the National Society of Professional Engineers that the regimentation inherent in union organization cannot be compatible with professional development," he stated, adding that management is continually relying upon engineering judgment and, as such, "engineers must be identified with the management side of the economic picture."

Trade Fair

Those responsible for the Canadian International Trade Fair report that the bookings for 1955 to date indicate an increase over last year.

The 1955 Fair will take place in Toronto from May 30 to June 30, inclusive, and will be located, as in previous years, in the grounds of the Canadian National Exhibition.

News of the Members

Samuel McClements has moved from Fort William, Ont., to Minneapolis, Minn., where he is employed by Scott Atwater Inc., manufacturers of outboard motors.

The appointment of **E. J. Sheare** as managing director of Taylor Instrument Companies of Canada Ltd., Toronto, has been announced. Mr. Sheare has been industrial sales manager of the company and has had many years' experience in the application of temperature, pressure, flow and liquid level controls to Canadian industry.

George R. Mather has entered private practice in the radio engineering consulting field, with offices at 22 **Front** St. West, Toronto.

Mr. Mather is a graduate of the University of Alberta and has been supervisor of antennas and propagation engineering of the electronic equipment department, Canadian General Electric Co. Ltd., and assistant broadcast engineer, Department of Transport telecommunications division. He has represented Canada at international broadcast frequency conferences and is the author of several articles on broadcast propagation.

Charles J Barhydt of the New York Central Railroad has returned to Canada and is located at the company's offices in St. Thomas, Ontario.

Announcement has been made by **W. D. Sheldon, Jr.**, president of Sheldon's Engineering Ltd., of Galt, Ont., of the appointments of **Arthur Nearingburg**, as general sales manager; **T. K. Birss**, as Toronto branch manager; and **John P. Stuart**, as London branch manager. **W. C. Caldwell** has been appointed special projects manager and promoted from his former appointment of sales manager.

John W. Lee, of the Ontario Hydro, has moved from Niagara Falls to North Bay, where he is the electrical maintenance superintendent for H.E.P.C. in the north eastern region.

T. R. Banbury has been appointed president of Superstat Canada Ltd., with head office at 1156 Yonge St., Toronto. The company is engaged in the promotion of Superstat Electric Water Treatment for scale prevention in hot water and boiler feed systems.

Ian Y. Morrison has recently joined the sales staff of Powerlite Devices Ltd., Toronto.

An honour graduate of London University, Mr. Morrison came to Canada in 1947 and was with Canadian General Electric Co. Ltd. at Peterborough and for the past five years with Canadian Comstock Co. Ltd. in St. Catharines, as assistant to the project manager.

H. Robert Musson has joined Keep Rite Products Ltd., of Brantford, Ont., as assistant to the general sales manager. He will be in charge of refrigeration and air conditioning applications.

Previous to this move, Mr. Musson was associated with A. D. Margison & Associates Ltd., Toronto and in charge of design and supervision of heating, ventilating, air conditioning and refrigeration. Earlier he was employed with Canadian Ice Machine Co. Ltd., Toronto as sales and installation engineer in the air conditioning division.

Frederic Sloley, of Toronto, has severed his connections with Renold-Coventry Ltd., and R. & M. Bearings Canada Ltd., and is setting up his own sales agency to handle mechanical power transmission supplies.

Dr. A. H. Younger has been moved from Toronto to New York with Chemical Construction Corporation, 525 West 43rd St., New York. In Toronto he was with the Canadian office, Chemical Construction (Inter-American) Ltd.

Albert Hopkins has recently formed Hopkins Exploration Consultants with head offices at Suite 607, 320 Bay St., Toronto. Branch offices have been opened at Algoma, Ont., and Uranium City, Sask., and nine technical men are employed.

Lorne D. Almack, of Toronto, will shortly be moving to England, where he will be with English Electric Co. Ltd., Liverpool, England. Mr. Almack is with the John Inglis Co. Ltd., Toronto, as chief inspector.

Z. Saurazas is employed as a design engineer in the Toronto office of the firm of consulting engineers, Wiggs, Walford, Frost and Lindsay. He was previously with the Ontario Hydro.

Anthony Soda, of Windsor, has established his own business in the construction field in that city. Mr. Soda was previously with the Chrysler Corporation of Canada Ltd., as layout engineer.

A. J. McConvey is now handling the sales and service of molded plastics for that section of Canadian General Electric Co. Ltd. Located now in Hamilton, his territory covers Hamilton and Western Ontario, excluding the Niagara Peninsula.

Samuel Cass has recently been ap-

pointed head of the newly formed Metropolitan Toronto Traffic Engineering Department, with the title of Metropolitan Traffic Engineer.

Mr. Cass is an engineering graduate of the University of Toronto and previous to joining Metropolitan Toronto was with the traffic division of the City Planning Department of Toronto.

D. W. Moore, of Toronto, has joined the design department staff of Orenda Engines Ltd., Malton, where he is employed as a development engineer on gas turbine accessories. Mr. Moore was formerly with the electronic equipment department of Canadian General Electric Co. Ltd., Toronto, and is a graduate of Liverpool University, England.

Larry F. Labow has recently been appointed managing director of Pardee Amalgamated Mines Ltd. which is engaged in the development of various properties across Canada. The headquarters of the company is at 170 Bay St., Toronto.

Mr. Labow is also manager of Technical Mine Consultants Ltd., Toronto, which is active in the development of extensive uranium deposits in Canada. Included are programs of construction in the Blind River District in preparation for production at Pronto Uranium Mines Ltd. and Algom Uranium Mines Ltd. The company also did the original work to the newly located New Brunswick uranium fields near Fredericton and is currently engaged at Birch Island, B.C.

Mr. Labow is a graduate in mining engineering of Queen's University and served with the R.C.E. in Europe during the last war.

Announcement has been made of the recent establishment of the firm of consulting engineers, Quan and Carruthers at 738 Spadina Ave., Toronto. The principals are **Bruce Quan** and **Fred H. Carruthers.**

Mr. Quan is a graduate in electrical engineering of the University of Toronto and since 1947 has been with Mathers and Haldenby, architects, in the capacity of head electrical engineer.

Mr. Carruthers graduated from the University of Saskatchewan in mechanical engineering and came to Toronto in 1937. From 1946 to 1950 on with S. M. Peterkin and also R. P. Allsop & Associates, in 1950 he joined Mathers & Haldenby as head mechanical engineer.

Quan and Carruthers will provide a consulting service covering all phases of electrical and mechanical systems and equipment for industrial, commercial and institutional projects.

KCS Data Control Ltd., of Toronto, whose founders include **Dr. J. Kates** and **L. Casciato,** has recently been formed to specialize in the design, application and programming of high speed electronic computing machines and systems, data processing and automatic control equipment. The high speed computing service which is offered, makes it possible to handle design, engineering, industrial and business calculations with considerable economy, even if of moderate extent. The company also will apply electronic methods to production scheduling, planning and statistical analyses, as well as to automatic inventory control.

Manitoba

J. Hoogstraten Elected President

Jack Hoogstraten, professor of civil engineering at the University of Manitoba and a member of the Association of Professional Engineers of Manitoba for many years is the newly elected president of that body.

He received his bachelor of science degree in civil engineering from the University of Manitoba and his master's degree from the University of Michigan. Besides his duties at the University he is engaged in consulting engineering work.

He succeeds Gerald B. Williams who is the chief engineer, highways branch of the Province of Manitoba. Mr. Williams has safely guided the affairs of the Association of Professional Engineers through 1954 and brought into being a recommended minimum salary for engineers, set the machinery in motion for introducing an engineers-in-training program which would benefit the younger, inexperienced engineer, as well as a host of other important things.

Professor J. Hoogstraten

Professor Hoogstraten recently represented the Association of Professional Engineers of Manitoba at the Dominion Council meeting in 1954 and is well suited to the task of heading the new Council for 1955 in that he has been on council several years and has been chairman of a great many committees. At present Professor Hoogstraten is greatly interested in the promotion of public interest in the affairs of engineers and has been very active in that field. It is natural to assume therefore that 1955 should be a year in which great strides in the field of public relations will be made by the Association.

The general annual meeting of the Association held January 21, 1955, was one of the best and was attended by the largest number in the history of the Association. The officers elected to the executive council of the Association and those remaining from 1954 are vice-president, D. M. Stephens, president and general manager of the Winnipeg Electric Company; councillors: Gerald B. Williams, past president; N. S. Bubbis, general manager, Greater Winnipeg Water and Sanitary District; G. W. Moule, contract engineer, City of Winnipeg Hydro Electric System; L. A. Bateman, general superintendent in charge of production, City of Winnipeg Hydro Electric System; and C. S. Landon, secretary-treasurer and registrar.

Saskatchewan

650-ft. TV Tower for Saskatoon

On December 7, 1954, CFQC-TV commenced broadcasting from a 650 foot tower on a hill 15 miles east of Saskatoon.

Its construction and design have many features of interest to engineers. The antenna, of the wave stack type was designed by R.C.A., Montreal, and it was fabricated and erected by Dominion Bridge of Lachine. It is made up of 29 sections of 3-ft. diameter hollow steel about 23 feet long, and each weighing 3,000 pounds. A special gin pole attached to the last section placed was used in the erection. Sections are connected by means of 127 bolts. The tower is supported by means of 18 guy wires with anchorages 200 ft. and 400 ft. from the base.

The studio is located in downtown Saskatoon. Transmission to the antenna is by means of a miniature transmitter and micro-wave beam operating at 7,000 megacycles. The beam transmits both video and audio signals. The main transmitter re-transmitts at 100,000 watts video and 60,000 watts audio. All equipment is Canadian-made by R.C.A. Victor.

CFQC TV 650-foot antenna under construction 15 miles east of Saskatoon

Vern Dallin

A. A. Murphy

A. A. Murphy, pioneer radio station operator of Saskatoon, is owner of the station, and Vern Dallin is assistant manager. Detail design of base footings and guy blocks were done by Professor B. Torchinsky. Location surveys were made by D. Ferguson, of Underwood McLellan and Associates, consulting engineers.

New Power Plant at the University of Saskatchewan

On January 13, 1955, 60 members of the Saskatoon Section of the Institute and Association of Professional Engineers of Saskatchewan were conducted through the new University of Saskatchewan steam power plant. Professor J. Wedgwood explained that the plant would completely replace the old plant as the source of steam heat for the university. It also contains standby power and water pressure boosting facilities for the new university hospital.

The boiler capacity of the plant is 120,000 pounds of steam per hour at a pressure of 150 psi. A W. H. Allen Company turbo-generator would supply 750 kwh. of standby. Boilers are designed for use with either natural gas or oil fuel. Conversion could be made with little difficulty to coal burning operation.

Estimated cost of the plant is one million dollars. Architects were Webster and Gilbert of Saskatoon. Consulting engineers were H. H. Angus, of Toronto.

British Columbia

Aptitude Tests

Facilities have been arranged by the Association of Professional Engineers of British Columbia for senior high school students throughout the province to take special evaluation tests to help determine their aptitude for a career in professional engineering. Details of the plan have been circulated to local high school principals through whom students may arrange to take the test.

In Vancouver the test may be arranged for any Thursday at the Association offices. In other parts of the province it is given by special arrangement with professional engineers in the respective centres. Cost to the student is less than half the charge for individual interview and interpretation by the nationally known vocational consultant retained by the Association.

In announcing the program, Registrar J. A. Merchant, P.Eng., of the Association of Professional Engineers, said that engineering is a greatly satisfying profession for those who are suited to it.

Mr. Merchant emphasized that although such tests have proved their value as a guide in choosing a career, they are not required as a qualification for entering engineering training. The facilities are provided conveniently throughout the province, at a reduced rate, as a public service in the educational program of the Association.

Engineers in the News

D. F. Rice has been appointed to the newly created position of supervisor of research administration for The Consolidated Mining and Smelting Company. The announcement was made by A. D. Turnbull, manager of the company's research and development division.

N. F. Brookes, of New Denver, and **T. R. Buckham,** of Carnegie Mines, Sandon, were elected president and vice-president respectively, of the Slocan District Board of Trade at its annual meeting.

V. M. Martinoff is now associated with Franklin Design Service, Division of Safeway Inc. in Oakland, California. He had been with the aluminum division of Kaiser Engineers, also in Oakland.

L. A. Mitten has accepted the position of production manager of Industrial Coatings Ltd. He was previously manager and project engineer of the Vancouver office of Hansel Engineering Co.

R. H. Cristopherson, formerly with Dominion Securities Corporation, is now with Northern Construction Co. and J. W. Stewart Ltd.

R. O. Darling, formerly of Victoria, is now working with H. A. Simons Ltd. as a mechanical engineer.

W. V. Rudd has accepted a position with H. A. Simons Ltd. He had previously been employed by Associated Consulting Engineers.

J. W. Brown is now a junior distribution engineer with the Puget Sound Power and Light Company. He has been employed by the Whatcom County Engineering Department in the State of Washington.

S. J. Crocker has succeeded **H. V. Warren,** as president of the B.C. and Yukon Chamber of Mines. Mr. Crocker is president and managing director of B.C. Equipment Co. Ltd.

W. E. Boresky has left the International Pacific Salmon Fisheries Commission to go with H. A. Simons Ltd.

Walter Johnson has accepted a position with Rilco Laminated Products Inc. at Tacoma, Washington. He had previously been employed with the B.C. Engineering Co.

D. J. Kermode is now with B. D. Bohna. Previously he had been with Heaps, Waterous, of New Westminster.

H. Hornstein, who had been working with Baynes-Manning at Calgary, is now a resident engineer in the construction department of S. S. Kresge Co.

R. H. Fenton has been appointed sales engineer for Rosco Metal & Roofing Co. Ltd. He was previously employed with Heaps-Waterous, of New Westminster.

A. D. Veenhuizen, of the Municipality of West Vancouver, has accepted a position with A. B. Sanderson, bridge consultant, Victoria.

R. N. Caesar is now with H. A. Simons Ltd. He was formerly a field engineer with the Morrison-Knudsen Company of Canada.

C. H. MacDonald has joined the staff of Discovery Yellowknife Mine at Yellowknife as their chief engineer.

C. W. Nash, of the B.C. Power Commission has been promoted to director of load development, at Victoria.

L. E. Wight, also of the B.C. Power Commission, has filled the vacancy of District Manager at Nanaimo, left by Mr. Nash.

M. J. Stewart, formerly of the Department of Health, has left for Berkeley, California, where he will take post-graduate studies and also do some teaching.

M. K. Kuehl has accepted a position with Western Consulting Ltd. He was previously employed by the Canadian Pacific Railway Company.

J. R. Moran, formerly with the Victoria Machinery Depot, is now employed by the B.C. Power Commission as an assistant mechanical engineer.

A. Janeso has accepted a position with Swan, Wooster & Partners. He was formerly with D. W. Thomson, consultant.

D. C. Malcolm, who has been with The Consolidated Mining & Smelting Company at Trail, has accepted the position of field engineer with Preston East Dome Mines Ltd. in the east.

D. S. W. Love has left for Edmonton where he will take on the duties of resident engineer for **J. L. Miller.** He was previously with the Pacific Lime Company at Blubber Bay.

Harry Gordon, formerly of the C.M. & S. Company design office at Trail, has accepted a position in the structural department of H. A. Simons Ltd.

Personals

News of the Personal Activities of Members of the Institute

Dr. Richard L. Hearn. M.E.I.C., has been appointed chairman of the Hydro-Electric Power Commission of Ontario, succeeding Robert H. Saunders who died following injuries suffered in an aircraft accident. In accepting the appointment Dr. Hearn retires as general manager and chief engineer of the commission.

Since first joining the commission more than 40 years ago, Dr. Hearn has been associated with many of its major undertakings. As senior executive, he has played a leading role in the commission's unprecedented power expansion program, embracing major hydro-electric projects and Canada's largest steam generating installations. Latterly, he has applied his wide experience to studies of the future possibilities of producing electrical energy from atomic energy.

Dr. Richard L. Hearn, M.E.I.C.

A native of Toronto, Dr. Hearn received his early education at St. Albans School there. He graduated with a B.A.Sc. degree from the University of Toronto in 1913, and obtained his first employment with the commission as design engineer on the Wasdells Falls power plant. Later he became supervisor of designing and draughting on the Queenston-Chippawa project, at one time the largest hydro-electric plant in the world, and now renamed the Sir Adam Beck-Niagara Generating Station No. 1. In 1918 he was appointed assistant engineer on construction.

Dr. Hearn went to the United States in 1921 as assistant chief engineer of the Washington Water Power Company in Spokane, and three years later returned to Canada as chief engineer and secretary-treasurer of H. G. Acres and Company Limited. From 1930 until 1934 he was consulting engineer for the Dominion Construction Company and H. F. McLean Limited and served as their chief engineer from 1934 until 1942.

He returned to the commission in 1942 as executive assistant to the chairman, and was subsequently loaned as chief engineer in charge of construction of the Polymer Corporation synthetic rubber plant at Sarnia. Again in 1944 he was on loan by the commission to serve as Canadian technical advisor to the Public Utilities Division of the Combined Production and Resources Board at Washington. In 1945 Dr. Hearn was named the commission's chief engineer of design and construction.

Dr. Hearn is a director of Atomic Energy of Canada Limited and is actively interested in the production of electricity from atomic energy. He is also handling the general direction of the commission's present initial two-year program to study the development of an atomic reactor for the generation of power in co-operation with Atomic Energy of Canada Limited.

Dr. Hearn has received professional recognition on many occasions for his contribution to Ontario's publicly-owned hydro enterprise and to the Canadian engineering field. In 1952 the honorary degree of doctor of engineering was conferred upon him by the University of Toronto, and his abilities were signally marked four years ago when the commission's Richard L. Hearn Generating Station, Canada's largest fuel-electric power plant, was named in his honour. Dr. Hearn is one of two outstanding Canadian engineers to receive the 1954 Julian C. Smith Medal of the Engineering Institute "for achievement in the development of Canada". One of the highest Canadian engineering honours, the medal will be officially presented to him at the Institute's annual general and professional meeting this May in Toronto.

Dr. Otto Holden, M.E.I.C., has been appointed chief engineer of the Hydro-Electric Power Commission of Ontario, succeeding Dr. Richard L. Hearn, M.E.I.C., who has been appointed chairman of the commission.

Associated with all phases of the commission's tremendous expansion program initiated in 1945, Dr. Holden brings to his new post all the capabilities and energies that have earned him a reputation as one of the world's leading hydraulic engineers.

Since 1947 he has ably filled the post of assistant general manager of engineering. In administering the commission's planning, engineering, construction and research divisions, Dr. Holden played a key role in speeding some 14 new major power sources into operation in the province during the past seven years. His great service to the commission, with which he has been associated since 1913, was signally recognized when the La Cave generating station on the Ottawa River was renamed the Otto Holden Generating Station. It was officially opened in 1952. Highlighting Dr. Holden's career is the 2,200,000-hp. St. Lawrence power project for which he has guided much of the design of the Canadian section.

Dr. Otto Holden, M.E.I.C.

Dr. Holden was born in Toronto and attended public school and the collegiate institute there. He graduated from the University of Toronto with a B.A.Sc. degree in 1913 and received his C.E. in 1940. In 1944 the university recognized his contribution to the engineering profession by conferring upon him the honorary degree of doctor of engineering.

Joining the staff of the commission as a draughtsman in 1913, he filled various posts in the hydraulic department. In 1918 he was placed in charge of the design of hydraulic plants, particularly the Nipigon River plant at Cameron Falls and the Sir Adam Beck-Niagara generating station No. 1 at Queenston, as well as numerous other plants throughout the province.

Named deputy head of the hydraulic department in 1924, he supervised the design and construction of the commission's power plants, storage works and hydraulic structures. The first complete development of an interprovincial power site on the Ottawa River was begun

at Chats Falls in 1929, and Dr. Holden had the task of supervising the design and construction of the development. When he became chief hydraulic engineer in 1937, a post he held for ten years until being named assistant general manager of engineering, he was intimately concerned with the fulfilment of the commission's plans. He served with distinction on the International Committee, charged with the design and construction of the remedial works in the Niagara River, which will not only preserve and enhance the beauty of the falls, but will provide for more effective use of the river's water in the production of power.

As a distinguished professional engineer, Dr. Holden has received many honours at the hands of his colleagues. He is a past councillor of the Engineering Institute, a past director of the American Society of Civil Engineers, of the American Institute of Electrical Engineers, and of the Senate of the University of Toronto. He is a past president of the Engineering Alumni Association of the University of Toronto, and a past president of the Royal Canadian Institute. He has contributed many papers to technical societies, which have been published in the journals of these organizations.

Dr. J. J. Green, M.E.I.C., chief of the Defence Research Board division concerned with armaments and aeronautics, has been named defence research member of the Canadian Joint Staff in

Dr. J. J. Green, M.E.I.C.

Washington, D.C. He will take over his new post next summer from Brig. Harold E. Taber.

Dr. Green's distinguished record in the field of Canadian aviation particularly fits him for one of the Defence Research Board's most important posts. As senior liaison officer in the United States, one of his chief duties will be to promote an increasing flow of scientific knowledge about defence projects and especially in the expanding fields of aviation and guided missiles.

Fellowship in the Institute of Aeronautical Sciences and other United States organizations, in addition to his past and current activities relative to aircraft and guided missile development in Canada, provide Dr. Green with an unusually wide knowledge of U.S. techniques in these fields and valuable contacts with the scientists and engineers concerned.

During the four years following the war he was chief research aeronautical engineer of the Air Transport Board. He then joined the Defence Research Board staff as deputy director general of defence research. Two years later he was promoted to his present post.

Last year he was elected the first president of the newly-created Canadian Aeronautical Institute.

Gerald G. Fisch, M.E.I.C., vice-president of J. B. Fraser and Associates Limited, has been appointed to the post of general manager of the company.

Mr. Fisch is a chemical engineering graduate of McGill University, and a 1950 graduate in business and engineering administration of the Massachusetts Institute of Technology.

He had several years' experience in Canadian industry prior to joining J. B. Fraser and Associates as Montreal representative in 1950.

Geoffrey H. Kimpton, M.E.I.C., has been appointed divisional manager in charge of general consulting for Canada by J. B. Fraser and Associates Limited.

Mr. Kimpton was formerly associated with Leetham, Simpson Limited, and with Stevenson and Kellogg Limited.

Upon graduation in chemical engineering from McGill University in 1935, he joined the industrial engineering group of the Dominion Rubber Company. In 1936 he became plant manager and chemist with the Oxygen Company of Canada. After four years of service with the R.C.A.F. in the aeronautical engineering group on maintenance and development work, he joined Stevenson and Kellogg Limited.

Cecil D. Wight, M.E.I.C., former director of planning for the City of Ottawa, has been appointed vice-president of the Mount Royal Paving and Supplies Limited in Montreal.

A 1928 civil engineering graduate of Queen's University, Mr. Wight has had wide municipal experience. He joined the engineering staff of the City of Ottawa in 1932; was appointed assistant commissioner of works in 1942; and commissioner of works in 1949. In 1950 he was named a member of the Ontario Municipal Board.

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Henry W. Burri, M.E.I.C.

Rensselaer Polytechnic Institute, and McGill University where he received his B.Eng. degree in mechanical engineering in 1935. He also obtained diplomas in mechanical draughting and in sales managing courses. After several years in the mechanical engineering field, he joined Canadian Carborundum Company Limited.

Mr. Burri is a member of the Corporation of Professional Engineers of Quebec.

Hugh Chambers, M.E.I.C., has retired as chairman of the board of Air Reduction Canada Limited after 33 years of service in welding circles in Canada.

One of the pioneers of arc welding, Mr. Chambers began his career in this field in 1922 when he established the Canadian branch of an English railroad supply firm. The company also acted as Canadian agent for Wilson Welder & Metals Co. Inc., a United States firm which was among the first manufacturers of welding machines, electrodes and supplies.

Hugh Chambers, M.E.I.C.

Under his direction, the firm's welding supply business developed rapidly and soon overshadowed their railroad supplies to the extent that in 1928 a plant for the manufacture of welding rods was set up in Montreal. In 1932 it was decided that the operation had grown sufficiently large to warrant forming a Canadian company. As

M. F. Macnaughton, M.E.I.C., is vice-president, technical control, of Mount Royal Paving and Supplies Limited in Montreal. He was previously associated as vice-president with Milton Hersey Co. Ltd.

Mr. Macnaughton received his B.Sc. degree in civil engineering from McGill University in 1922, and his M.Sc. degree from the University of Michigan in 1924.

Henry W. Burri, M.E.I.C., formerly assistant general sales manager of Canadian Carborundum Company Limited, has been appointed general sales manager of the company.

Mr. Burri started with Canadian Carborundum in 1944 as a salesman. In 1952 he was appointed sales manager of the eastern sales district and has steadily risen in the sales branch to his present position of general sales manager in which he will guide the expanding sales activities of the company throughout Canada.

A Montrealer by birth, Mr. Burri attended the Montreal Technical School,

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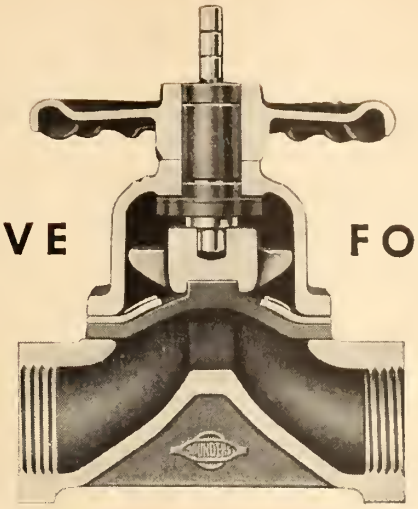
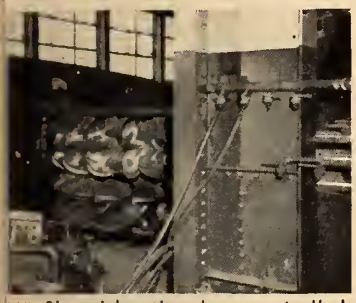
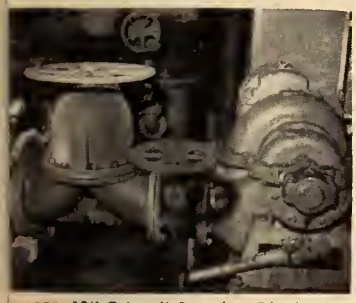


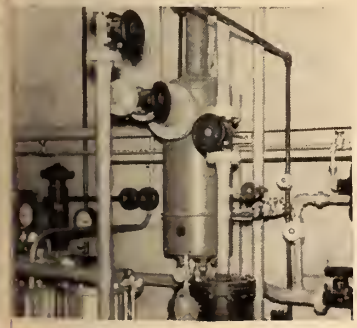
GRINNELL-SAUNDERS DIAPHRAGM VALVES



AIR—Six quick-acting, lever-cantralled Grinnell-Saunders Diaphragm Valves main-tain leak-praaf air cantral at Daminian Engineering Warks, Ltd., Mantreal, Quebec.



WATER—12" Grinnell-Saunders Diaphragm Valve handling water at the Canadian International Paper Company Mill, La Luque, Quebec.



GAS — 12 Grinnell-Saunders Diaphragm Valves ranging in size fram ¼" ta 1½" an Hydrogen Gas lines. Oxygen, Nitragen, Acetylene and Prapane lines alsa use these valves at this Canadian General Electric Company plant at Guelph, Ontaria.

Credit the tight closing diaphragm with providing important advantages. The diaphragm lifts high for streamlined passage, in either direction; closes tightly for an absolute seal, even when scale lodges on the valve weir.

That feature alone can mean impressive savings. For a *single* leak in a valve on an air line, even as tiny as 1/32 inch, can waste in one month's time the equivalent of the cost of a new Grinnell-Saunders Valve.

Grinnell-Saunders Diaphragm Valves offer other advantages too. Bodies, linings, and diaphragm materials are available to meet most service conditions. The only part that ever needs replacing is the diaphragm, which can be changed in minutes without removing the valve body from the line. In down-time and overtime saved—in maintenance and repair work avoided—you are dollars ahead when you rely on Grinnell-Saunders Valves.

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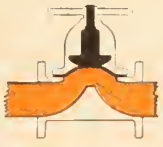

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reward for his effort Mr. Chambers was appointed president and managing director. In 1932 he became a staunch supporter of the then new shielded arc electrode which has since proved itself to be one of the main factors in establishing arc welding as a prime industrial tool. His firm manufactured the first flux coated electrodes in Canada.

Mr. Chambers acted promptly on the parent company's decision in 1938 to close its foreign branches and was successful in gaining ownership of the Canadian company.

The millions of pounds of electrodes, hundreds of welding machines and welding accessories delivered to Canadian industry during World War II established the firm as one of the country's largest suppliers of welding equipment.

In 1945 when ownership of the company was acquired by Air Reduction Company Inc., Mr. Chambers retained his post as president. Air Reduction is one of North America's leading suppliers of industrial gases and equipment for both the oxy-acetylene and arc welding processes. Its manufacturing facilities, strategically located in every major U.S. city, as well as its research and development facilities, brought many advantages to the Canadian company.

Mr. Chambers was appointed chairman of the board of Air Reduction Canada Limited in 1951, a post he has held until the present time. A new plant was completed in 1953 in Ville St. Laurent, Que. It is a tribute to Mr. Chambers who was farsighted enough to realize the potential of arc welding over three decades ago.

E. Y. Carlson, M.E.I.C., has been named director of the industrial minerals research branch of the Saskatchewan Department of Mineral Resources, replacing R. V. Tomkins, M.E.I.C., who has accepted the position of chief engineer with Aggregates and Construction Products Limited in Regina.

Mr. Carlson, a 1950 ceramic engineering graduate of the University of Saskatchewan, previously held the position of industrial research engineer.

He is a member of the Association of Professional Engineers of Saskatchewan.

A. L. Ross, M.E.I.C., has been appointed general manager of Square "D" Company of Canada Limited in Mount Dennis, Ont. For the past year and a half he has occupied the position of executive assistant to J. L. Fink, president of the company.

Previous to joining the company, Mr. Ross was associated with the Hydro-Electric Power Commission of Ontario; Mueller Limited; and Defence Industries Limited.

Mr. Ross graduated in electrical engineering from McGill University in 1932.

Prof. E. A. Allcut, M.E.I.C., professor of mechanical engineering at the University of Toronto, has been recently appointed a member of the Power Test Codes Committee of the American Society of Mechanical Engineers.

Gerald A. Blackburn, M.E.I.C., has been named assistant director of the planning and development branch of the Civil Service Commission.

Mr. Blackburn has been with the commission since 1947, first as a personnel selection officer, and for the last six years, as chief of the professional examining section. His new duties will include the planning and development of recruiting techniques, liaison with universities and professional associations and general responsibility for advertising.

A native of Aylesford, N.S., Mr. Blackburn holds a degree in electrical engineering from St. Francis Xavier University, and has also undertaken post-graduate work at the Massachusetts Institute of Technology.

Upon graduation he joined the staff of St. Francis Xavier University where he later became professor of physics and mathematics. From 1940 until 1946 he served with the Canadian Army, for a time as a major attached to the headquarters staff of Field Marshal Montgomery.

He is a member of the Association of Professional Engineers of Nova Scotia.

A. J. S. Michaud, M.E.I.C., has been appointed district engineer of the harbours and rivers engineering branch of the Department of Public Works of Canada at Rimouski, Que. He succeeds Leo G. McLaren, M.E.I.C., who was transferred to the position of district engineer at Quebec City.

A native of Sorel, Que., Mr. Michaud received his early education at Ecole Olier and Ecole Centrale de Preparation in Montreal. In 1928 he enrolled in Ecole Polytechnique, graduating in 1934 with degrees in civil engineering and applied sciences. He also completed special engineering courses in air conditioning and aeronautical engineering.

For five years after graduation, Mr. Michaud was associated with the B. F. Sturtevant Company in the sales and design division in Boston and Montreal. He then joined the staff of the former federal Department of Mines and Resources as mining roads inspector, and the following year was employed in the works and buildings branch of the Department of National Defence.

In 1941 he was commissioned in the R.C.A.F. and appointed to the aeronautical engineering branch. He was discharged in 1945 with the rank of flight-lieutenant.

Mr. Michaud joined the Quebec provincial Department of Public Works in 1945 as assistant district engineer in Montreal. He left the provincial service to become town engineer at Ste. Therese, Que. in 1947-49, and then joined the federal Department of Public Works at Rimouski. During the period following the fire which destroyed a large portion of the town in 1950, he was appointed manager of the Rimouski Relief and Reconstruction Committee necessitating being on loan from the Department for eight months. He was then transferred to the Department's chief engineer's staff in Ottawa where he has served ever since.

Lt.-Col. Philip L. Debney, M.E.I.C., has retired as assistant city engineer after 30 years' service with the City of Edmonton.

A native of Wimbledon, England, Col. Debney came to Edmonton in 1912 and until 1921, except for service in World War I, worked as a railway engineer. After employment with the gas company in Edmonton, he joined the city engineer's department in 1924.

Col. Debney interrupted his training at the University of Alberta in 1915 to enlist as a gunner in the 32nd Battery, Canadian Field Artillery, and served with this unit for most of the war. He was awarded the Military Medal. He transferred to the 68th Battery in 1918 and returned to Canada in 1919.

He went back to the Army in 1925 as a lieutenant in the Edmonton Regiment reserve, and advanced until he was named the regiment's commanding officer in 1935. Four years later he left the regiment to command the 9th Army Troops Company of the R.C.E., which he mobilized for active service when World War II was declared.

He went overseas with his unit, but returned to Canada in 1941 to take charge of engineer units for the 4th division. In 1944 while stationed with the engineers' training centre at Camp Petawawa, Ont., he was made a legionnaire of the United States' Legion of Merit for his work on a joint Canadian-American board.

Last February he was elected president of the Edmonton United Services Institute. He is a member of the Association of Professional Engineers of Alberta.

P. L. Mathewson, M.E.I.C., has been appointed assistant chief of motive power and car equipment for the Canadian National Railways. He was previously chief of research, a position he has held since July, 1952.

A native of New Westminster, B.C., Mr. Mathewson graduated from the University of British Columbia with a B.Sc. degree in 1927. He entered railway service with the C.N.R. at Toronto in 1930 as an electrical inspector in the motive power department, and moved to Montreal in 1937 as assistant engineer to the chief electrical engineer. He became research engineer in the department of research and development in 1943, and was appointed transportation engineer in the operation department in 1946.

Mr. Mathewson received in May, 1952, the Ross Medal of the Engineering Institute for the best paper on an electrical subject. His subject was "The Application of Diesel Electric Locomotives".

He is a member of the Corporation of Professional Engineers of Quebec.

Charles E. Weyman, M.E.I.C., was the successful candidate for alderman in the recent Fredericton city council elections.

Vice-president and chief engineer for the Caldwell Construction Company in Fredericton, Mr. Weyman is a 1946 graduate in civil engineering of the University of New Brunswick.

He is an active member of the Institute's Fredericton Branch of which he is immediate past chairman.

E. L. Hartley, M.E.I.C., has been named general manager of Western Bridge and Steel Fabricators Ltd. He was previously contract engineer.

After graduating from the Liverpool Institute School in 1930, Mr. Hartley entered Queen's University, graduating in civil engineering in 1933.

In 1934 he entered the properties department of Jas. Richardson & Sons Ltd. in Winnipeg, and two years later joined W. G. Swan Engineering Co. Ltd. in Vancouver. In 1937 he was appointed engineer in charge of construction of the Canada Packers Ltd. Vancouver plant and he also served during this period as assistant estimating engineer for the

(Continued on page 315)

Western Bridge Company. In 1938 he was associated with B.C. Appraisal Co. Ltd. and also with Dominion Bridge Co. Ltd. during the construction of the Lions Gate Bridge.

At the beginning of World War II he served with the Royal Canadian Engineers as works officer in the Vancouver area, and in 1940 was field engineer at 2nd Canadian Division headquarters. He was promoted to the rank of captain in 1941 and served with the first Canadian Army overseas until the end of the war. He was mentioned in despatches, named a Member of the British Empire, and awarded the E.D. He was also named an officer of the Order of Orange Nassau by the Netherlands Government.

In 1945 he entered Western Bridge and Steel Fabricators Limited as design engineer, and was appointed to the position of contract engineer in 1947.

Mr. Hartley is a past-chairman of the Vancouver Branch of the Engineering Institute.

Samuel G. Gamble, M.E.I.C., has been named chief topographical engineer of the surveys and mapping branch of the Department of Mines and Technical Surveys.

Samuel G. Gamble, M.E.I.C.

He has headed since 1949 the air surveys section of the Topographical Survey which plots and produces maps from aerial photographs. In his new post he will be responsible for the work of the Topographical Survey which carries out field control surveys and completes the resulting map manuscripts for the medium and large scale standard topographical maps of Canada.

A native of Ottawa, he attended Ashbury College. He graduated from the Royal Military College in 1932, and continued his studies at McGill University where he obtained his degree in civil engineering in 1933. He also attended the 6th course of the National Defence College in 1952-53.

Mr. Gamble has been continuously employed by the department since 1946 and served as a student assistant on field surveys during the summers of 1932 and 1933, and as a junior topographical engineer from 1935 until 1938.

He then joined Perron Gold Mines Limited in 1938 as mining engineer and from 1939 until the end of the war served with the Royal Canadian Engineers. During this period he was assigned to the Northwest European theatre and became assistant director of surveys for the First Canadian Army with the rank of lieutenant-colonel. Upon his return to Canada he was named plant engineer with Perron Gold Mines, remaining in this position until joining the Topographical Survey in 1946.

Mr. Gamble is a councillor of the Canadian Institute of Surveying and Photogrammetry, and was the first chairman of the Ottawa Branch of the Institute. He is a member of the Professional Institute of the Public Service of Canada, the Military Engineers' Association, and was the first president of the Engineer Survey Association formed in Ottawa in 1946.

Gilmour S. Boa, M.E.I.C., chief engineer of Steel Building Sales and Supply, Limited of Toronto, recently won the Gold Medal for the World's Shooting Championship at the matches conducted by the International Shooting Union in Caracas, Venezuela. The title was won in the English Match, a small bore rifle event resembling the course of fire used in Canadian competitions.

Mr. Boa's greatest previous success at his chosen sport came in 1951 when he won the King's Prize, the most celebrated rifle match in the world, at the Imperial Meeting at Bisley, England. He is the current Canadian Small Bore Rifle Champion, and has won the King's Medal for the Canadian Army Championship three times.

A 1946 civil engineering graduate of the University of Toronto, Mr. Boa was associated with the Ontario Division of Dominion Bridge Company Limited, working in various capacities in the draughting, erection and engineering departments before taking over his present duties. Steel Building Sales and Supply, Limited is the Ontario distributor for

Gilmour S. Boa, M.E.I.C.

Butler pre-engineered buildings. Mr. Boa is responsible for modifications to the standard designs, as well as engineering of foundations and mechanical services, and supervision of construction operations.

D. D. Reeve, M.E.I.C., has been appointed chief engineer at a recent meeting of the board of directors of Pacific Coast Pipe Co. Ltd. in Vancouver.

Mr. Reeve, a 1933 mechanical engineering graduate of the University of British Columbia, joined the Pacific

D. D. Reeve, M.E.I.C.

Coast Pipe Co. Ltd. in 1952 as development engineer. He had previously served as engineering consultant for two years in Vancouver, and has held engineering positions in several western and eastern pulp and paper mills, and in the aluminum industry.

W. L. Wardrop, M.E.I.C., has established consulting offices in Winnipeg under the firm name of W. L. Wardrop and Associates, specializing in municipal, structural and industrial engineering.

Mr. Wardrop, who is engineer of water works and sewerage for the City of Winnipeg, graduated from the University of Manitoba in electrical engineering in 1939, and in 1947 he received his degree in civil engineering.

He was associated for a time with the reclamation branch of the Manitoba government. From June, 1941 until April, 1946, he was attached to the Royal Canadian Corps of Signals, serving in both England and Australia with the rank of captain. He has been a member of the militia since that time.

Mr. Wardrop joined the engineering department of the City of Winnipeg in May, 1937 as an engineer in the design branch. He was appointed to his present position in 1949.

He is a member of the Association of Professional Engineers of Manitoba, the American Water Works Association, the Canadian Institute of Sewage and Sanitation, and of the Western Canada Water and Sewage Conference.

W. L. Wardrop, M.E.I.C.

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CORRECTION

Remus Rodaru, M.E.I.C., was referred to in error in the January issue of the *Journal*, page 60, as "former" managing director of the Cardinal Engineering and Machinery Company in Montreal. The *Journal* reported correctly his appointment as field manager and petroleum consulting engineer for Oka Oil Limited. Actually, Mr. Rodaru is continuing, as managing director, of the Cardinal Engineering and Machinery Company in addition to his new duties with Oka Oil Limited.

E. G. Fraser, M.E.I.C., has been appointed manager of marketing and product research for Canada Wire and Cable Company Limited. He will be located at the head office of the company in Toronto.

Mr. Fraser graduated in electrical engineering from the University of Manitoba in 1935. He joined the electrical engineering department of the company in 1937, remaining at the head office in various positions in the company's engineering department until 1948, except for the years 1940-1945 when he served overseas with the Royal Canadian Signals.

E. G. Fraser, M.E.I.C.

In 1948 he was transferred to the Montreal office as eastern district engineer where he remained until his appointment to his present position.

Robert Chambers, M.E.I.C., has been appointed superintendent of power developments in the construction division of The Shawinigan Engineering Company Limited.

A native of Edmonton, Mr. Chambers received his electrical engineering degree from the University of Alberta in 1937. He joined the company that same year at the Three Rivers terminal station and has since done extensive work in surveying and in the design and construction of transmission lines.

He took part in the construction or remodelling of all five St. Lawrence River crossings, the La Tuque powerhouse and other plants.

From 1945 until 1949 he was assigned the job of carrying out design and construction supervision of a transmission line for B.C. Electric, after which he was named superintendent, transmission line construction.

Mr. Chambers was also superintendent of construction during the building of the St. Maurice chemicals plant in 1952 and 1953.

Stefan Mitescu, M.E.I.C., has been appointed assistant manager of Canadian Petrofina's new oil refinery, now being built at Pointe-aux-Trembles, Que. He has been on the staff of the company since November, 1953.

Mr. Mitescu received his M.Eng. degree with honours from the Polytechnical School of Bucharest in 1928, and has held several responsible Rumanian government positions, including that of head of the foreign trade division of the Department of National Economy from 1935-40. During the following six years

Stefan Mitescu, M.E.I.C.

he was general manager of one of Rumania's largest chemical industries, Marasesti.

A member of the Rumanian Body of Graduate Engineers, he served as vice-president of the Association of Rumanian Chemical Industries, and as a board member of the General Association of Rumanian Industries.

Since coming to Canada in 1948, Mr. Mitescu served as a senior engineer in the technical department at the Aluminum Company's Arvida works where he supervised the section for the development of new chemical products. During this period he became the author and co-author of several patents.

Donald A. J. McDonald, M.E.I.C., has been appointed purchasing agent for the communications equipment division of Northern Electric Company Limited in Montreal.

Donald A. J. McDonald, M.E.I.C.

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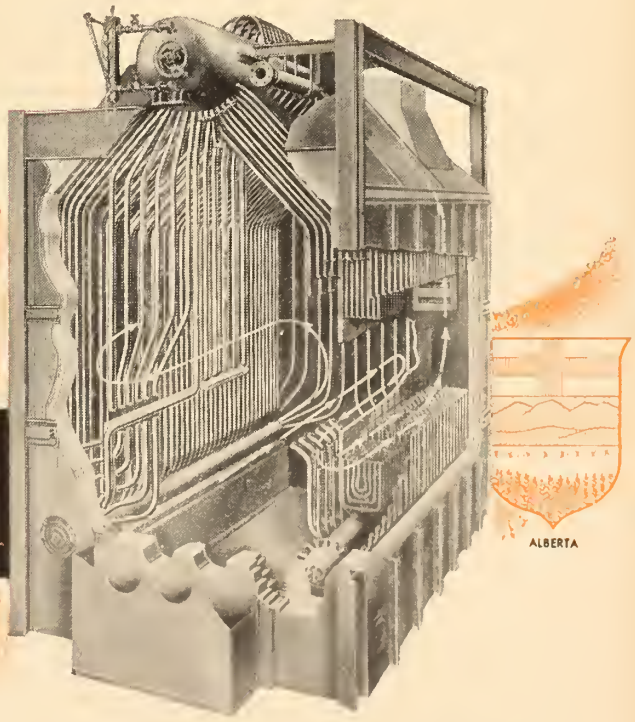

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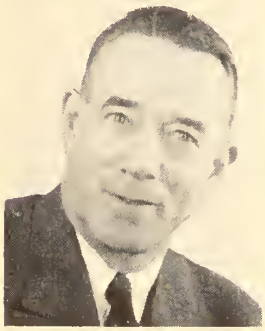

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A B.A.Sc. and M.A.Sc. graduate in mining engineering of the University of Toronto, class of 1938 and 1939, Mr. McDonald was, prior to his new appointment, patent engineer and assistant superintendent of manufacturing methods.

J. A. Grant, M.E.I.C., has been appointed chief engineer of the Belleville plant of Northern Electric Company Limited.

A graduate electrical engineer of McGill University, class of 1934, Mr. Grant has served as assistant superintendent of equipment engineering at the Belleville plant since October, 1950.

J. A. Grant, M.E.I.C.

He is this year secretary-treasurer of the Belleville Branch of the Engineering Institute.

Jacques Vinet, M.E.I.C., is now associated as estimator with The Key Construction Limited, engineers and contractors.

A 1938 graduate in civil engineering of Ecole Polytechnique, Mr. Vinet was formerly district engineer with the Province of Quebec Public Works Department.

R. N. Boyd, M.E.I.C., has been transferred from the position of works engineer at the Du Pont of Canada Limited nylon intermediates plant at Maitland, Ont., to the position of supervising engineer, chemicals, in the company's engineering department in Montreal.

Mr. Boyd received his B.Sc. degree in mechanical engineering from the University of Toronto in 1939.

R. P. Matthews, M.E.I.C., has opened offices as a communications consulting engineer in Montreal. He was previously manager of sales engineering with Federal Electric Manufacturing Company Limited in Montreal.

A 1940 graduate in engineering physics of the University of Saskatchewan, Mr. Matthews is a member of the Corporation of Professional Engineers of Quebec.

H. R. Blair-Leighton, M.E.I.C., has joined the staff of Ontario-Minnesota Pulp and Paper Company Limited in Fort Frances, Ont.

Previously he was associated as lubrication engineer with the E. B. Eddy Company in Hull, Que.

C. F. Duff, M.E.I.C., formerly associated with Brown Corporation in Montreal

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Photo shows section of a seven mile line of Hyprescon 42" diameter pipe laid in Quebec City, George Demers, Consulting Engineer. The tie rods are anchored to a concrete base necessary in this section where marsh conditions were encountered.

has joined the staff of Riordon Sales Corporation, Limited of Montreal.

Mr. Duff, a 1940 mining engineering graduate of McGill University, was vice-president and general superintendent of Moldply Limited in Montreal before joining Brown Corporation.

A. J. Scott, M.E.I.C., project engineer with Defence Construction Limited, has joined the staff of Consolidated Toronto Development Corporation Limited in Toronto.

A 1944 graduate in civil engineering of Durham University, Mr. Scott has been previously associated with Central Mortgage and Housing Corporation in Camp Borden.

G. A. Gray, M.E.I.C., has been appointed an Ottawa representative in the Ontario district territory for McDonnell and Miller, Inc. of Chicago, Ill.

After graduation in mechanical engineering from Queen's University in 1949, Mr. Gray was associated as sales engineer with the Canadian Ingersoll-Rand Company in Montreal, and with Ontario Equipment and Supply Limited in Ottawa.

Dr. Z. Przygoda, M.E.I.C., has opened his offices as consulting engineer in Toronto, specializing in building design and supervision. He was previously

Dr. Z. Przygoda, M.E.I.C.

associated with Town Planning Consultants Limited in Toronto.

Dr. Przygoda was born in Warsaw, Poland. He graduated in civil engineering from the Technical University of the Free City of Danzig in 1935, and after the war received his doctorate in engineering from the University of Munich on the basis of a thesis on prefabricated structures and town planning.

Upon graduation from university in 1935, Dr. Przygoda opened his own offices in Warsaw, and was responsible for the design of several tuberculosis hospitals. He also designed the office building of the British Vauxhall Car Company in Warsaw.

Dr. Przygoda participated in the Battle of Warsaw, but was captured and confined to concentration camps in Germany. After his liberation by the Third U.S. Army near Garmisch-Partenkirchen, he was employed by the American Army for about three years on the reconstruction of the Olympic stadium, as well as on the construction of Army structures. At the same time he completed his work toward his doctorate degree.

The university then recommended him to the Israeli Government for the design of a 1000-bed prefabricated hospital to be built in Germany and shipped to Israel, a project sponsored by General Lucius D. Clay, military governor of the U.S. zone in Germany. Dr. Przygoda spent two years in Israel on the design of various structures, and town planning schemes, and he received second prize in the town planning competition for the new section of the harbour town of Haifa.

Dr. Przygoda then proceeded to England where he studied for a period of four months at the Royal Institute of British Architects library, and afterwards came to Canada where he was first associated with Kaplan & Sprachman, architects, and with Town Planning Consultants Limited, both of Toronto.

He is a member of the Association of Professional Engineers of Ontario.

Abram Friesen, M.E.I.C., has been transferred by P.F.R.A. from Outlook, Sask., to Regina.

Mr. Friesen graduated in civil engineering from the University of Saskatchewan in 1949.

H. D. Walford, M.E.I.C., has recently been transferred as departmental engineer to the Rogerstone extrusion department of the Northern Aluminium Company in Cardiff, Wales.

Mr. Walford graduated in civil engineering from McGill University in 1949, after which he undertook post-graduate work at Cambridge University and at Centre d'Etudes Industrielles in Geneva.

N. D. Woollings, M.E.I.C., service engineer in the industrial department of Alchem Limited, has been transferred from London, Ont., to Toronto as field engineer.

Mr. Woollings received his B.A.Sc. degree in chemical engineering and his M.A.Sc. degree in sanitary engineering from the University of Toronto in 1950 and 1951.

R. Leo Payer, Jr.E.I.C., has joined the pole line hardware division of N. Slater Co. Ltd.

He received his B.Sc. and M.Sc. degrees in electrical engineering from the University of New Brunswick in 1948 and 1953, respectively. Since graduation he has been associated with

R. Leo Payer, Jr.E.I.C.

Shawinigan Engineering Company Limited and Aluminum Company of Canada Limited.

He is a member of the American Institute of Electrical Engineers, and of the Corporation of Professional Engineers of Quebec.

T. C. Arnold, Jr.E.I.C., has been promoted by Aluminum Company of Canada Limited from industrial engineer to engineer in charge of maintenance for hydrate plant No. 2 and Alumina plant No. 2.

Mr. Arnold is a mechanical engineering graduate of the University of Toronto, class of 1950, and is a member of the Association of Professional Engineers of Ontario and of the Corporation of Professional Engineers of Quebec.

H. K. Walter, Jr.E.I.C., is founder and president of H. K. Walter and Associates Limited in Kitchener, Ont.

Mr. Walter graduated in mechanical engineering from Queen's University in 1945 and was employed for a time as mechanical engineer by Wm. Roberts Electric Ltd. in Kitchener.

James T. Thorne, Jr.E.I.C., is associated with the industrial engineering subdivision of the Ford Motor Company of Canada at Windsor.

He graduated in 1949 from the University of Toronto in engineering and business.

V. K. Jameson, Jr.E.I.C., is now works manager of Canada Creosoting Company Limited, North Vancouver. He has been associated with the company since his graduation in mechanical engineering from the University of Saskatchewan in 1950.

Mr. Jameson began his career as assistant supervisor of operations with the company in Calgary and was later appointed assistant manager of the Edmonton branch. In 1953 he was transferred to Trenton, Ontario, as assistant works manager and in 1954 was appointed works manager in Vancouver.

George C. Heaton, Jr.E.I.C., formerly employed with Addison Industries Limited, has recently accepted a research appointment with Ferranti Electric (Canada) Limited in Toronto.

He is a mechanical engineering graduate of Oxford University, class of 1950.

J. E. Boucher, Jr.E.I.C., has joined the staff of Computing Devices of Canada Limited, in Ottawa, as instrumentation engineer. He was previously employed by Sperry Gyroscope Company of Canada Limited in Ottawa.

Mr. Boucher received his B.Sc. degree in engineering physics in 1950 from the University of Alberta, and his M.Sc. degree in electrical engineering from McGill University in 1951.

T. H. Shillingford, Jr.E.I.C., has recently moved to Roseau, Dominica, B.W.I., where he is working as road construction engineer with the Public Works Department.

A 1950 graduate in civil engineering of Nova Scotia Technical College, Mr. Shillingford was first employed by the National Defence, H.M.C. Dockyard in Halifax, and later with the Montreal Engineering Company in Montreal.

W. L. Allen, Jr.E.I.C., has recently been transferred by Canada Cement Company Limited from Exshaw, Alberta

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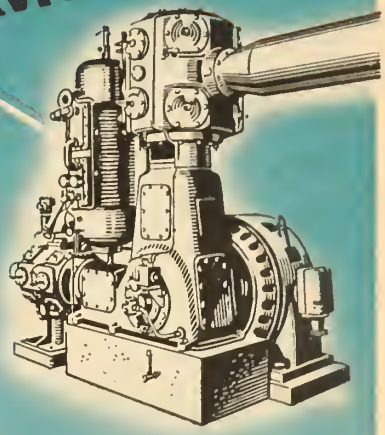

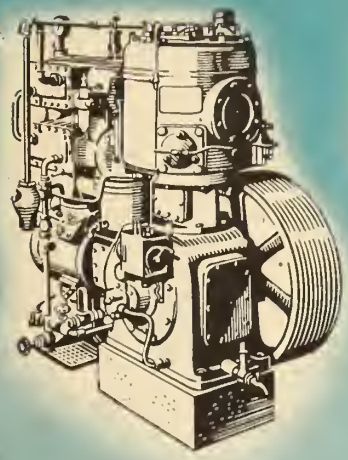

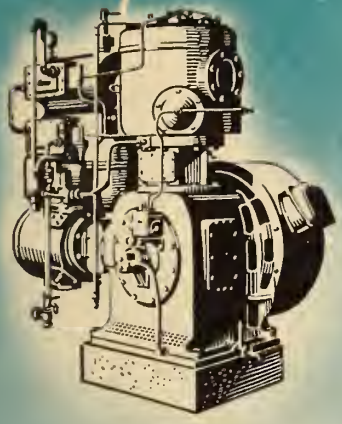

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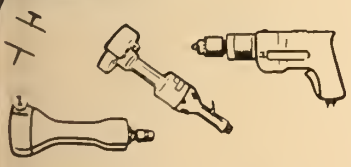

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where he held the position of plant engineer, to the head office in Montreal where he is now employed in the department of technical operations as kiln supervisor.

Mr. Allen is a 1950 graduate in civil engineering of the University of Alberta.

Paul LaPrairie, JR.E.I.C., who graduated in mining engineering from the University of Toronto in 1950, has been transferred from the New York offices of the American Metal Company Limited to the Newcastle subsidiary company in New Brunswick.

J. H. McCullough, JR.E.I.C., has recently been transferred by the Aluminum Company of Canada Limited to the Kingston Works where he is employed as metallurgist in the technical department. He was previously located in Arvida.

Mr. McCullough graduated in metallurgical engineering from the University of Toronto in 1950.

A. M. Syme, JR.E.I.C., is at present located in the Yukon Territory where he is employed with the Hudson Bay Exploration and Development property at Kluane Lake.

Mr. Syme obtained his B.Eng. degree in mining engineering and his M.Sc. degree in geology from McGill University in 1950 and 1951, respectively.

W. Odinotski, JR.E.I.C., has been appointed to the position of division engineer, chemicals division, by Shawinigan Chemicals Limited in Shawinigan Falls.

He joined the company in 1951 and participated in its engineers' training program before entering the engineering development department.

Mr. Odinotski is a 1951 graduate in chemical engineering of McGill University.

D. C. Kinley, JR.E.I.C., has been promoted by Shawinigan Chemicals Limited in Shawinigan Falls to the position of division engineer, buildings and services.

He has been associated with the company since 1951, taking part in the training program prior to joining the engineering development department.

Mr. Kinley received his B.Eng. degree in civil engineering from the Nova Scotia Technical College in 1951.

G. P. Berthin, JR.E.I.C., has joined the engineering department of MacDonald Brothers Aircraft Limited in Winnipeg as a project engineer in the electrical section. He was formerly in the employment of the Canadian General Electric Company in Peterborough.

Mr. Berthin graduated in mechanical engineering from the University of Manitoba in 1952.

Donald F. Currie, JR.E.I.C., is employed as sales engineer with Shell Oil Company Limited in Montreal.

He graduated in mechanical engineering from McGill University in 1952.

Selwyn Fox, JR.E.I.C., who is engaged in post-graduate forestry studies at the University of Toronto, has been awarded a $1,250 research fellowship by the Canadian Lumbermen's Association.

He graduated with honors in forestry engineering from the University of British Columbia in 1952, and was employed by B.C. Forest Products as

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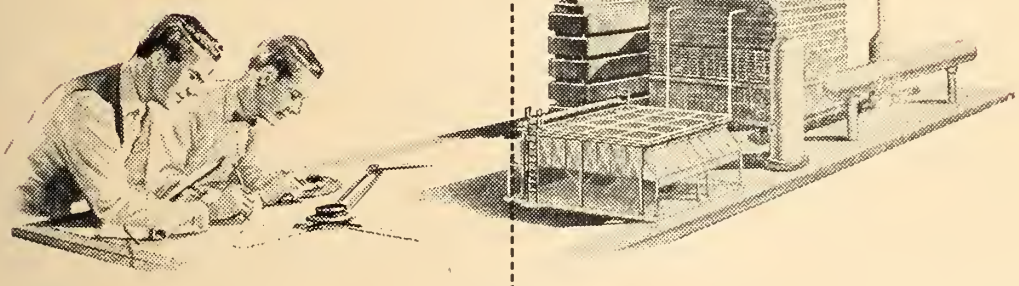

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FLUOR of CANADA

assistant engineer at Port Renfrew until September last when he undertook further studies in forestry.

D. Hoogeveen, JR.E.I.C., is employed as assistant transmission and streetlighting estimating engineer with the Saskatchewan Power Corporation in Regina.

Mr. Hoogeveen graduated in electrical engineering from the Academie van Beeldeude in 1952.

C. Clarke Robinson, JR.E.I.C., formerly associated with Imperial Oil Limited at Sarnia, has joined the engineering department of Babcock-Wilcox & Goldie-McCulloch in Galt, Ontario.

Mr. Robinson graduated in mechanical engineering from the University of Manitoba in 1952.

K. O. Anderson, JR.E.I.C., holds the position of materials engineer in the Department of Highways in Edmonton. He was previously resident highway engineer in the department.

Mr. Anderson graduated in civil engineering from the University of Alberta in 1953.

Gordon J. Willmon, JR.E.I.C., has been appointed Leduc area civil engineer by Imperial Oil Limited, having recently been transferred from Edmonton.

Mr. Willmon is a 1953 graduate in mechanical engineering from the University of British Columbia.

D. G. Munro, JR.E.I.C., formerly on the staff of H. H. Angus & Associates Limited in Toronto, is now associated with The Johnson Temperature Regulating Company in Vancouver.

Mr. Munro is a 1953 graduate in mechanical engineering of the University of Saskatchewan.

D. M. McKim, JR.E.I.C., has been promoted to the position of division engineer, carbide division, by Shawinigan Chemicals Limited, Shawinigan Falls.

He has been with the company since 1947, when he joined the staff as chemical engineer engaged on research work upon graduation in chemical engineering from McGill University.

Mr. McKim was in 1953 secretary-treasurer of the Institute's St. Maurice Valley Branch. He was previously active as chairman of the Shawinigan Falls Junior Section.

C. W. Kirkpatrick, JR.E.I.C., is at present engaged as project engineer in the munitions division of the Massey-Harris-Ferguson organization in Hamilton.

He joined the organization in 1953 following his graduation from the University of Toronto. The first six months of his employment were spent in the firm's general manufacturing training program.

A. D. Murchie, JR.E.I.C., who recently completed a post-graduate course in business administration at the University of Western Ontario is on the staff of the development engineering department of the Polymer Corporation at Sarnia, Ont.

Mr. Murchie graduated in mechanical engineering from the University of Toronto in 1953.

W. G. Plewes, JR.E.I.C., has accepted the position of research officer in the division of buildings research with the National Research Council in Ottawa.

A graduate civil engineer of Queen's University, class of 1954, he was previously associated with Canadian National Railways in Winnipeg.

J. A. Forrest, S.E.I.C., who graduated from the University of Saskatchewan in 1953 with a B.Eng. degree in mechanical engineering, is sales engineer on the staff of Hughes Tool Service Limited, Edmonton.

He is at present in Houston, Texas, where he is attending a ten-month company training program.

J. D. Kingston, S.E.I.C., who graduated in civil engineering from Queen's University in 1954, has now returned to the university as a demonstrator in the civil engineering department.

He was previously employed on a geophysical survey with Seismic Party No. 11 of the Socony-Vacuum Oil Company of Canada Limited at Grande Prairie, Alberta, where he served as computor.

Paul C. J. Locke, S.E.I.C., has joined the staff of the industrial relations department of Canadian Westinghouse Company Limited in Hamilton.

Mr. Locke is a 1954 graduate in electrical engineering of Queen's University.

John Mekechuk, S.E.I.C., who graduated in civil engineering from the University of Alberta in 1954, is now structural engineer in the architectural branch of the Department of Public Works in Edmonton.

R. C. Starr, S.E.I.C., who graduated in civil engineering from McGill University in 1954, is now on the staff of the Western Bridge Company in Vancouver.

Ylo Saar, S.E.I.C., an electrical engineering graduate of the University of Manitoba in 1954, has joined the personnel department staff of the Hydro-Electric Power Commission in Toronto.

Lawrence C. White, S.E.I.C., is employed as instrumentman with the Ontario Department of Highways, Division 6, in Toronto.

J. N. Rossall, S.E.I.C., of Niagara Falls, who is in his third year of chemical engineering at the University of Toronto, has recently been awarded one of nine Ontario Hydro Electric Power Commission scholarships totalling $2,300.

In announcing the winners, the late Robert H. Saunders, Hydro chairman, said: "Each award is presented for the purpose of encouraging and assisting promising students in the engineering and technical fields and is a tribute to the accomplishments of graduates in this profession. We welcome the opportunity to contribute in this way to Canada's future, for today's students will guide the nation's technological advance tomorrow."

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Dr. Frederic Henry Sexton, HON.M.E.I.C., one of Nova Scotia's most eminent educators, founder and president emeritus of the Nova Scotia Technical College, passed away in Wolfville, N.S., on January 12, 1955.

Dr. Sexton was born at New Boston, N.H., on June 9, 1879. He received his education in the public schools of Billerica, Mass., Cambridge English High School, and the Massachusetts Institute of Technology. He graduated from the last with the degree of B.Sc. in mining engineering in 1901. In 1919 he received from Acadia University the honorary degree of doctor of science, and from Dalhousie University the honorary degree of doctor of laws. He was awarded the honorary degree of doctor of laws from St. Mary's in 1954.

After his graduation from the Massachusetts Institute of Technology, he assisted in metallurgy at the Institute and was research metallurgist with the General Electric Company in Schenectady, N.Y. He came to Nova Scotia in 1904 and was appointed assistant professor of mining engineering at Dalhousie University.

In 1907 he was chosen by the Nova Scotia government to found the Nova Scotia Technical College and set up the first system of technical education in any of the Canadian provinces. During his 40 years of presidency, the College reached the highest standard of any college of this type. Throughout his career he strove against narrow specialization. He saw to it that the curriculum was broadened to include such courses as history, political science, psychology and economics, believing that engineering students need more than professional knowledge if they are to take their place in the modern world. His work during this period was vast in scope and drew national recognition. Besides his duties as president, Dr. Sexton took a leading part in what has been termed the less advanced stages of technical education—evening technical and coal mining schools, short term industrial courses, apprenticeship training, and vocational high schools. He retired as president of the college in May, 1947.

Dr. Frederic H. Sexton, Hon.M.E.I.C.

Dr. Sexton contributed several noteworthy works to the field of engineering and education: "Education for Industry in Nova Scotia", "Mining History of the Maritime Provinces", "Canada and Its Provinces", and "Technical Education in Canada".

He held prominent positions in many organizations, serving as a member of the Canadian Advisory Council on Vocational Education, as vice-chairman of the Canadian Legion Educational Services, and as a member of the Maritime division, board of directors of the Canadian National Institute for the Blind. He was a past president of the Mining Society of Nova Scotia, the Canadian Education Association and the Nova Scotia College of Art. In 1943 he was appointed a Commander of the Order of the British Empire. That same year he was the recipient of the Julian Smith Medal of the Institute "for achievement in the development of Canada".

Dr. Sexton joined the Engineering Institute of Canada as a Member in 1940. He was awarded Honorary Membership in 1947.

Dr. Robert Charles Wallace, HON.M.E.I.C., scholar, scientist and education administrator, who played a significant role in the life of three Canadian universities, passed away in Kingston, Ont., on January 29, 1955.

R. C. Wallace, Hon. M.E.I.C.

Dr. Wallace was born in Orkney, Scotland, on June 15, 1881. After obtaining his M.A. and B.Sc. degrees from the University of Edinburgh in 1901 and 1906, he undertook post-graduate work at Gottingen University, Germany, where he received his Ph.D. degree in 1909 He was awarded his D.Sc. degree from the former university in 1912.

During his student years, Dr. Wallace was a Neil Arnott Scholar in physics in 1900, a Hope Prize Scholar in chemistry in 1901, a Science Master in Secondary School from 1901 until 1904, an 1851 Royal Exhibition Scholar and Carnegie Fellow at Edinburgh University from 1907 until 1910, and a Research Scholar in crystallography at St. Andrew's University in 1910.

He began his outstanding career in Canadian education in 1910 when he came to this country as lecturer in charge of geology and mineralogy for the University of Manitoba. Appointed professor in this department in 1912, he continued in this capacity for 16 years. During this period he also served in the government of Manitoba, first as commissioner for northern Manitoba with headquarters at The Pas from 1918 until 1921, and then as commissioner of Mines and Resources from 1926 until 1928.

In 1928 Dr. Wallace was appointed president of the University of Alberta. He retained this position until his appointment as vice-chancellor and principal of Queen's University in 1936.

During his 15 years' association with Queen's, Dr. Wallace guided the university during World War II and through the period of expansion brought on by heavy post-war enrolments. He kept standards high while providing for an ever increasing number of students. At the same time he exercised supervision over the university's program of extramural studies, through which many students may complete much of their work toward a degree by home study . . . a field in which Queen's pioneered in Canada.

He was the author of numerous papers on mineral statics, economic geology, natural resources, and educational subjects.

Dr. Wallace was active in several important posts after his retirement from Queen's three and a half years ago. He was executive director of the Arctic Institute of North America, adviser to the Department of Education of Ontario on government grants to universities, Canadian advisory editor of the Encyclopaedia Americana, member of the Defence Research Board and of its selection committee, and honorary president of the Canadian Association for Adult Education in which he long had taken a prominent part.

He was a past president of the Canadian Institute of Mining and Metallurgy, of the Manitoba Educational Association, the Association of Canadian Clubs, and of the Royal Society of Canada.

His great contribution to the Canadian field of education was recognized by the award of the honorary degree of doctor of laws by the University of Manitoba in 1928, Queen's University in 1930, the University of Toronto in 1933, the University of Saskatchewan and McMaster University in 1936.

Dr. W. A. Mackintosh, principal of Queen's, paying tribute to his predecessor, said:

"R. C. Wallace has left his imprint on three Canadian universities and on many areas of Canadian life. From his boyhood home in the Orkneys, he went to Edinburgh, and Gottingen and St. Andrew's, and became a geologist broad in training and rich in experience. As a citizen, as a field geologist, as commissioner first of northern Manitoba, and then of mines and natural resources in Manitoba, he gained a deep understanding of Canadian life and problems.

"His strongest interests went far beyond geology and his concern with education early marked him as one who would assume wider responsibilities as he did at Alberta and Queen's. Here at Queen's University we will for many years reap the fruits of his stewardship as vice-chancellor and principal, of his search for first-class scholars, his insistence on standards, and his eloquence and distinguished representation of the university."

Dr. Wallace was awarded Honorary Membership in the Engineering Institute of Canada in 1940.

Ronald McIsaac, M.E.I.C., associated with railway engineering for over 40 years, passed away in New Glasgow, N.S., in November, 1954.

Born in Antigonish, N.S., on October 30, 1885, Mr. McIsaac received his engineering education at St. Francois Xavier University there and first entered the railway field in 1906, serving as rodman on the National Transcontinental Railway. In 1908 he became instrumentman with the same company, and four years later joined the St. John and Quebec Railway as draughtsman. He was shortly after appointed resident engineer, which position he retained for two years before entering private practice in 1914. In 1917 he was employed as transitman with the Canadian Government Railways, and in 1919 was named assistant engineer in charge of location for Canadian National Railways with headquarters in Moncton, N.B. In 1927 he was transferred as divisional engineer to New Glasgow, N.S., where he resided until the time of his death. He retired from active railway work in 1950.

Mr. McIsaac was a member of the Association of Professional Engineers of New Brunswick and of Nova Scotia.

He joined the Engineering Institute of Canada as a Member in 1940.

Alexander Carmichael Dunn, M.E.I.C., pioneer coal operator and president of Great West Coal Company Limited in Edmonton, Alta., passed away on April 6, 1954.

Mr. Dunn was born at Alloa, Scotland, on January 29, 1883. He attended Alloa Academy and Patons School there, and after completing five years' apprenticeship with McCreathe & Stevenson in Glasgow and with J. Orr, mining engineer in Alloa, and at the same time attending the Glasgow Technical College, he received his diploma in mining engineering.

In 1904 he was appointed a mine surveyor by Alloa Coal Company Limited, and from 1905 until 1907 was employed in underground work after which he received the British Mine Manager's Certificate.

Mr. Dunn then came to Canada where he was employed in the fuel department of the Canadian Pacific Railway. He was stationed at various mines in Alberta.

In 1909 he was appointed mine manager and director of Clover Bar Coal Company Limited in Edmonton. Two years later he was named director in charge of mining operations of Great West Coal Company Limited of Edmonton which operates the Black Diamond Mine. In addition, he served as managing director of Jasper Coal Company Limited in Edmonton from 1929 until 1940, and as director of Luscar Coals Limited and Mountain Park Coal Limited since 1920. He was appointed managing director of Great West Coal Company Limited in 1950 and was subsequently named president of the company.

Mr. Dunn held the Alberta Mine Manager's Certificate and also the Alberta Mine Surveyor's Certificate. He was a member of the Canadian Institute of Mining and Metallurgy, and a member of the Association of Professional Engineers of Alberta. He joined the Engineering Institute of Canada as a Member in 1941.

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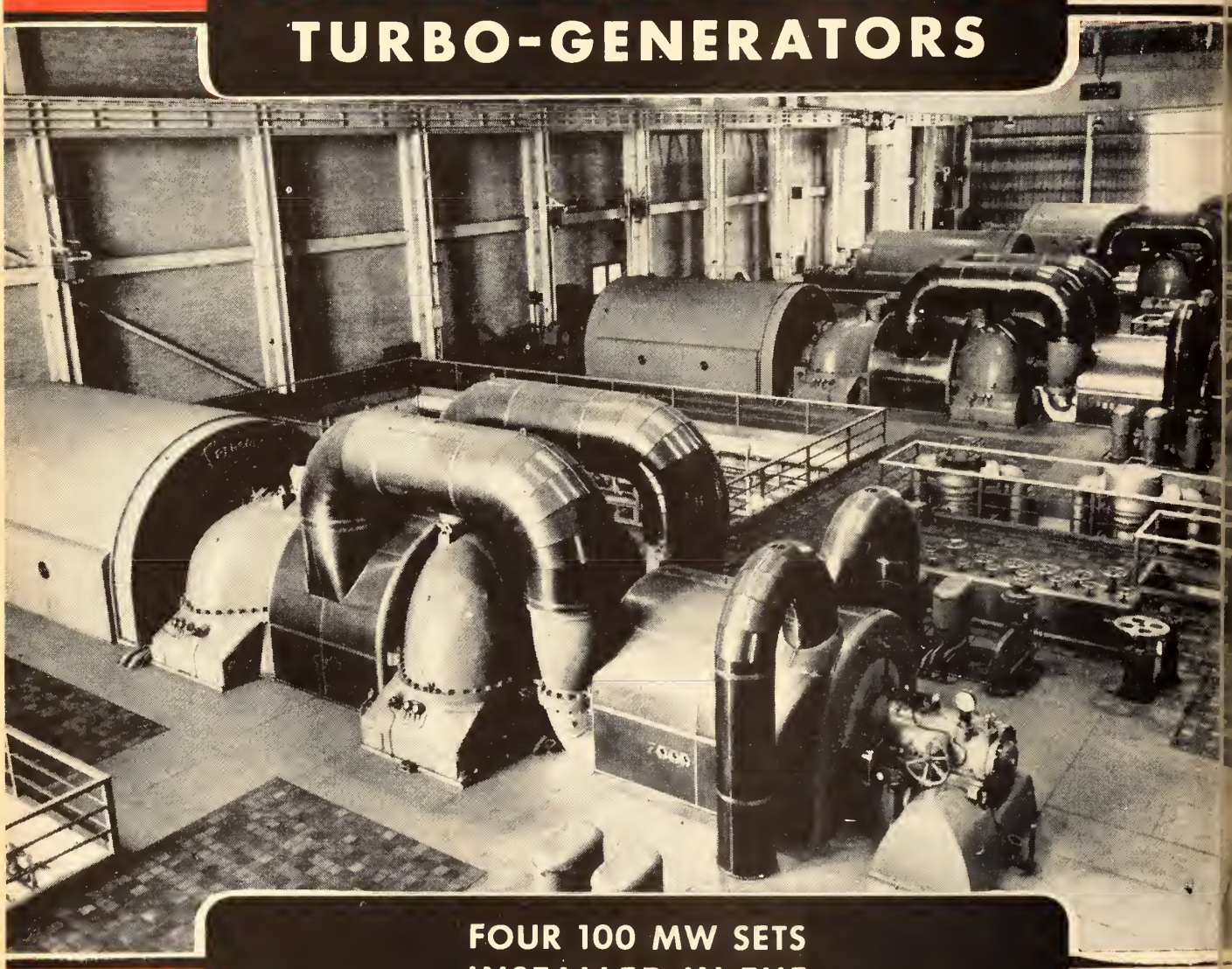

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Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

Situations Vacant

CHEMICAL

TWO SALES ENGINEERS wanted with plant maintenance experience to sell corrosion resistant cements, coatings, pipes, tanks, etc. We prefer chemical engineers and require one each for Quebec and Ontario. Salary and expenses plus profit sharing. File No. 5071-V.

INTERNATIONAL MANUFACTURER expanding its research facilities in Canada requires a competent paper engineer for research and development work on pulp, fine papers, paper specialties and shipping containers. This position with a future is open only to graduate chemical engineers from a recognized university who have at least three years industrial experience in pulp and paper. Remuneration will be negotiated. Replies will be given all applicants who send a complete resume of their educational background, work ability, personal data and references and a recent photograph. File No. 5083-V.

CHEMICAL ENGINEER or chemist required, preferably with experience in paint printing inks, rubber or plastics industries. To sell chemicals, oils and colours in Toronto district. Apply fully in writing to File No. 5084-V.

CHEMICAL ENGINEER with some production experience required by large modern plant in Montreal for the study and development of production techniques associated with new products. Salary to be arranged. File No. 5129-V.

CHEMICAL ENGINEERS graduates from recognized Canadian Universities with 0-5 years experience. Required for process development studies, solution of technical assignments in production units, and on-the-job training in production supervisory capacities. Positions are in petrochemical plant located in Sarnia. Please reply in detail stating experience, education, etc. All replies will be kept in strict confidence. File No. 5147-V.

CIVIL

CIVIL ENGINEERS are required for assignment in numerous fields including structural design, hydraulics, hydrometrics, public health engineering, highway construction, general engineering, surveying. Civil Service Commission, Ottawa. File No. 5066-V.

SENIOR STRUCTURAL ENGINEER. Rapidly expanding structural consulting firm offers excellent opportunities to experienced senior and intermediate engineers who must have first class qualifications, references and a high degree of intelligence. There are responsible positions offering excellent remuneration to capable and ambitious persons. Those confident of their ability should reply. File No. 5069-V.

PROFESSOR CIVIL ENGINEERING, for appointment September 1st, 1955, to direct, supervise and give undergraduate and post graduate instruction in specified field In civil engineering. Salary range $5,900 to $6,600 with superannuation, hospital insurance and other benefits. Applicant should be university graduate, preferably with postgraduate training and should have had several years practical experience in responsible engineering work. Location Halifax, N.S. File No. 5110-V.

CIVIL ENGINEER, recent graduate, to act as sales engineering representative for reputable and well recognized company in building products and specialty field. Must have strong inclination toward aggressive sales. Real opportunity for recognition and advancement to the right individual. Territory Montreal, Quebec and Maritimes. File No. 5113-V.

PROFESSIONAL ENGINEER, fully experienced in municipal engineering, required by a firm of consulting engineers. Applicant must be capable of taking full charge of the design of sewage treatment plants, sewerage systems, water supply and distribution, be fully competent to write specifications, and meet and discuss problems with municipal councils and engineers, and supervise the work of contractors. Work will be in Ontario from Toronto Office. Full details as to experience, education, and references required in first letter. File No. 5116-V.

GRADUATE ENGINEER with extensive experience in general structural design including heavy concrete structures to direct the work of design and detailing group in the Montreal office of an established firm of utility consultants. Applicants must have a thorough knowledge of Canadian building materials and construction practices. File No. 5119-V.

ASSISTANT PUBLIC HEALTH ENGINEER, Department of Health and Welfare, Victoria. Salary $387. rising to $464. per month. To assist in supervising policy of sanitation, approving plans for water and sewage systems, and related work. Eligible for professional registration in B.C. Preferably experience in public health engineering. British subject, under 45 unless veteran. Apply chairman, Civil Service Commission, Parliament Buildings, Victoria, not later than March 23rd. File No. 5123-V.

THE CITY OF PRINCE ALBERT (pop. 19,000) requires an assistant engineer. Must hold an engineering degree, preferably civil, from a recognized university. Position offers varied experience, future security, and an opportunity for advancement. Salary $325. to $375. per month, depending on qualifications. Reply stating age, experience, education and relevant information to File No. 5124-V.

WANTED AT ONCE salesman with experience in pipes for use in waterworks or sewerage systems. Experience in the installation of these pipes desirable but not essential. Please reply stating age, experience, educational qualifications and salary expected. Our employees are informed of this advertisement. File No. 5126-V.

CIVIL ENGINEER, preferably recent graduate, for bridge section of large transportation company with headquarters in Montreal. Duties include design of steel and reinforced concrete structures, preparation of reports and some travelling. File No. 5127-V.

APPLICATIONS ARE INVITED for a graduate civil engineer with one or two years experience for the post of assistant engineer in the Department of Municipal Affairs and Supply. The successful applicant will be required under direction to do topographic surveys, prepare designs of water and sewer systems, advise municipalities on public works generally and perform such other engineering duties as the Department may require. The salary for the post will be on the scale $4600—100—$4900. Applications should contain qualifications, age and experience and should reach the undersigned on or before March 15, 1955. File No. 5134-V.

ELECTRICAL

ELECTRICAL DESIGN ENGINEERS to do layout of aircraft electrical machines from design data and to produce wiring diagrams to design AC and DC generators and motors, regulators and protective devices. Require a degree in electrical engineering or equivalent plus 2 to 4 years industrial experience preferably in aircraft field, for expansion program of light engineering company manufacturing aircraft engine components. Location Ontario. Reply with full particulars, stating approximate starting salary. File No. 5051-V.

ELECTRICAL ENGINEER required in Edmonton, Alberta, who has graduated from a recognized Canadian university, and who has 3-10 years industrial experience in a chemical plant or refinery. He will deal mostly in equipment used in the manufacture of petrochemicals and synthetic fibres. Duties will include design, layout and estimating. File No. 5057-V.

JUNIOR ELECTRONIC DESIGN ENGINEER, required by electronic tube manufacturer to design cathode ray and receiving tube testing and allied equipment. Location Toronto. File No. 5063-V.

ELECTRICAL ENGINEER preferably 25-35 years of age, with some sales experience required as sales engineer for industrial motive power battery line with long established reputable firm. Good salary and prospects for promotion. Duties will involve some travelling. All applicants should state qualifications and salary expected. File No. 5064-V.

EASTERN ONTARIO UTILITY, requires graduate electrical engineer to fill the position of distribution engineer. Duties to include distribution planning and layout for improvement of voltage conditions and expansion of present system. Design and layout of substations and assist in supervision of operating force. Applicant preferably should have one or two years electrical distribution experience. Write giving age, education, personal particulars and salary desired. File No. 5065-V.

ELECTRICAL ENGINEERS are required to fill over 50 positions, particularly in the electronics field, for work involving the design and development of communications equipment. Requirements also exist for those inter-

NOTICE

The City of Prince Albert (pop. 19,000) requires an assistant engineer. Must hold an engineering degree, preferably civil, from a recognized university. Position offers varied experience, future security, and an opportunity for advancement. Salary $325 to $375 per month, depending on qualifications.

Reply stating age, experience, education and relevant information, to

J. W. Oliver,
City Commissioner,
Prince Albert, Sask.

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csted in electrical machinery, lighting and distrihution systems. Civil Service Commission, Ottawa. File No. 5066-V.

ELECTRICAL SALES ENGINEER for Toronto office, leading U.K. manufacturer electrical plant. Must have minimum five years sales experience. Age under 30 years. File No. 5067-V.

ELECTRONICS ENGINEERS required by large manufacturing firm with plants in Eastern Ontario and the Montreal area. Positions available in the development of communications equipment or field maintenance engineering. Out-of-town trips of short duration required on some assignments. Reply in confidence including age, education, experience and salary requirements. File No. 5070-V.

SENIOR ENGINEER required by prominent manufacturer for sales, liaison, and technical administration in connection with guided missiles, radar and fire control projects. This is a responsible position for which considerable technical experience in electronics or electrical engineering as well as proven administrative ability are necessary. Opportunity for advancement is unequalled and depends solely on ability. File No. 5073-V.

TWO JUNIOR ELECTRICAL ENGINEERS are required by a prominent mobile communications manufacturer located in Toronto. Both must be graduates in communications or general electronics option and have had about one year's experience in the electronic field preferably in the radio communications branch. One is required to work on production engineering in a technical liaison capacity. The other opening is for an application engineer in the systems development group. Reply giving full personal resume, experience, education and salary desired to File No. 5075-V.

ELECTRICAL ENGINEER required by repair shop in Quebec City. Repairs on electric motors, construction work, selling motors and controls, ball bearings, drives, belts, industrial hoses and electrical tools. Position offers, after some experience, management of whole firm. Must be bilingual. File No. 5077-V.

TWO ELECTRONIC ENGINEERS required in Toronto. Applicants should be graduate electrical engineers or physicists, with two or three years experience in design of electronic circuits. File No. 5085-V.

ELECTRICAL ENGINEER with 2 to 3 years experience, required for sales department of Toronto switchgear specialist. Knowledge of switchgear application desirable. File No. 5088-V.

CHIEF ENGINEER required by progressive manufacturer supplying equipment to utilities and large industrials. Must have experience and maturity to counsel staff and administer department. Technical background in design and development of electrical filter circuits together with mechanical design experience in manufacturing industry is most desirable. Remuncration commensurate with qualifications. File No. 5089-V.

GENERAL MANAGER required for the Saskatchewan Power Corporation operating a rapidly expanding province-wide electrical utility and an extensive gas utility. Headquarters Regina. Kindly state fully background and experience including previous training in and knowledge of electrical and gas utilities and industrial and public relations. State also salary expected and date available. File No. 5093-V.

ELECTRICAL ENGINEER, with four years general experience in substations and industrial layout of large motors, mining experience preferred. Write stating experience and qualifications to File No. 5095-V.

ELECTRICAL ENGINEERING DRAUGHTSMAN or electrical engineer, required for consulting engineer's office. Experience required in commercial and residential design, layout, etc. Permanent position. Please write advising experience to File No. 5096-V.

ELECTRICAL ENGINEER, graduate with at least 5 years experience protective relay work with electric operating utility company. Relay studies, system development studies and general technical electrical operating and design work. Permanent position long established consulting organization. Headquarters New York. Some travel Latin America. Knowledge of Spanish or Portuguese desirable, not essential. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5108-V.

ELECTRICAL DRAUGHTSMAN, required in Montreal hy naval architects office. Age 25 to 35 with technical and all around experience. Applicant would have to be of good personality and reasonahle executive ability to work in as assistant electrical engineer and eventually chief electrical engineer. File No. 5111-V.

SENIOR GEOLOGIST, required by Saskatchewan Department of Mineral Resources. Applicants require University graduation in geology or petrology as well as several years professional geological experience and membership in C.I.M.M. and Association of Professional Engineers to take charge of geological survey parties for approximately six months each year and to prepare reports and other duties the remaining six months. File No. 5112-V.

ELECTRICAL ENGINEER, graduate with at least 5 years experience protective relay work with electric operating utility company. Relay studies, system development studies and general technical electrical operating and design work. Permanent position long established consulting organization. Headquarters New York. Some travel Latin America. Knowledge of Spanish or Portuguese desirable, not essential. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5117-V.

Municipal Engineer

Applications will be received for the position of Engineer for the Town of Dryden, Ontario. Population 4,200.

Applicant should be qualified to layout and supervise the construction of watermain and sewerage extensions, the construction of streets, drainage and the general requirements of a growing community.

This is a permanent position to the qualified applicant with excellent opportunities, pension plan in effect after one year's service, also sick leave provisions.

Beginning salary $450.00 per month to be increased to $500.00 after a six-month probationary period.

Applicants should state their educational background, age, marital status, previous employer and references and a recent photograph. File No. 5143-V.

GRADUATE ELECTRICAL ENGINEERS—one senior—two juniors—Senior at least 10 years experience—Junior 3 to 5 years experience in electrical design, operation and construction of steam, hydro plants and substations. Permanent position with long established consulting organization for public utility operating companies located Latin America. Headquarters New York. Some travel necessary in future. Knowledge of Spanish or Portuguese useful not essential. Salary commensurate with qualifications. Good opportunity. Reply stating age, education, experience and personal particulars. File No. 5118-V.

A LARGE MANITOBA UTILITY requires a graduate electrical engineer, to fill the position of Asst. to the Transmission Line Engineer. Applicant should have at least three years experience in distribution practices, including layout of large distribution areas, estimating of costs of distribution changes and extensions, improvement of voltage conditions and expansion of existing systems, basic economic studies. Ability to write clear and concise reports to supervise and deal with field staff is essential. Location Winnipeg. Applications treated confidentially. File No. 5121-V.

ELECTRICAL ENGINEER communication option from Canadian University required by manufacturer of television located in Ontario. Applicants should be 2 to 3 years out of university and have some experience in radar or allied equipment. Position open in Production Department. File No. 5122-V.

GRADUATE ELECTRICAL ENGINEER to assume responsibility for design and development of distribution and small power transformer with manufacturer established in Alberta. At least one year design and or manufacturing experience desirable. Applicants to give personal data (including recent photo), education, experience, references and minimum initial salary expected. File No. 5131-V.

ELECTRICAL ENGINEER with at least two years of experience in industry. To handle under supervision, design of power distribution and control for plant extension and development work, supervision of draughting, test work, preparation of test reports and estimates. Required by smelting firm in the vicinity of Montreal. Experience in electric furnace smelting. File No. 5132-V.

MANAGER OF ENGINEERING required to direct our guided missile development and design program. The man for whom we are looking will have a background of at least ten years electronics experience. Specific experience in guided missiles would be a definite asset. His executive ability must be of a high order, and his supervisory experience be at engineering management level. This position will demand the best from a highly capable and mature engineering executive and in return offers an attractive salary, plus excellent opportunity for further professional and personal advancement. Reply in strictest confidence. File No. 5133-V.

MECHANICAL

MECHANICAL ENGINEER required in Edmonton, who has graduated from a Canadian University and who has about 3-5 years experience in a chemical plant or refinery. He will deal mostly in equipment used in the manufacture of petro-chemicals and synthetic fibres. Duties will consist of general engineering which will include design, layout and estimating. File No. 5055-V.

A MECHANICAL ENGINEER is required as maintenance superintendent at a 2,000 bed mental hospital in Weyburn, Sask., operated by the Saskatchewan Department of Public Health. The duties include planning and supervising the maintenance, repair and construction of buildings, grounds, roads, equipment and utilities. The employee would be responsible for the generation of electricity and supply of steam, and the operation of water and sewage systems. Considerable experience in buildings, maintenance and construction desirable. Qualifications should permit registration as a professional engineer. Starting salary $397.00 per month with automatic annual increases to $481.00 per month. Benefits—3 weeks annual sick leave, 3 weeks holiday with pay, excellent superannuation scheme. File No. 5060-V.

MECHANICAL MAINTENANCE ENGINEER

With five years' experience in oil refineries, required as assistant maintenance superintendent in Southern Ontario.

Please reply giving details of experience and salary expected to File No. 5141-V.

ENGINEERING DESIGNERS, DRAUGHTSMEN AND CONTRACT ENGINEERS

FOR BRITAIN

A large, progressive, and well established electrical engineering company in North East England offers opportunities to engineering designers and draughtsmen who have served a recognized engineering apprenticeship, possess technical qualifications to Higher National Certifcate standard in Electrical and/or Mechanical engineering and have had practical experience on the drawing board preferably in connection with the design of electrical switchgear.
Engagement would be for a minimum period of two years with the opportunity of continuance thereafter on a pensionable basis. Minimum salaries from £585 per annum at age 25 and £663 at age 30. Passage paid and housing assistance in approved cases. A few opportunities also occur on much similar terms for contract engineers, with qualifications and experience adequate to handle all phases of tender and contract work met with in world-wide electrical power supply equipment industry, particularly in respect to control and switchgear. File No. 5144-V.

MECHANICAL ENGINEER to be services engineer for large manufacturing plant in Eastern Ontario. Work will involve supply, distribution and use of plant services including steam, water refrigeration, compressed air, vacuum, ventilation and air conditioning. Duties will include control of all services departments and distribution systems, supervision of maintenance of services equipment, and studies, estimates, and reports on services distribution and consumptions. Must be graduate engineer, age 28 to 35, with several years of practical experience with supply of plant services. Must have the ability to take over leadership of a group and be prepared to make his own decisions and be responsible for them. Preferably should also have first class stationary enginer's certificate. Position will be permanent and offers excellent opportunity for advancement to the right man. Applications should contain all necessary personal data, and full information about previous engineering experience. Reply stating experience and other relevant information to File No. 5062-V.

OPPORTUNITIES ARE AVAILABLE to mechanical engineers at Ottawa and other centres across Canada, on assignments involving the design and installation of heating, ventilating and refrigeration equipment; the design and construction of power house equipment, dry-docks, lift and swing bridges; research on stress analysis and fatigue properties of metals as well as on thermodynamics and gas dynamics. Civil Service Commission, Ottawa. File No. 5066-V.

GRADUATE MECHANICAL ENGINEER, with 3-5 years experience to work as project engineer. Located in Head Office in Montreal, but may be called upon to travel to plants in Eastern Canada. He will be responsible for design and installation of a wide variety of industrial equipment and processes and for new plants or additions to existing plants as they expand. Training will be provided, so actual experience in this field is an asset but not essential. File No. 5068-V.

TWO MECHANICAL ENGINEERS to work in mechanical goods sales division. The men we are looking for should be recent graduates who have an interest in sales work. Will receive training to become familiar with products and then move to technical sales. They will deal with problems related to products in most of the larger well known industries. Being a large well known firm, we can offer a good future with better-than-average employee benefits. File No. 5068-V.

VACANCIES CREATED BY new developments offer interesting positions for mechanical engineers on Canada's leading design team. Applications from qualified persons are being considered for analytical and applied design work on full systems and flying control systems, including electro-hydraulic servo mechanisms, aircraft experience desirable but not essential. Salary commensurate with experience and ability. Replies held in confidence. Reply by letter in first instance giving resume of education and experience, with salary expected. Location Ontario. File No. 5076-V.

MECHANICAL ENGINEER with five or more years experience in industry, preferably pulp and paper, for duties involving organization of improvements, job schedules, machinery maintenance and some mechanical draughting. File No. 5081-V.

MECHANICAL ENGINEER required for development and design of precision mechanisms of control equipment. Must be graduate engineer, above 30 years of age and considerable experience. Must have the ability to take over leadership of an experimental group and be prepared to make decisions. Salary commensurate with experience and qualifications. File No. 5103-V.

MECHANICAL ENGINEER required for development and product design of optical equipment. Applicant should be not less than 30 years old, with at least 5 years experience in the optical field. Plant location Eastern Townships. Salary commensurate with experience and qualifications. File No. 5103-V.

ASSISTANT PROFESSOR MECHANICAL ENGINEERING for appointment September 1, 1955, to give undergraduate instruction in the thermal power and allied subjects. Salary range $4100 to $5000 with superannuation, hospital insurance and other benefits. Applicant should be university graduate with some years practical experience in steam power work. Location Halifax, N.S. File No. 5110-V.

VACANCIES IN CORNWALL, Ontario for graduate mechanical engineers. Age 24 to 28. Duties will cover design, construction and maintenance of all types of rayon machinery. Applications should be made to File No. 5120-V.

MECHANICAL ENGINEERS, graduates from recognized Canadian Universities with 0-10 years experience in a chemical plant or refinery. Duties will consist of general engineering, including design layout and estimating. Please reply in detail stating experience, education, etc. All replies will be kept in strict confidence. File No. 5137-V.

MISCELLANEOUS

METALLURGICAL ENGINEER for shift production work in non-ferrous smelter. Excellent opportunity for recent metallurgical graduate. Supply full particulars regarding qualifications and salary expected to File No. 5059-V.

SALES ENGINEERS graduates in chemical, electrical, mechanical, mining or metallurgical engineering, between the ages of 25 and 35, with at least 3 years industrial selling experience required by well known Montreal manufacturing firm with branches from coast-to-coast selling a wide range of mechanical equipment to the chemical, oil and gas mining, marine power, pulp and paper, metal and other industries in Canada. Reply in confidence giving a complete resume of your qualifications and experience. All replies will be acknowledged. File No. 5061-V.

MECHANICAL, ELECTRICAL AND CHEMICAL ENGINEERS are required for 35 positions at Ottawa to undergo training in patent law and regulations and then to assure the responsibility for the examination of applications for patents in the field of engineering and for making recommendations for the award or denial of patents. Civil Service Commission, Ottawa. File No. 5066-V.

RESEARCH OFFICERS, graduates in chemical, metallurgical and mining engineering and in engineering physics are needed for both fundamental and applied research at Ottawa and Chalk River, Ontario. Ample opportunity is provided in these posts to present and publish papers and to take part in technical conferences and forums both national and international. File No. 5066-V.

PLANT MAINTENANCE ENGINEER required by large manufacturing firm in Montreal for mechanical-electrical project design, construction and maintenance operations relating to buildings and building equipment. University graduates with some previous experience in plant engineering work preferred. In your reply, please include particulars as to education, age and approximate salary required. File No. 5070-V.

ENGINEERS REQUIRED FOR DEVELOPMENT and product design of microwave test equipment, magnetic amplifiers, transistor circuits, five control systems and other servo operated instruments for both military and commercial application. The continuing expansion of work in our engineering department offers opportunities for both junior and intermediate engineers. Previous experience in manufacturing operations is desirable, and supervisory ability would be an asset. File No. 5072-V.

YOUNG CIVIL OR MECHANICAL ENGINEER required by a pulp and paper company in Quebec. Applicant should have a minimum of three years experience in engineering and maintenance preferably in the pulp and paper industry. Applicant should be fluent in either French or English and should be able to get along in both. Replies should outline qualifications, experience, age and salary expected. File No. 5078-V.

THE NATIONAL RESEARCH COUNCIL, Ottawa, requires graduates in engineering physics, mechanical or electric engineering to work on the design and development of special instrumentation equipment and data processing systems. Three positions are open in the flight research section and one in the high speed aerodynamics lab. This work calls for an imagination and original approach to a large variety of advanced instrumentation and electro mechanical design problems. Initial salary in the range of $3750-$5750 per annum depending on qualifications. Apply by letter to the employment officer, Sussex Street, Ottawa, Ontario, quoting file ME 361 and listing complete details on education and experience. File No. 5080-V.

SASKATCHEWAN DEPARTMENT OF mineral resources requires petroleum geologists and petroleum development officers. Salary range $339-$413 and $326-$397 respectively. Both groups will perform duties in the conservation of oil and gas resources. The geologist's duties will be professional level in field and office, the petroleum development officers' will be largely field duties in connection with drilling operations. University graduation required. File No. 5082-V.

INTERNATIONAL MANUFACTURER expanding its research facilities in Canada requires a competent paper engineer for research and development work on pulp, fine papers, paper specialities and shipping containers. This position with a future is open only to graduate chemical engineers from a recognized university who have at least three years industrial experience in pulp and paper. Remuneration will be negotiated. Replies will be given all applicants who send a complete resume of their educational background, work ability, personal data and references and a recent photograph. File No. 5083-V.

THE NATIONAL RESEARCH COUNCIL, Ottawa, Canada, requires a university graduate to investigate problems in aircraft icing. Duties will include tests in flight as well as in icing tunnels and development work in

Principal Petroleum Engineer

required by

Saskatchewan Department of Mineral Resources
Competition No. c/c3510

Salary range $481-$566 per month

Applicants require University graduation in engineering plus extensive field and office experience in the oil and gas industry. To take charge of the development division of the petroleum and natural gas branch.

Application forms and additional information may be obtained from Public Service Commission, Legislative Buildings, Regino.

Closing date for receipt of applications: As soon as a qualified applicant is obtained.

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co-operation with commercial aircraft firms. Experience in aeronautical engineering problems and aircraft performance is desirable. Initial salary in the range of $3750 to $5750 per annum depending on qualifications. File No. 5086-V.

AN INTERESTING POSITION is open in our new Research Department. We require a graduate engineer from a recognized university with experience in adhesives, coatings, rubber, plastics or related fields. Remuneration will be negotiated. Replies will be given all applicants who send a complete resume of their educational background work ability, personal data and references, and a recent picture. File No. 5087-V.

CIVIL AND MECHANICAL ENGINEER required preferably with a few years of relevant experience and with good academic records for positions as research officers. To work on the dissemination of technical information to the construction industry and to study in the field new materials and techniques as used in construction. The ability to write clear reports to bridge the gap between research and industry is important. To undertake studies leading to the specification and assessment of materials and components for application in housing. Opportunities for study of the technical aspects of house construction will be provided. Salary will depend on training and experience. Applications with full details of education and experience should be sent to File No. 5091-V.

SCIENTISTS AND ENGINEERS with The Defence Research Board for challenging positions, with ample opportunity for advancement are available at several locations in Canada. Physicists, engineering physicists, electrical engineers, mechanical engineers, mathematicians, statisticians, chemists, biological and social scientists. There is also a requirement for trained scientists for work in operational research and scientific information. Qualifications: applications are invited from Canadian citizens or British subjects, graduates with a good academic record in science or engineering from a recognized university, preferably with post-graduate training. Proven scientific ability experience desirable. Salaries

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PROJECT ENGINEER

(Electrical and Electronic)

To design electrical and electronic installations in aircraft and to supervise a small section of electrical and mechanical draftsmen. Applicants should have a degree in electrical engineering or mechanical engineering with electrical subjects as a strong secondary and preferably 5 years experience in design of electrical and electronic installations in aircraft. Experience in supervision of draftsmen desirable. Salary commensurate with experience and qualifications. Reply stating age, education, experience, personal particulars and salary expected to File No. 5147-V.

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will be commensurate with qualifications and experience. Write outlining your qualifications to File No. 5092-V.

A LARGE MANUFACTURER in The Eastern Townships requires an engineer with maintenance background interested in industrial engineering, or visa versa. This is a newly created position to review and expand maintenance control procedures for a diversified maintenance work force—an expanding field with tremendous scope. Initiative and ability to present ideas effectively are essential qualifications. File No. 5094-V.

AIRCRAFT SALES MANAGER REQUIRED. Applicants must have a good aviation background and should not be more than 40 years of age. Preference will be given to those having an aeronautical engineering qualification. The position is a permanent one and available immediately. The successful candidate will be required to travel extensively in Canada, U.S.A. and the U.K. and will be resident in Montreal. Initial salary will depend on qualifications and experience, in addition, the company provides group pension and insurance plans and other benefits. Applications (six copies) giving full details of training, qualifications and experience and the names of three persons to whom reference may be made should be sent to File No. 5097-V.

SALES ENGINEER, experienced in concrete work. Territory province of Quebec. Bilingual preferred but not essential. Permanent position if satisfactory. Please reply giving details of experience, salary required, etc. Apply to File No. 5098-V.

ENGINEER REQUIRED with at least ten years experience in the diesel engine field preferably in application engineering. Age between 35 and 45 years. Must be Canadian graduate. The salary will be above the average for positions of this type and the development prospects are good. Location Montreal. File No. 5100-V.

HYDRAULIC TURBINE SALES ENGINEER wanted. Must be thoroughly familiar with all phases of turbine design and application problems. Proven record of good administrative and sales ability essential. Selected applicant to open office and represent in Canada one of the world's foremost water turbine manufacturers. Total turbine horsepower manufactured to date by this firm exceeds 10 million horsepower. This firm has not heretofore been directly represented in Canada but present long-range plans are predicted on obtaining right man who can secure reasonable share of Canadian market. Five figure starting salary will be commensurate with experience and proven ability. Give full details with first letter which will be considered strictly confidential and no investigation made thereof without prior consent of applicant. File No. 5101-V.

THREE RECENT GRADUATE engineers required at our plant in Ontario, with experience as follows: some experience in design of machinery and equipment; some electrical experience, or electrical engineer with mechanical experience; experienced in machinery and equipment design—new and maintenance —in charge of draughting room. File No. 5104-V.

OPPORTUNITIES FOR SENIOR ENGINEERS and technicians for permanent positions in rapidly expanding research organization located in Toronto. Senior engineers should be experienced in electro-mechanical, electronic, servo-controlled and computing instrumentation. Salaries open. Write detailing education, qualifications and experience. All inquiries will be treated in strictest confidence. File No. 5105-V.

MECHANICAL OR ELECTRICAL ENGINEER age 25-35, required by large organization in Montreal for planning, maintenance and administrative duties connected with properties occupied by company in particular very large head office building. Opportunities for promotion and enlargement in scope of duties within same and related fields. Staff benefits generous and comprehensive. Reply giving details education, experience and personal data. File No. 5106-V.

APPLICATIONS INVITED WITH university graduation in Engineering and several years experience in field and office petroleum enginering work; to perform supervisory and professional duties related to draughting of sound conservation practices regulations; estimation of reserves; and general reservoir management. Location Western Canada. File No. 5109-V.

PROFESSOR AND HEAD OF THE DEPARTMENT OF POWER ENGINEERING, required by The Institute of Science, Bangalore. This is one of the foremost institutions of India. As head of the department, to administer

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PETRO CHEMICAL
CHEMICAL and PETROLEUM
ENGINEERS and CONSTRUCTORS

require

ENGINEERS · DESIGNERS
and DRAFTSMEN

With experience in the above fields, for their engineering design office in Southern Ontario.

Please reply with brief details of experience, academic qualifications, and Salary to File No. 5140-V.

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the power engineering department and coordinate the activities of the four sections of electrical engineering, mechanical engineering, civil and hydraulic engineering, and high voltage engineering. Qualifications: a degree in electrical engineering of a recognized University, practical training in well-known electrical manufacturing concerns or large power projects and or power supply organizations. Duration of appointment, one year renewable. Salary between the equivalent of $8,750 and $9,500 per annum (national income tax reimbursed if levied), depending on qualifications and experience, plus family allowances. File No. 5115-V.

A GRADUATE CHEMICAL OR MECHANICAL engineer for technical services work in marketing department of major Canadian oil company, Toronto office. Good technical background in petroleum fuels, lubricants and associated products essential, plus ability to make successful customer contacts and sales meeting presentations. Interesting prospects for advancement and liberal employee benefit plans. Give all information in first instance. All replies confidential. File No. 5125-V.

SALES ENGINEER with experience in combustion, oil burning equipment and lines related to boiler room equipment required by established engineering company located in Montreal. Write giving full details of experience and salary desired. File No. 5128-V.

OPPORTUNITY
FOR AN
ENGINEER

If you have had ten or more years of experience in o pulp or paper mill, or in the sale of industrial equipment, or some combination of the two. Then we have an opening in sales engineering that could be very interesting to you.

We are o well established manufacturer of pulp ond paper mill equipment. Living conditions in our centrally-located city are considered very desirable.

This is a senior position suitable for a serious and ambitious man who expects ond warronts liberol remunerotion. Our present staff have been advised of this advertisement. Your communication, outlining your background will be treated in confidence. File No. 5152-V.

CONSTRUCTION SUPERINTENDENT

Excellent opportunity for top flight mon with o proven record of successful jobs completed In chemicol or petro chemicol field.

Ability to orgonize ond odminister lorge projects, including cost control, lobor relotions, stores, field supervision, together with o good technicol ond procticol bockground.

Appliconts should hove 10 yeors' experience in construction field. Voconcy open with mojor petro chemicol, chemicol ond petroleum engineers ond constructors.

Pleose reply with experience ond solory expected to File No. 5139-V.

MANAGER OF ENGINEERING

Required to direct our guided missile development and design program. The man for whom we are looking will have a background of at least ten years electronics experience. Specific experience in guided missiles would be a definite asset. His executive ability must be of a high order, and his supervisory experience be at engineering management level.

This position will demand the best from a highly capable and mature engineering-executive, and in return offers an attractive salary, plus excellent opportunity for further professional and personal advancement.

Reply in strict confidence to File 5133-V

A FIRM LOCATED IN MONTREAL requires the services of a graduate engineer who is experienced in the fields of water conditioning and purification, sewage and industrial waste treatment. A bacteriological background would be of advantage. File No. 5120-V.

SENIOR AND INTERMEDIATE ELECTRONIC engineers and physicists are required by a leading Canadian firm to carry out design and development work in the fields of radar, microwave communications, telephony and AM & TV broadcast equipment. All replies are confidential and will be acknowledged. File No. 5135-V.

TORONTO AFFILIATE of world wide concern engaging in extensive and varied research has immediate requirement for experienced patent attorney or agent to organize a patent department. In addition to supervising Canadian prosecutions and making infringement and validity investigations, appointee will maintain liaison with overseas patent department and will work in close co-operation with personnel engaged in licensing activities. Applicants should submit complete resume of personal data. All replies will be treated confidentially. File No. 5136-V.

TWO ENGINEERS WANTED. Electrical or mechanical. Must be graduate of Canadian or U.S. University. Experience not necessary. State full particulars and preference for production or design. Independent company located mid-western Ontario city. Full benefits. File No. 5138-V.

LARGE ESTABLISHED PAPER COMPANY REQUIRES GRADUATE MECHANICAL, civil and electrical engineers with necessary experience to undertake investigations, preliminary designs and estimates for expansion of existing mills and new projects which may be contemplated. Good opportunity for qualified men with pulp and paper mill experience. Office located in Montreal. Replies should state age, qualification, experience and salary expected. Interview will be arranged with prospective applicants. File No. 5153-V.

REFINERY POWER ENGINEER
McCOLL-FRONTENAC OIL COMPANY LIMITED

Recent graduote in mechonicol or chemicol engineering required for the company's Montreol Eost Refinery. One or two yeors' bosic experience required with plont utilities such os steom, oir ond woter. Knowledge of plont electricol systems useful but not essentiol.

Position provides excellent opportunity for professionol experience ond promotion. Duties, ofter suitoble troining period, will include such motters os performonce studies on steom boiler plont, steom engines ond turbines, pumps, oir compressors, condensers ond similor mechonicol equipment; economic studies on efficient usoge of plont utilities; preporotion of estimotes ond loyouts for extensions to plont utility systems.

Solory dependent on experience ond quolificotions.

Applicotions will be treoted confidentiolly ond should be oddressed in writing, with full porticulors, to:

McColl-Frontenoc Oil Company Limited,

Industriol Relotions Deportment, 1425 Mountoin Street, Montreol 25, Quebec.

Situations Wanted

GRADUATE ENGINEER with six years varied experience in the pulp and paper industry available for position as assistant superintendent in sulphate pulp mill or paper mill. Married, 29 years of age, will locate in United States or Canada. File No. 163-W.

CHEMICAL ENGINEER, M.E.I.C., age 35, 10 years experience in research, development and production desires position as assistant sulphite superintendent or control superintendent in pulp or paper mills. File No. 660-W.

EXECUTIVE ENGINEER Mechanical graduate P.Eng. Ontario and Quebec. M.E.I.C., age 39, married with wide and diversified Canadian experience in engineering design, construction, maintenance, industrial, manufacturing and business field. Accustomed in dealing with management and personnel (technical and otherwise). Capable administrator and organizer, aggressive, tactful. Would consider position offering responsibility, scope and future. Eastern Canada preferred. Available by arrangement. File No. 1793-W.

EXPERIENCED ENGINEER M.E.I.C., would furnish structural designs and quantity estimates in steel, concrete or wood, for architects or others requiring only occasional work of this type. File No. 2672-W.

ELECTRICAL ENGINEER, P.Eng., Ont. Jr.E.I.C., with post graduate business administration training. 7 years sales and manufacturing experience at responsible level. Presently in sales administration, functions including formulation of sales policies, supervision of sales, sales promotion, sales forecasting, etc. Seeks responsible position in sales administration (industrial Market). File No. 2975-W.

MECHANICAL ENGINEER, B.Sc., Queen's, P.Eng., Ontario, married, 2 children, with 9 years experience; two years design and maintenance in modern newsprint mill, five years design of steam power generating plants with large consulting company, two years and currently utilities engineer with design engineering and construction company. Familiar with equipment and operation of 900 lbs. 750F power plants; stoker, pulverized fuel, and gas firing, coal and ash handling, water pumping and treatment for steam and process use, large air compressors, instrumentation and control, code piping, chemical plant services, heating and ventilating. Recently completed start-up of 4½ million dollar project in Western Canada. Seeking responsible position with industry, government agency, or consulting group. File No. 2990-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng. (Ont.) B.Sc. (Queen's) 1941, age 38, 13 years experience in manufacturing methods, process engineering, production engineering of high precision components, plant layout and engineering, desires position as plant engineer or mechanical superintendent; available immediately. File No. 3272-W.

MECHANICAL ENGINEER (M.E.I.C.), age 36, married. Experience: 2 years designer draftsman, 3 years industrial engineering, methods and production control. Trained in time and motion study and certificate as MTM practitioner. Desires responsible position in industrial engineering methods or plant management. File No. 3900-W.

MECHANICAL AND ELECTRICAL ENGINEER, Jr.E.I.C., graduated 1949 from Vienna University; married, 2 children; 3½ years in Canada, perfectly bilingual; experience covers: heating, air conditioning, drying and piping with consulting engineer and contractor; as junior engineer, field supervisor and project engineer; equipment, instrumentation, process and service piping for complex chemical plant, as draftsman and mechanical engineer; layout, detailed planning, supervising the erection of complete electrical system and equipment for large cement plant, as chief of electrical section; good organizational capabilities and experience in dealing with management, staff, suppliers and contractors; seeks responsible and challenging position in industry, plant or with consulting engineer; first class references. File No. 3945-W.

ELECTRICAL ENGINEER, Jr.E.I.C., U. of Manitoba, 1950, 29 years of age. Test Course, 2½ years design of mercury arc rectifier controls, 5 months automotive plant engineering, 9 months supervisory capacity in hydro electric generation. Will consider any location. File No. 4021-W.

CIVIL ENGINEER, P.Eng., M.E.I.C., desires ½ day employment in Toronto. 19 years experience in architectural, structural and town planning designs. File No. 4182-W.

MECHANICAL ENGINEER, B.Sc., P.Eng., Ont., single, with 8 years experience; 5 years plant engineering, maintenance and design specializing in application of instrumentation, agitation and related chemical plant services and equipment; 2 years project engineer with large chemical company, design and installation stainless steel plant equipment; past year with refinery organization, piping and pressure vessel design. Seek scope for initiative in project design, engineering sales or field work utilizing experience. Travel not objectionable, prefer Ontario, Montreal, or U.S.A. File No. 4248-W.

ELECTRICAL ENGINEER, B.Eng. (Hons.), M.A.Sc., M.E.I.C., P.Eng., age 36, married and presently completing ninth year as a professor of electrical engineering. Has taught many different courses on senior and graduate levels with emphasis on power. Broad general experience in construction, public utility engineering and as a naval officer. Has done considerable consulting work of a general nature. Seeks appointment which should offer a broad challenge, be conducive to personal growth and in keeping with background preferred. File No. 4402-W.

STRUCTURAL ENGINEER, 36, married, M.E.I.C., P.Eng., B.Sc. Eng., A.M.I.C.S., A.M.I. Struct. E. with extensive experience in design of reinforced concrete, structural steel, and wood structures (schools, factories, hospitals, industrial containers, foundations, office buildings, etc.), seeks responsible position in Toronto area. Preferably junior partnership or associateship. File No. 4041-W.

METALLURGICAL ENGINEER, Jr.E.I.C., P.Eng., B.Sc. (Chemistry), B.E. Nova Scotia Technical College 1952. Married, age 32. Experience includes one year as chemist in control laboratory of a non-ferrous smelter; one year as assistant welding engineer with a steel fabricator, and approximately one year with a research firm on ore preparation and reduction of ores. Desires technical position with firm located in Ontario or Quebec. File No. 4128-W.

CIVIL ENGINEER, M.A.Sc., Jr.E.I.C., P.Eng. (Man.), graduate 1952. Age 26, single. Two years experience on heavy building construction. Resident engineer on construction of water treatment and sewage disposal plants complete with distribution systems. Related summer experience with water works and private disposal systems. Would like to hear from employer in Canada or U.S.A. who requires a capable worker. References available from all previous employers. Will be available early summer. File No. 4415-W.

CIVIL ENGINEER, M.Sc., 1931, Technical University of Warsaw, A.M.I. San.E., M.E.I.C., P.Eng. (Man. & Sask.), war veteran, age 49, over 15 years experience in hydraulic works, water supply and sewerage, formerly residing in Great Britain and one and one half years in Canada. At present employed as city assistant engineer. Seeks position with a municipality or firm which offers a good opportunity for advancement. Location secondary, available in one month's notice. File No. 4443-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng., 1951 graduate, N.S.T.C. Experience in plant engineering (one year) and design (three years). Desires position with increased responsibility. File No. 4559-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng., ten years experience of mechanical and chemical plant design, installation and maintenance. Presently holding management position heading design team on specialized machinery and equipment. Seeks position where initiative, responsibility and organizing ability are used to the fullest. Would consider the commercial aspect of engineering. File No. 4568-W.

YOUNG ELECTRICAL ENGINEER, Jr.E.I.C., invites offers of challenging position requiring initiative and responsibility and providing incentive and opportunity. Graduated from University of Manitoba in 1950, age 27, married with one child, Jr.E.I.C. Has been 4½ years with electric utility and has gained experience in maintenance of electrical equipment, operating problems, estimating, and supervision. More details available on request. Presently employed. File No. 4603-W.

MECHANICAL ENGINEER, M.E.I.C., age 34, married. 10 years experience in drafting, piping layouts, estimating, inspection and plant maintenance in petroleum refinery. Desires position in industrial plant or refinery. Location Alberta or British Columbia interior. Available on one month's notice. File No. 4637-W.

CIVIL ENGINEER, P.E., M.E.I.C. Thirty years experience includes natural gas development, gas transmission, distribution design service on customers premises, rehydration, oil fogging, reconditioning. Desires position in industry or consultant. File No. 4638-W.

MECHANICAL ENGINEER, B.E., Saskatchewan 1953, P.Eng. (Ont.), S.E.I.C., Member S.A.E., age 23, married. 1½ years experience in automotive industry including one year training plan, purchasing and material handling. Present duties consist of liaison between management and engineering design sections, planning of new parts depots, floor layouts, equipment purchases and coordination of new construction projects giving considerable administrative experience. Desires position in Western Canada with opportunity for advancement. File No. 4639-W.

CONSTRUCTION EXECUTIVE available early spring. Presently in senior management capacity. Proven record of high profits; able to initiate, organize and administer large volume of business. Mature judgment in financial matters and high level negotiations. Extensive experience in estimating, tendering, costing, and project supervision. Author of technical articles. Age 45, married, Professional Engineer (Ontario), M.E.I.C. Would join construction company or allied industry as senior executive investing some capital if required. File No. 4640-W.

ELECTRICAL ENGINEER, U.N.B., 1953; S.E.I.C.; Athlone Fellow 1953; age 23, married. Presently in final year of graduate apprenticeship with the British Thomson-Houston Company, Rugby, England; apprenticeship concentrated on light and heavy rotating machinery, control gear, and electronic control equipment. Additional experience (including summer work) in switchgear, protective relaying, transformer testing, power transmission problems, and drafting; senior thesis "Symmetrical Component Analysis". Seeks position concerning power system engineering in any part of Canada or abroad. Available for work in October, 1955. File No. 4641-W.

CHEMICAL ENGINEER, B.Sc. (Ch.E.), M.E.I.C., M.A.I.Ch.E., 42, single, Canadian and U.S. resident; equal knowledge of English and German; experience: 12 years consisting of research and development in fuel technology, and process and project engineer in petroleum refinery engineering. Desires overseas assignment in petroleum refinery process or project engineering. Available immediately. File No. 4642-W.

CIVIL ENGINEER, Jr.E.I.C., B.Sc. (C.E.), Sask. 1953, age 25, single, presently employed in design, estimating and supervising of construction of irrigation projects, seeks new position. Preference for city engineering department or consulting firm engaged in municipal work. Preferable, but not necessarily, Western Canada. File No. 4643-W.

ENGINEERING AND BUSINESS MANAGEMENT background. Jr.E.I.C., Queen's, civil, 1952. Will graduate from Harvard Graduate Business School in June 1955 after training in labour relations, control, finance, production and marketing. Work experience includes construction engineering, surveying and mapping work and one summer preparing reports on capital expenditures for a large utility. Job objective is responsible work in the producing department of a manufacturing, construction, mining or transportation organization. Size of company is not paramount. File No. 4644-W.

STRUCTURAL AND CIVIL ENGINEER, Jr.E.I.C., P.Eng., European University graduate in structural engineering (1947), age 34, family, 6 years Canadian experience mainly in field work and supervision on industrial and residential construction projects, also as office engineer and designer. Seeks permanent position in line with education and experience with a well established firm in Southern Ontario, preferably Toronto. Willing to accept the position of a Junior designer where hard work and ability would lead to greater responsibility and advancement. Available on short notice. References. File No. 4645-W.

MECHANICAL ENGINEER, B.Sc. (M.E.) honours, Manitoba 1949, P.Eng., Jr.E.I.C., age 28, experience heating and ventilation, mechanical power transmission, power plant, design, drafting and construction supervision. Desires position design and development, plant engineering or consulting. Hard worker, conscientious. Preferably Niagara or Southern Ontario. File No. 4646-W.

ELECTRICAL ENGINEER, B.Sc. (Eng.) London University, England 1950. Single, age 36. Experienced public utility also applications and development of protective relays with well known British manufacturers. Seeks position anywhere in Canada, public utility preferred. File No. 4647-W.

METALLURGICAL ENGINEER, Master of Science degree in Met. Engr., B.Sc. (Hons.) in chemistry, P.Eng., Jr.E.I.C., Diploma of the National Foundry College, England in Foundry Management and Technology. Applied experience in almost every phase of metallurgy—heat treatment; foundry work—non ferrous, cast iron; steel melting and rolling; machining; writing standards, etc. Will take full charge of all assignments. Seeks position either with a consulting firm, or as a group leader or supervisor in the manufacturing development and engineering field. Location and size of company not important. File No. 4648-W.

CIVIL ENGINEER, Jr.E.I.C., registered in British Columbia, would take responsible position in construction or development work. Past experience includes: design and supervision of permafrost installation, project engineer or heavy construction, construction methods and estimating, town engineering, as well as several years practical construction experience. Would prefer position in western provinces, very interested in permafrost work. File No. 4649-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), B.Sc., M.E. 1953, Canadian, age 24, married, experience in sales, manufacturing methods and design. Desires work of definite mechanical nature, either engineering and/or sales. Toronto area preferred with moderate travel acceptable. File No. 4650-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C., veteran, 2½ years R.C.A.F., B.Eng., mechanical engineering, Saskatchewan 1949. Age 32, married, 1 child. Administrative experience obtained as follows: 2 years as a field engineer in charge of parties on water storage and land surveys and related drilling operations; 1 year as an assistant to the heads in both the wood preparing and mechanical departments of a large paper mill; and in a large chemical plant 1 year as a development engineer and 2 years of supervising in production departments. Desires a responsible challenging position with good future opportunities. Prefer Ontario or S.W. Quebec. File No. 4653-W.

INDUSTRIAL ENGINEER, Jr.E.I.C., B.A.Sc. mechanical engineering 1950, Toronto. Single, age 26. Three years experience with management consultant—plant layout, material handling, production planning, inventory control, preventive maintenance, and job evaluation. Position wanted with progressive company, giving responsibility and opportunity for advancement. Available immediately to locate anywhere in Canada. Resume and references will be furnished upon request. File No. 4654-W.

ELECTRICAL COMMUNICATION ENGINEER, A.M.I.E.E. (England), graduate with diploma Leningrad University (Russia). Desires employment on maintenance, installation or development of radio, telephone or telegraph equipment. Ukrainian born, British subject. Recently arrived in Canada from England. Experience: 2 years in the Trunk Telephone Exchange in Leningrad (Russia), 2 years engineer in Telephunken Laboratories in Berlin (Germany), and main work 18 years in research and development of electronic communication equipment in the G.E.C. Laboratories (England). Detailed resume on request. File No. 4655-W.

CIVIL ENGINEER, P.Eng. (Que.), Jr.E.I.C., graduate N.S.T.C. 1952, age 25, married with one child, desires position to gain municipal engineering or town planning experience. 2½ years experience resident engineer highway construction for provincial government. Available on reasonable notice to employer. File No. 4656-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng., B.Sc. (M.E.) 1953. 2½ years experience as maintenance engineer in pulp and paper industry. Married with 2 children. Desires position in Manitoba. Available on reasonable notice. File No. 4657-W.

INDUSTRIAL AND CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.), B.A.Sc. Toronto. Age 37. Experience in plant engineering; 3½ years in Canada, 5 years in Europe. Experience covers equipment layout, design of mechanical handling, pressure vessels, tanks, heating, ventilation, industrial wastes, piping, steel and reinforced concrete structures, quarries; surveying; development of new equipment and structures and maintenance engineering. Desires position with manufacturing company or consulting engineers in Toronto area. Available on reasonable notice. File No. 4658-W.

MECHANICAL ENGINEER (Scot), A.M.I. Mech.E., aged 30, arriving in Canada (Toronto) mid-April, 1955, would welcome enquiries from prospective employers with regard to responsible position in design, development, project or plant maintenance work, etc. Available for interview immediately upon arrival. Excellent references. 14 years experience including 5 years apprenticeship with 3 years workshops training. Experience includes design work with regard to water tube boilers and refrigeration plant and design, project handling, estimation, construction supervision, etc., with regard to special purpose apparatus and machinery associated with explosives manufacture. File No. 4659-W.

MECHANICAL ENGINEER, Jr.E.I.C., '51 graduate, N.S.T.C., B.Sc., B.E., married, no children. 3½ years with Canadian Electrical manufacturer, completed graduate training course, 2 years experience on development, assembly and testing of 7.5 to 230 KV. circuit breakers, plant layout, tooling and general machine shop practice. Desire responsible position with opportunity for advancement. File No. 4661-W.

YOUNG ENGINEER, 1953 graduate, Ecole Polytechnique, presently completing M.Sc. degree in Industrial management at the School of Industrial Management, Massachusetts Institute of Technology. Good academic and extra-curricular background. Would consider employment with a medium sized manufacturing concern in the areas of production, marketing or industrial engineering; with a management consulting firm; with a municipality. Thoroughly bilingual. Province of Quebec preferred. File No. 4662-W.

MECHANICAL ENGINEER, P.Eng., M.E.I.C., graduate institution of mechanical engineers of Great Britain. Age 36, married. 5 years apprentice British Railways Locomotive Works. 6 years engineers office Royal Airforce (squadron leader), 8 years experience Canadian Aluminum Industry in fields of mechanical engineering and production in smelter and fabrication plants. Past 3½ years production engineer in major aluminum forge plant. Seeks position of responsibility with opportunity for advancement. Preferably in Canada, but will consider reasonable location overseas. Apply to File No. 4663-W.

CHEMICAL ENGINEER, P.Eng. (Ontario), Jr.E.I.C., M.A.Sc. (Toronto), 3½ years experience in research and development in plastics, pulp and paper, fluorescent materials, also in laboratory testing and analyses. Working knowledge of biochemistry. Desires research and (or) development position in Toronto area. Available on 2 weeks notice to present employer. File No. 4664-W.

ELECTRICAL ENGINEER, graduate 1949 Melbourne University, Australia. B.E.E., Assoc. A.I.E.E., single, age 26 years, five years electrical engineering experience, graduate G.E. test course at present in U.S., desires employment commencing March preferably in Toronto or Montreal. 1½ years design experience with Dept. of Civil Aviation and 2½ years experience as sales engineer with Australian General Electric company handling motor and control gear sales and switchgear and transformer sales. Desires employment as sales engineer. File No. 4665-W.

P.ENG., Jr.E.I.C., age 30, estimating and design, 2 years; instrument man on various types of field surveys, 2 years; commercial college, 1 year. File No. 4666-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C. Married, 26 years old, bilingual. Supervisory experience in inspection. Quality control and methods work. Supervision and responsibility desired. Prefer Montreal area, will consider Eastern Canada. File No. 4668-W.

MECHANICAL ENGINEER, S.E.I.C., Polytechnique 1955, graduating, married, bilingual. Equivalent of 2 to 3 years experience in plumbing and heating line as an apprentice, service man, design, estimate and surveillance of complete plumbing and heating system for a contractor. Desires a position in the heating industry. Also interested in sales. Will consider any offer of situation connected with the heating line preferably in Montreal. File No. 4669-W.

CIVIL ENGINEER, Jr.E.I.C., graduated 1949. Age 27. Married, 1 child. Two last years with Montreal contractor as job engineer on two large projects including R.C. bridge construction, earthworks, roadwork and tunnelling. Previously employed in Australia by large pulp and paper company in responsible position on civil engineering design and supervision. Also experienced in open cut mining and large scale earthmoving operations. Particularly interested in design and use of precast and prestressed concrete. Desires responsible position with contractor or consultant in Toronto or Western province. File No. 4670-W.

INDUSTRIAL ENGINEER (S.E.I.C.), available after graduation from Wayne University, Detroit, Michigan in June 1955 with B.S.I.E. degree. Theoretic knowledge of motion and time study, industrial organization and management, plant layout, automation, materials handling, statistical quality control, and production control. Experience in solving production problems using digital electronic computors and linear programming. Summer employment including surveying, asphalt paving, machinery maintenance and moving assistant to field engineer on warehouse construction, general office work and plant engineering with a large company. Interested in permanent position with chance for advancement in Industrial engineering field, preferably in Western Ontario but not absolutely necessary. Available July 1, 1955. References. File No. 4676-W.

ELECTRICAL ENGINEER, S.E.I.C., U.N.B., 1953, age 32, married, at present on test course with large electrical industry, desires position offering opportunity for further development, with small or medium sized company. Training in several departments, particularly interested in household appliances, TV and service departments. File No. 4677-W.

CHEMICAL ENGINEER, McGill 1945, age 31, single with 5 years experience in pulp and paper; quality control, production and development. Desires responsible position in chemical or allied field in Montreal area. Available immediately. File No. 4681-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.) B.A.Sc. Toronto 1949, 31 years old, married, six years experience mechanical and structural design of industrial buildings, materials handling plateworks, piping, heating and ventilation. Desires permanent position with responsibility and opportunity for advancement. Available on one month's notice to present employer. File No. 4683-W.

CIVIL ENGINEER, S.E.I.C., S.I.C.E., B.Sc. (Hons.) Leeds University 1954. Age 22½, married. Experience in centrifugal pump design, road construction and design, estimating. Has done soil mechanics lab. work and prestressed concrete design. Desires position in S.W. Ontario in soil mechanics and structural design with outdoor work. At present employed in Toronto. Available on 2 weeks notice. File No. 4686-W.

CIVIL ENGINEER, M.E.I.C., Sask. '36, is seeking field training on large construction projects. Age 41, married, three children, good health. 8½ years with R.C.A.F.; 7½ years with a prairie construction company specializing in commercial and institutional buildings; 3 years with Central Mortgage and Housing Corporation. Available immediately. Training and employment summary with the Institute. Past experience mainly office and administrative. File No. 4678-W.

METALLURGICAL ENGINEER, B.Eng. (1950) M.Sc. (1951), Jr.E.I.C. Age 28, married, two children. Experience: research work in melting and testing titanium alloys; production, heat treating and testing of steel, plant engineering. Presently supervisor of metallography, physical testing, experimental heat treatment and metallurgical investigations in the laboratory of a large company. Fluently bilingual. Desires work in metal industry, production or research, ferrous or non-ferrous. Will accept position anywhere in Canada or U.S.A. File No. 4679-W.

CIVIL ENGINEER, M.Sc., single, lectured 4 years at University. Experience, highway construction, surveying, soil analysis, municipal engineering, 4½ years as project engineer. Defence construction which included general engineering, attending site and engineers meetings and negotiations with clients. Desires responsible position with architects or consulting engineers. Location Southern or Western Ontario. File No. 4680-W.

MECHANICAL ENGINEER, 1953 Manitoba graduate, Jr.E.I.C., single, returning to Canada in December from two years works training on Athlone Fellowship with British turbine manufacturer. Desires to apply for design or manufacturing position, preferably related to power generation industry. Location Manitoba, Ontario or Quebec Provinces. File No. 4687-W.

CIVIL ENGINEER, P.Eng. (Man.), M.E.I.C., Jr.A.S.C.E. Single, age 27. Graduate U. of M. 1951. Two years experience as resident engineer and field engineer on defence construction projects. One year as structural steel and miscellaneous iron estimator. Presently employed as town engineer in a community with a population of 22,000. Desires a position with a construction or consulting firm. Location immaterial. Available on one month's notice to present employer. File No. 4688-W.

Available June 1st 1955

SEVENTEEN CANADIAN ENGINEERS

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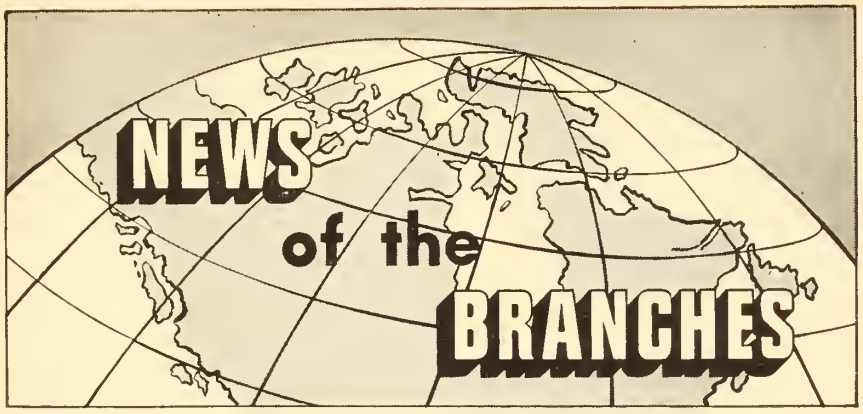

Activities of the Forty-seven Branches of the Institute and abstracts of papers presented at their meetings

Belleville

J. A. Grant, M.E.I.C.
Secretary-Treasurer

Engineering Standards

The Belleville Branch held its fourth meeting of the season on January 10 at the Masonic Temple with 14 members and guests present.

The chairman, Mr. Drysdale, opened the meeting and announced the plan for the President's Night which takes place on February 21. The speaker, H. P. Dial, was introduced by Mr. Lusk.

Mr. Dial spoke on Engineering Standards as set up at Du Pont of Canada and the formal talk was followed by a question period which indicated considerable interest in the subject.

Border Cities

P. N. Brown, Jr.E.I.C.
Secretary-Treasurer

W. D. Donnelly, M.E.I.C.
Branch News Editor

Hammering Improves Grain

Engineers of the Border Cities Branch at their November 18 meeting at Chuck's Grill learned that hammering of hot metal improves the grain structure and makes the metal strong and tough. Modern practice has advanced a long way from the technique of the old-time village blacksmith but the basic ideas are the same.

Ordinary carbon steel is fast being replaced by special alloy steels which stand up better to the speed of modern civilization. The Dominion Forge and Stamping Company of Windsor has a special laboratory to check the physical and chemical properties of the steels used in forgings.

The blacksmith's hammer has been replaced by huge hammers raised by electricity; with air and steam power used to increase the force of gravity. The anvil has given way to special dies which form the hot metal to the shape required with a few hard blows of the hammer. Heat treating furnaces with special controls have replaced the forge of the blacksmith and assure that the metal is at the correct forging temperature. Scale is removed by pickling in acid or by shot-blasting.

The old-time skill of the blacksmith still lives in the forge operators who exercise great care in forming blocks of steel into intricate forgings for automobiles and jet engine parts.

A film entitled "Forging in Closed Dies" showed a modern forge shop in operation. A lively discussion followed with a panel of four executives of the Dominion Forge and Stamping Company answering questions.

Brockville

M. H. D. Broadbent, M.E.I.C.
Secretary-Treasurer

G. M. Woods, M.E.I.C.
Branch News Editor

Psychology in Industry

On Thursday evening, January 6 at Phillips Electrical Company 50 engineers and the personnel managers of the Brockville Branch heard Dr. G. M. Mahoney speak on "Psychology Holds a Place in Industry". A graduate of McGill University, Dr. Mahoney is a specialist in factors relating to employee morale and productivity, and managerial organization.

"Modern psychology, both as a science and as an art in practice, has a place alongside other applied sciences in assisting in the solution of the complex problems of industry today," stated Dr. Mahoney of Montreal.

"Starting with scientific methods of selection and placement of personnel, the psychologist can provide unique help to personnel officers and management in the training and development of managers. The psychologist can solve the personal difficulties and conflicts that spring from the strains and tensions of modern production methods," he said.

During his talk Dr. Mahoney outlined the requirements or training necessary for a person to become a plant psychologist. Among these is a five year internship in the field where considerable experience can be derived by dealing with industrial problems and personnel. The speaker illustrated his talk with many of his experiences in handling industrial psychological problems and showed how the psychologist can make better use of the employee who does not necessarily meet the standards required by the company for which he works but still possesses the potential ability.

Dr. Mahoney was introduced by G. M. Woods and thanked on behalf of the Branch by chairman, F. F. Walsh.

After an interesting discussion, a buffet luncheon was held in the cafeteria.

Central British Columbia

H. D. DeBeck, Jr.E.I.C.
Secretary-Treasurer

General Meeting in Vernon

A general meeting was held at the Allison Hotel in Vernon on February 11 with 22 in attendance. Vice-Chairman A. F. Joplin was in the chair.

Following the refreshments and dinner a business meeting took place. Lists of committee appointments and proposed meeting dates for 1955 were read, and the chairman summarized the report of the Student Guidance Committee as presented earlier at the executive meeting. It was agreed that the Branch executive approach the B.C. Engineering Society Branch to determine the factors involved in creating a single executive for both bodies.

Cornwall

L. H. Snelgrove, M.E.I.C.
Secretary-Treasurer

W. Rothwell, M.E.I.C.
Branch News Editor

On Wednesday, January 12 1955, the monthly meeting of the Cornwall Branch was held at the Cornwall Golf and Country Club. R. L. Blackett acted as chairman for this meeting in the absence of Jack Morris, Branch chairman, who was away in England on a business trip.

Branch Discussion

A formal discussion had been arranged for the evening with the object of obtaining the views of members as to the type of meetings for 1955 that would have the widest appeal. A. A. B. McMath, vice-chairman of the program committee led the discussion and outlined a tentative program produced by the program committee. This was debated at some length and many interesting suggestions were offered by those present. It was generally agreed that meetings should be held on different week days each month rather than on one fixed day of the week. It was also decided to have one supper meeting and one luncheon meeting during the course of the season. A wish was expressed by G. B. Stidwell that one meeting should be a member's night at which the speaker or speakers would be members of the Branch.

After the discussion refreshments were served. These were followed by the showing of a film on the quest and drilling for oil.

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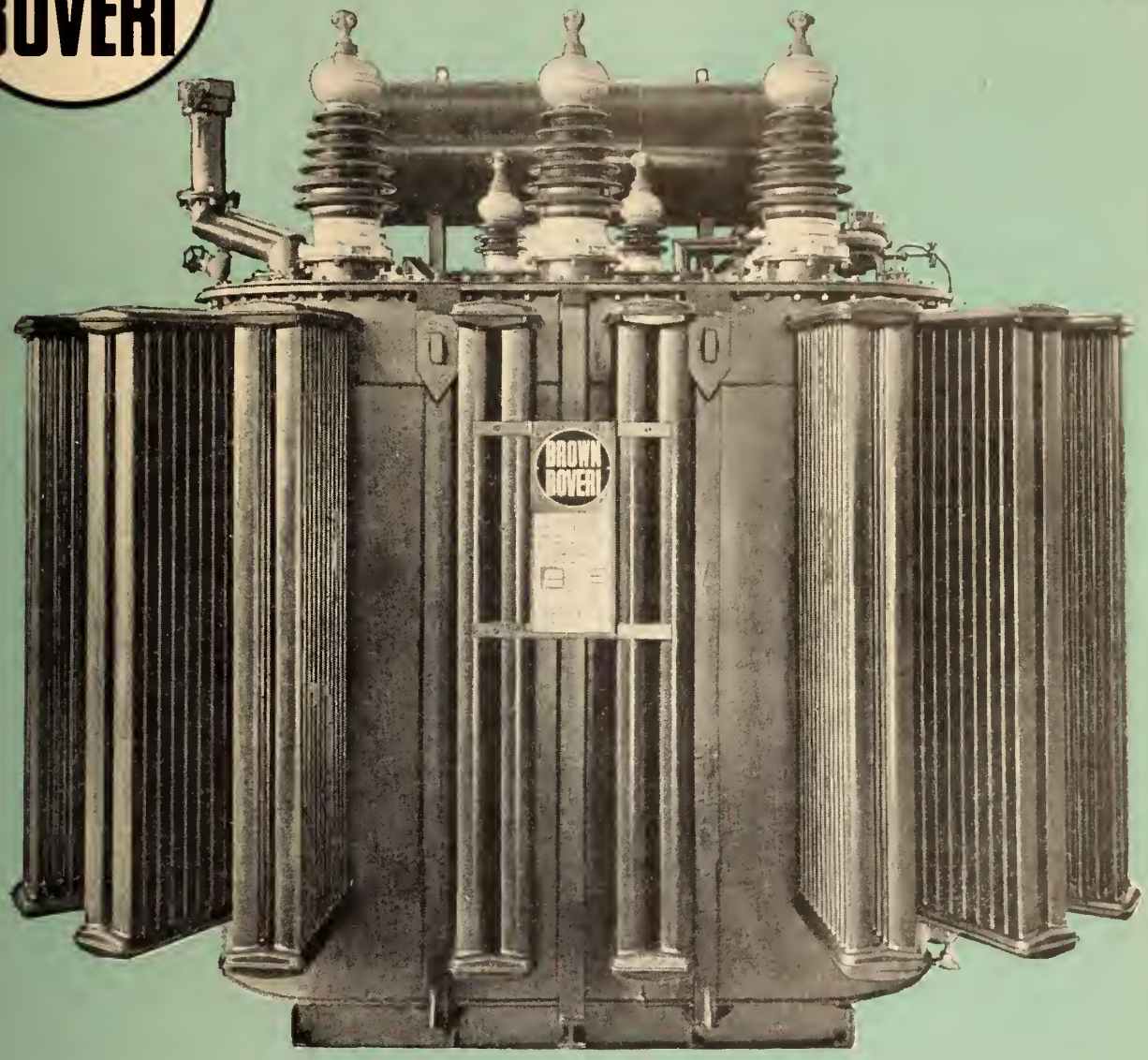

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Edmonton

R. B. Kerr, jr.e.i.c.,
Secretary-Treasurer
P. H. Buckland, m.e.i.c.,
Branch News Editor

Presidential Visit

On the evening of Thursday, November 25, 1954, the Edmonton Branch of the Engineering Institute held its second dinner meeting of the season in the main ballroom of the MacDonald Hotel. The honoured guests for the evening were the E.I.C. president, Dr. D. M. Stephens and E.I.C. general secretary, Dr. L. Austin Wright.

The guests were welcomed to Edmonton by the acting mayor, Alderman C. A. Roy. Mr. Roy expressed the wish that the annual E.I.C. convention would choose Edmonton as its site in the very near future.

Dr. Stephens was introduced by the Edmonton Branch chairman, Mr. Keith Cumming.

Canada's Growth

Dr. Stephens gave an outline of Canada's growth. He stressed how Canada has been broadening out both geographically and economically in the past few decades. Before the First World War Canada's economy stretched in a narrow ribbon approximately 200 miles wide from coast to coast. More use is now being made of the country's great north land. Most of this development has been in the form of mining and major construction projects in which engineers have played a very important part. Further Canadian development would require more and more engineers.

Dr. Stephens expressed concern over the fact that although the need for engineers in Canada was ever increasing, the present number of engineers in training was not encouraging. Approximately 1,200 engineers graduate each year in Canada as compared with 29,000 per year in the United States and 39,000 per year in Russia. Canadian graduates numbered only four per cent of their American counterparts; whereas they should number at least 10 per cent based on the relative populations of the two countries. Canada should be graduating more than twice as many engineers as it is now doing.

Dr. Stephens suggested that one way of encouraging more engineering students would be to relax rigid mathematics standards required for entrance to engineering schools. This would open up a place for students who would have contributions to make in fields other than engineering design.

Dr. Shephens was thanked by Fred Siebert of the Edmonton Branch. After Dr. Stephens' speech, the E.I.C. prize for the outstanding student about to enter fourth year engineering at the University of Alberta was presented to Gary Clark Bliet.

Councillor Norman J. Allison then introduced the E.I.C. general secretary, Dr. L. Austin Wright. Dr. Wright brought up the question of confederation between the E.I.C. and provincial engineering associations. He mentioned that the problem is being studied but stressed that there are many problems to overcome and patience will be required by all concerned if a successful confederation is to result.

Dr. Wright was thanked by Mr. E. K. Cumming.

University Tour, December 8

On the evening of December 8, 1954, the engineering faculty of the University of Alberta conducted a tour through its new engineering building for the benefit of the Edmonton Branch. The meeting consisted of a series of eight formal talks and demonstrations by members of the university staff, as well as an informal tour of the building.

The first presentation was in connection with oil well drilling. Professor J. Gregg gave a talk on the principles involved in crude oil well logging, and a description of the drilling of the demonstration oil well located on the campus of the university was given by P. Dranchuk.

The second subject, lightweight concrete, was covered by Professor G. Ford. Professor T. Blench took up the third subject, hydraulic models and their uses. "The University in a Technological Society," was discussed by Professor L. Gads, and Dr. D. Quon gave a fifth talk on natural gas research.

Dr. G. W. Govier spoke on the viscosity of crude oil, illustrating the use of a new type of viscosimeter now under development at the university. This unit will be used mainly for viscosity determinations of crude oils, and it was demonstrated by R. A. Ritter. Two more topics were covered, namely, prestressed concrete and frost action on soils and the speakers were Professor R. N. McManus and Dean R. M. Hardy, respectively.

Most of the laboratories in the new engineering building were opened for inspection. In general, the building and equipment, as presented, indicated an engineering faculty which was both progressive in its methods and well advanced in its teachings.

J. J. Carey Speaks on Steel Problems

At the meeting of January 12, 1955, J. J. Carey, gave a talk entitled "A Metallurgical View of Steel Problems." Mr. Carey was introduced by L. Jehu, as supervisor of metallurgical service for the Steel Company of Canada Limited.

Mr. Carey dealt principally with the reasons for failures in steel which has not been stressed beyond its normal limit. He described the three main types of steel, distinguished mainly by the way they solidify on casting.

Rim steel is low carbon steel the outside of which is relatively pure. This steel is used where the surface qualities are important; such as, for wire and sheet steel. This type of steel has the disadvantage of having considerable variation in its physical properties.

Semi-killed steel has fewer impurities than rim steel. This steel is used in structural members particularly.

Special steels are fully deoxidized steels and cover a wide variety which have special qualities.

Mr. Carey then covered the main defects found in steel. He stressed the importance of determining the real cause of the defect. Often these defects are not so much the fault of the material as of the process used to fabricate the product. Of the various defects found in steel products, the following are due to faulty material rather than fabrication of the product. Laminations which would cause the steel to fall into two pieces with the slightest application of pressure, are caused while the steel is being hot rolled. This is a steel production problem which cannot be economically eliminated. Surface defects in the steel are usually due to splashing during the molding operation or thermal cracks caused by reheating between successive rolling operations. The various types of steel can at times get mixed up. In addition, non-metallic substances can get mixed with the steel. All steels have directionality in respect to their tensile strength. Thus, if steel is drawn in the wrong direction, it will fail prematurely.

(Continued on Page 343)

Edmonton Life Members

At the meeting of January 12, life memberships were presented to three very popular Edmonton engineers. All three had been active in Institute affairs for over thirty-five years. Left to right are E. K. Cumming, Branch chairman, who made the presentations, H. L. Roblin, district engineer for the C.N.R.; Fred V. Seibert, consulting engineer, and J. W. S. Chappelle, consulting engineer.

J. J. Carey

Mr. Carey showed a series of slides illustrating defects in the material and failures caused by poor fabrication methods.

Mr. Carey was thanked for the Edmonton Branch by E. K. Cumming.

Fredericton

IRA M. BEATTIE, M.E.I.C.,
Secretary-Treasurer

NOREEN E. DONAHOE, S.E.I.C.,
Branch News Editor

A. M. Doyle Guest Speaker

On January 17, 1954 a dinner meeting was enjoyed by the members of the Fredericton Branch and their guests at the Lord Beaverbrook Hotel.

A. M. Doyle, vice-president and general manager of Canadian General Electric, spoke to the group on the electrical industry of today.

Mr. Doyle gave a general picture of the electrical industry and discussed its far reaching effects on the average citizen in Canada. He first described the important part electricity plays in the production of ores and development of natural resources since four-fifths of the power produced in Canada is used in this manner. Then he described the many uses which the average person is aware of and which contribute to an improved standard of living. Finally he discussed the use of electricity on the farms and in the city from a more general point of view.

The very informative speech was enjoyed by all those present and C. C. Atkinson, president of the University of New Brunswick Engineering Society, thanked the speaker.

After Mr. Doyle's address, the group met informally and motion pictures were shown.

Halifax

PROF. K. F. MARGINSON, M.E.I.C.,
Secretary-Treasurer

F. H. TREMAIN, M.E.I.C.,
Branch News Editor

Supper Meeting in Lunenburg

The winter activities of the Halifax Branch began on October 20, 1954, at a supper meeting which was held at the Bluenose Lodge, Lunenburg, N.S. During the past few years it has been customary to hold one meeting outside the city limits for the benefit of the outside members. These meetings have proved very popular and this one was no exception, there being over 60 members present. The guest speaker was George C. Lawrence, director of chemistry and reactor research division, Atomic Energy of Canada, Limited, Chalk River. Mr. Lawrence's talk was very interesting and enjoyed by all.

Students Are Guests

The November meeting was held on the evening of November 22, 1954, at the auditorium of the Sea Gull Club in Halifax, N.S. The senior class of the Nova Scotia Technical College were guests of the Branch at this meeting. E. C. MacNearny, senior student and president of the Engineering Society at the college reported on the highlights of the students' activities of the last annual meeting held in Quebec City. The principal speaker of the evening was the field secretary, Dr. L. F. Grant, who, as always, gave a very interesting talk.

The annual meeting of the Branch was held at the Y.M.C.A. building on December 16, 1954, and was a supper meeting. The business of the meeting included the reading of the various reports and the installation of new officers for the coming year.

The report of the scrutineers was as follows:

Chairman, W. A. Devereaux; executive Halifax area, O. K. Smith, R. D. T. Wickwire and R. F. MacAlpine; executive outside Halifax, E. C. Parsons and J. J. Kinley.

A minute of silence was observed in memory of the following members who had died during the past year: H. P. Donkin, R. F. MacKinnon, G. F. Murphy, H. F. Lawrence and K. L. Dawson.

The highlight of the meeting was an open forum type discussion on Branch activities. This discussion covered many and varied subjects and it is hoped that several new suggestions can be fulfilled this coming year.

Hon. R. H. Winters Speaker

On January 27, 1955, the annual joint banquet of the Association of Professional Engineers of Nova Scotia and The Engineering Institute of Canada Halifax Branch was held at the Nova Scotian Hotel with over 300 members present. The guest speaker was the Honorable R. H. Winters, minister of public works. Musical entertainment during the evening was much enjoyed.

Hamilton

A. F. BARNARD, JR.E.I.C.
Secretary-Treasurer

ROSS R. PACKER, JR.E.I.C.,
Branch News Editor

Annual Dinner

After the annual dinner of the Hamilton Branch held in the Hamilton Golf and Country Club in Ancaster on January 20, 1955, the secretary-treasurer gave the financial report and the membership report which showed 465 members. This is the same as last year's report, except that a greater proportion of the members are Juniors instead of Students.

The following new Life Members were introduced to the Branch: E. D. W. Courtice, F. I. Ker, A. Love, W. L. McFaul, and J. B. Wilkinson.

Mr. Hedden of McMaster University spoke of bonds between his institution of research and the engineering profession.

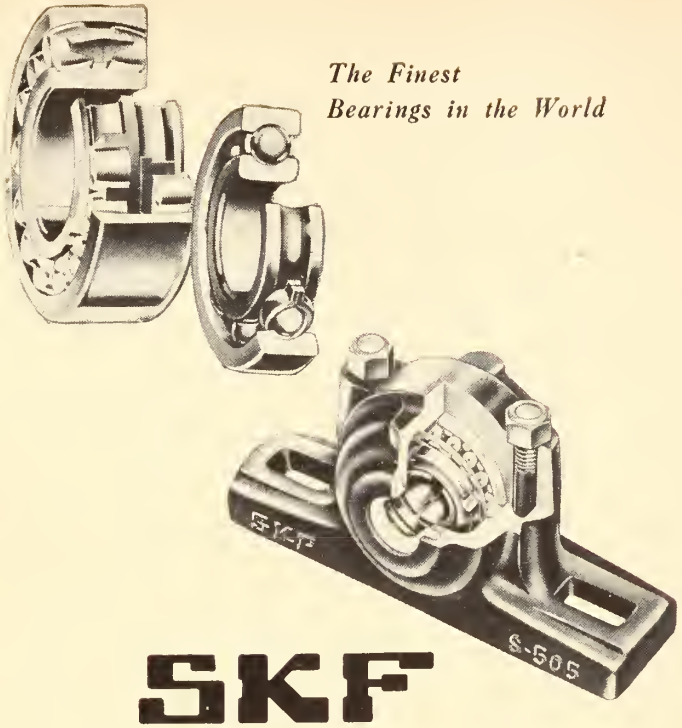
L. G. Crowford Speaker

The speaker, L. G. Crawford, chief engineer, western area of the Bell Telephone Company of Canada, was introduced by Mr. Woodhouse of the Bell Telephone in Hamilton. During his talk on "Engineering Miniaturization in Telephone Equipment", Mr. Crawford employed slides to assist the audience in visualizing the problems and in seeing their solutions. The first problem was the number of wires needed in large cities early in the century.

The miniaturization of component parts of every telephone circuit is very important as was realized when it was pointed out that there are 52 million telephones on this continent which may be interconnected.

The invention of the vacuum tube in 1911 and the development of the theory of modulation besides reducing the required space greatly increased the power and amplification of telephone circuits. There were other inventions such as coaxial cables consisting of an inner conductor with eight outer conductors capable of transmitting 1,800 simultaneous conversations. Although these contribute much, they presented another problem: the distance between

At the dinner meeting of the Fredericton Branch on January 17. Left to right: Dr. E. O. Turner, Reg. Tweeddale, A. M. Doyle, Prof. Howard MacFarlane.



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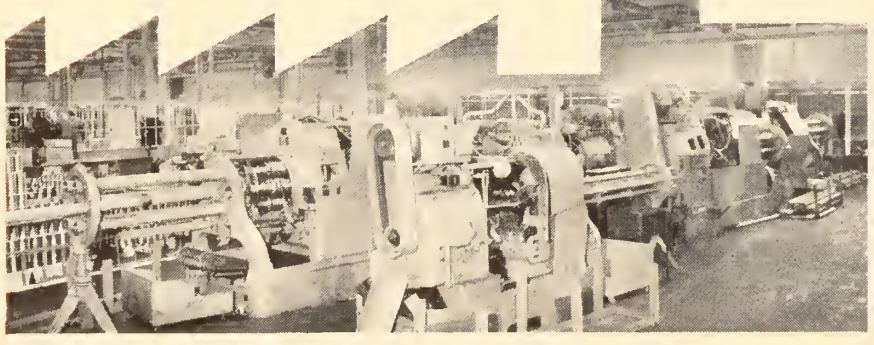

repeater stations had to be reduced to five miles.

The installation across the continent of equipment automatically routing long distance calls has enabled time to be reduced from 23 minutes to 13 seconds and has eliminated nine operators originally required during the 1920's for transcontinental calls. At present only residents of a New Jersey community dial their own long distance numbers—a spreading service by means of which already eleven million stations may be reached.

The advantages of transisters were shown by a miniature radio broadcasting station that the speaker had in his vest pocket. Mr. Crawford concluded by showing some of the newest electrical components of telephone circuits and prophesying some of the future developments in telephony.

Ted Hill thanked the speaker. The outgoing chairman, W. A. Wheten, reviewed the year and mentioned one of the problems for next year—that of federation between professional engineering groups.

After the incoming chairman, F. E. Milne, received the gavel of office, he introduced the 1955 executive: J. E. Kelly, vice-chairman; A. F. Barnard, secretary-treasurer; D. B. Annan, and R. N. Dobson, for two-year terms on the executive; I. M. Macdonald and J. A. Reid, for one-year terms; N. A. Eager, councillor; W. A. Wheten and N. A. Parry ex-officio; and N. Metcalf, Branch representative to the Nominating committee.

The meeting concluded after J. Kelly thanked the outgoing executive.

Ladies Auxiliary

Mrs. F. J. Veale
News Editor

Bursary Established

At the annual meeting of the Hamilton Branch Auxiliary, held at Fonthill, an annual bursary for an engineering student attending McMaster University was established, the student to be chosen from Hamilton and district on the basis of financial need and academic standing by the Prizes and Scholarship Committee of the university.

Encouraging reports were read by the secretary, treasurer, and convenors of the bridge, crafts, music, and service interest groups.

The election of officers for 1955 was handled by Mrs. F. J. Veale, Mrs. D. A. McCann and Mrs. A. Frame. The new executive is as follows: honorary life member, Mrs. L. C. Sentance; honorary president, Mrs. Frank Milne; past-president, Mrs. J. A. Tyerman; president, Mrs. J. S. R. Beck; vice-president, Mrs. J. R. S. Carruthers; recording secretary, Mrs. J. G. Mitchell; treasurer, Mrs. J. M. Skinner; corresponding secretary, Mrs. D. Friesen; program convenor, Mrs. J. M. Rasberry; social convenor, Mrs. J. J. Kelly; membership secretary, Mrs. W. H. Hendry; and telephone convenor, Mrs. G. S. Wilson.

A gift was presented to the retiring president, Mrs. J. A. Tyerman, by Mrs. J. B. Wilkinson.

The coffee hostesses were Mrs. J. M. Rasberry; Mrs. W. A. Reid; Mrs. C. C. Smith; and Mrs. H. E. Seeley.

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After a short business meeting of the Hamilton Branch Auxiliary chaired by Mrs. J. S. R. Beck, an auction sale was very ably handled by Mrs. Betty Hillgartner. The members had previously been asked to bring baked goods, preserves, household articles, clothing outgrown by their children, and any items which someone else might be happy to have.

The hostesses at the coffee hour were Mrs. J. B. Wilkinson; Mrs. A. P. Delaney; Mrs. R. G. Northrup; and Mrs. E. T. S. Bailey.

At the following meeting on February 25, the Auxiliary was privileged to entertain the wives of the national executive of the Engineering Institute who visited Hamilton. Mrs. J. N. Rasberry, program convenor, arranged the program which included a flower arrangement demonstration.

Kitchener

JOHN R. RUNGE, M.E.I.C.
Secretary-Treasurer

J. L. FAIR, M.E.I.C.
Branch News Editor

Fifth Anniversary Dinner

Many members and friends of the Kitchener Branch marked the fifth anniversary of its formation at a dinner meeting at the Granite Club on January 28. The head table guests included the chairmen of the Toronto and Hamilton branches, newly elected life member Frank Midgely of Galt, as well as the guest speaker and civic representatives of Kitchener and Galt.

Chairman J. A. Tod gave some brief farewell remarks, noting two items of particular interest: the election of M. A. Montgomery as a vice-president of the Institute and the election of Frank Midgely to Life Membership in the Institute. Mr. Midgely was presented with an unusual memento of the occasion and responded with some entertaining recollections from his career.

The incoming chairman, L. J. R Sanders presented J. A. Tod with the chairman's gavel in recognition of his contribution to the Branch and his transfer to a new field of work in Toronto.

The address of the evening was entitled "Atomic Power—A Review and Future Prospects" by W. A. Osbourne, president of Babcock-Wilcox and Goldie-McCulloch Limited of Galt. As Mr. Osbourne was unexpectedly prevented from attending, the address was read by R. A. Green, nuclear engineer of the same company. In dramatic terms Mr. Osbourne's paper sketched the exciting series of discoveries in atomic physics and the harried lives of the scientists that were the basis of the development and use of a nuclear weapon of a devastating force hardly dreamed of before that time.

Attention was drawn to the wartime inheritance of secrecy that still surrounds many of the details of the works involved in the release and utilization of the energy from fissionable material. Even as progress in science has been accelerated with free interchange of ideas and information, so also is it needful that this interchange be extended to bridge national barriers with confidence and understanding to harness nuclear energy for constructive ends.

Mr. Osbourne cited some of the estimates of the cost of building and operating atomic power plants and showed clearly that at the present time energy is available from other sources at lower cost. Reference was made to some of the urgent problems awaiting better solutions, such as structural materials, waste disposal, and protection of personnel.

A short discussion period followed in which Mr. Green answered questions and referred to the fact that Canadians have made substantial contributions in this field.

Lethbridge

R. D. HALL, JR.E.I.C.
Secretary-Treasury

PAUL HARDING, JR.E.I.C.
Branch News Editor

Ladies Night December 11

The Lethbridge Branch held a Ladies' Night December 11, which approximately 70 members and ladies attended. Refreshments and dinner were served in the Marquis Hotel.

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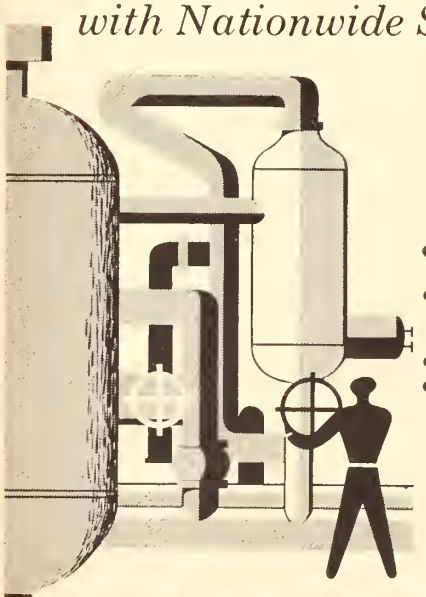

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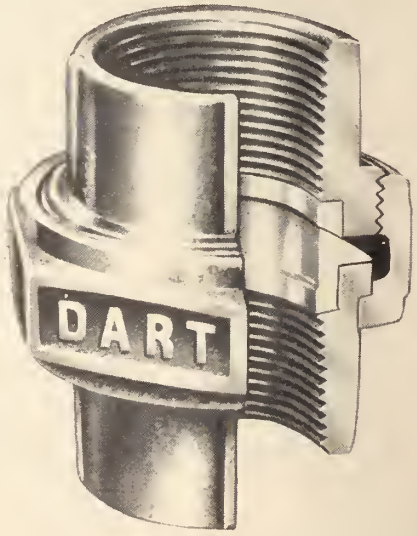

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Following dinner, George Brown led in the community singing, and Miss Joy Dalton and Mrs. Janet McLeod entertained with solo selections.

An excellent film "The Man With A Thousand Hands", loaned by the International Harvester Company was shown by Dick Beddington. The film covered the engineering and construction features of the Kitimat-Kemano-Nechako project of the Aluminum Company of Canada. This film was of special interest to the members since it followed the *Journal* issue which covered this project in detail.

On Saturday, January 15, 1955, the Lethbridge Branch of the Engineering Institute held its first meeting of the New Year at the El Rancho Banquet Hall. Piano and violin entertainment was given by Mr. and Mrs. George Brown. W. Kergan sang "The Hills of Home", and "The Lost Chord."

The speaker for the evening, J. Gilbreath, western district engineer of Holophane Limited, was introduced by R. MacKenzie. Speaking on the topic, "Light for Living", Mr. Gilbreath pointed out that we are extremely dependent upon artificial lighting from the time we are born and throughout life. The light that has raised our standard of living has been taken for granted until a power failure causes inconveniences in our homes and institutions, and on our highways.

It is often necessary to re-light buildings which may be many years old. The Holophane lenses gather light rays and throw them at various angles, or they may spread the light or just concentrate it. This control of light by prisms is 99 per cent efficient. The concentrated light required in operating rooms, the fluorescent light required in stores, offices, etc., the umbrella spread type of light required for streets, all require special types of glass and lenses.

Mr. Gilbreath also gave some interesting statistics on the efficiency of various types of lights. An ordinary lamp of 100 per cent illumination, has an illumination efficiency ranging from 11 per cent to 18 per cent; an ordinary lamp with radal wave reflector of 85 per cent illumination, has an efficiency ranging from 16 per cent to 18 per cent; a lamp with deep reflector of 14 per cent illumination has an efficiency ranging from 25 per cent to 30 per cent; while a lamp with prismatic globe 65 per cent illumination has an efficiency between 40 per cent and 55 per cent.

The addition of refractors allows an increase in the spacing of luminares. Mr. Gilbreath briefly discussed the B.C.D. rating or brightness, comfort, disability rating, and showed slides on the various effects of artificial lighting in buildings.

Mr. Gilbreath was thanked by C. E. Little.

Montreal

R. J. Harvey, M.E.I.C.,
Secretary-Treasurer

J. A. Paget, M.E.I.C.,
Publicity Chairman

Sir Adam Beck No. 2 Power Development

On November 30, 1954, the Civil Section was addressed by O. E. Johnston, M.E.I.C., project engineer during construction of the Sir Adam Beck development, and recently appointed assistant generation engineer for the Hydro Electric Power Commission of Ontario. The speaker was introduced by L. E. Mitchell, M.E.I.C.

With the aid of excellent slides, the speaker showed the various features of the project including the slot type intake structures, excavation and lining of two 5-mile tunnels of 51 ft. excavated diameter, and the construction of 2½ miles of canal in open cut. Except for a short length of lined trapezoidal section adjoining the tunnel outlets, the canal is an unlined rectangular section.

At one point in its length, the open cut canal crosses the power canal for No. 1 development at 45 degrees. The forebays of the two plants are also interconnected through an open channel adjoining the intake structures. Extensive use of model tests was made in determining the shapes and dimensions of the crossovers and shape of forebay No. 2. Mr. Johnston estimated that model tests on the latter shape effected a saving of half a million dollars in rock excavation.

Under the terms of the 1950 Niagara Treaty which permitted this development, the Commission was required to maintain a flow of 100,000 c.f.s. over the Falls during the daylight hours of the tourist season, but the flow could be reduced to 50,000 c.f.s. during the night

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and throughout the winter months. To take full advantage of the power potential, a storage reservoir is being constructed adjacent to the forebay and a pump-turbine plant will be built to raise the water to the reservoir. This will permit the installation of four additional units at the No. 2 station, utilizing the flow from the reservoir in periods when maximum flow is required over the Falls. The Commission is also constructing a control dam on the Niagara River below the No. 2 plant intakes to stabilize water levels and provide adequate regulation of flow over the Falls.

Mr. Johnston indicated that the ultimate capacity of the 16-unit plant will be 1,680,000 hp. The 6-unit pump-turbine plant will contribute an additional 236,000 hp. Estimated cost of the development is $350,000,000.

G. Hoganson, M.E.I.C., expressed the appreciation of the audience for this very interesting and informative talk.

A.G.T.

Atomic and Solar Batteries

At the meeting of the Electrical Section November 30 the guest speaker was Dr. Paul Rappaport.

At the present time a great deal of publicity is being given to production of atomic energy by the two processes of fission and fusion; fission in the case of heavy atoms such as uranium, and fusion in the case of light atoms as hydrogen. Dr. Rappaport reported on another method of obtaining "atomic energy", that is, by extracting energy directly from radioactive particles.

This method converts the energy of radioactive particles directly to electrical energy without the necessity of transforming the atomic energy into heat as is the case, at the present time, with the fusion and fission processes. This is the method used in atomic batteries. The radioactive particles which one could consider for use in an atomic battery are alpha, beta and gamma particles. Alpha particles carry two positive charges. Alpha emitters are not, however, too efficient or too practical.

A beta particle carries one negative charge, has approximately 1/2000 the mass of the hydrogen atom and is, in fact, an electron. Beta particles are of the most interest in the direct production of electrical power, at the present time. Gamma particles carry no charge and are similar to X-rays in this respect. They constitute powerful and penetrating rays but are difficult to use in practice.

A radioactive material for use in an atomic battery should be a beta emitter with these characteristics:

1.—Long Life
2.—Material should emit spontaneously and should not be affected by temperature, humidity etc.
3.—Vacuum should not be required.

Strontium 90 is a highly suitable material for this use, having a half life of 20 years. It produces no gammas, and hence no sheilding is required. The end products are stable.

Atomic and solar batteries are similar in that both transform radiation energy directly into electrical energy. These devices are not new. The presently known types of atomic batteries may be divided into four classes.

The first of these is called the high vacuum charger. This was one of the first types experimented with. The voltage produced is about $3.5.10^5$, the current about 1.10^9, and the efficiency about 25 per cent. It requires a vacuum and is a laboratory device.

The second type of battery is the dielectric charger. In this device beta particles are emitted in air and penetrate the film between two metal plates. The voltage produced is about 10,000, the current about 1.10^{11} and efficiency about 1 per cent. This is a high impedance device of limited usefulness.

The third type of battery is called the contact potential cell. The voltage is about one volt per cell, current about 1.10^{11} ampere, and efficiency about 1.10^2 per cent.

The fourth type consists of the electron voltaic devices. This is the most practical type at the present time. Such batteries are being produced and sold commercially. An atomic battery utilizing the electron voltaic effect consists of an NPN Germanium or Silicon junction which is bombarded by beta particles. If the energy of the Beta particle is greater than the strength of the bond in the crystal lattice then the bond can be broken, creating a hole and a free electron. This may result in a current multiplication of about 10^6. The released electrons flow across the junction, producing a voltage which will cause a current to flow in an external circuit.

In these devices, a radioactive source of 50 millicuries is used. For Silicon, the voltage produced is about 0.2 volts per cell, the current is 1.10^8 ampere and the efficiency is about 2 per cent.

Such a silicon battery can operate transistorized devices. This is their main field of application at the present time, although other uses are envisioned, such as driving clocks, etc.

A typical battery occupies a volume of one cubic centimeter and produces 0.36 milliwatts at the present time. Using a 200 millicurie source and a theoretically higher possible efficiency a silicon battery could produce 36 milliwatts per cc. as an upper limit. The voltage of these cells drops with time. This is thought to be due to damage to the crystal lattice by high energy particles. The silicon battery operates very well at low temperatures, in fact, the output is about 20 times greater at -60°C. than it is at 0°C.

This battery has the unusual feature that almost all the power developed can be delivered to the load.

M. M.

Lightning Protection

On Monday, December 13, 1954, L. M. Connors gave an interesting speech on lightning protection.

Lightning occurs when negative charges in a cloud become so great that the air gap breaks down and the negative charges rush to join the positive charges in the earth. Photographic evidence shows that streamers sometimes leap out of the earth, attracted by the negative charges in the cloud which then rush to earth to complete the stroke. Thunder does not always accompany lightning. When it does occur, thunder of course is caused by the sudden expansion of the air which has been heated by the lightning discharge.

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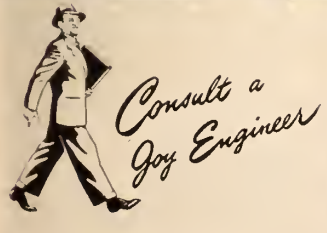

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Lightning discharges occur in periods of time measured in microseconds; hence when lightning strikes a power line it sets up a very steep fronted wave. The surge impedance of the line, a typical value for which is 500 ohms, will determine what the resultant current and voltage will be at any point. This surge current may be as high as 50,000 amperes.

If this steep fronted wave hits an open circuit such as an open switch, the voltage rises to twice its value, the current drops to zero at the open circuit and a reflected wave of the same polarity is reflected back on the line.

Now a transformer at the end of a line often has a higher surge impedance than 500 ohms. Hence when the lightning surge current reaches the transformer, the voltage will rise to some value less than twice its previous value and this may cause the insulation to flash over unless lightning arresters are present.

A lightning arrester must present a very high impedance at the normal 60 cycle voltage on the line, must present a very much lower impedance to the higher lightning surge voltages, thus draining the impulse off the ground, then must immediately present its normal high impedance to the line voltage to seal off any power arc. Since, as previously mentioned, this action takes place in the order of microseconds, a lightning arrester has an arduous duty to perform.

Overhead lines are more subject to damage than substations. Substation insulation level is generally lower than the line insulation level but since substations are so very important to the system we are justified in spending more on protection. Overhead lines are usually protected by an overhead ground wire.

Lightning arresters have been developed which have a special kind of gap that is shunted and shielded and whose operation is predictable. Basic insulation standards have been established at various insulation levels. A standard waveform for use in testing lightning protective devices has been standardized. It is called the 1½ by 40 wave, so called because it reaches its peak in 1½ microseconds and recedes to half peak value in 40 microseconds.

There are two main types of arresters, the station type and line type. Line types are rated up to 73 kv. and station types as high as desired. The important points to consider are IR drop and durability. In general, station types are superior. In testing arresters the AIEE has set up various standards. One of these is that the arrester must withstand 150 amperes for 2,000 microseconds applied 20 times.

It was pointed out that a machine is not necessarily protected by having a transformer between it and the line. In the case of an overhead line feeding a machine, an arrester should be placed about 1,500 feet from the machine out on the line. It is very important from the point of view of lightning protection to have very low resistance grounds.

Following Mr. Connors' speech, slides were shown. G. E. Lewis gave a commentary on the slides, recapitulating the points brought out in Mr. Connors' speech. A question and answer period followed.

The Royal Military College Looks to Chemical Engineering

Dr. J. W. Hodgins of the Royal Military College, Kingston, Ont., was the guest speaker at the meeting held in the Officers' Mess of the Royal Canadian Engineers' Armoury at 3 Hillside Ave., Westmount, on Thursday, January 29, sponsored by L. A. Phillips. Major J. N. Davies, meeting chairman, introduced Dr. Hodgins.

Dr. Hodgins' talk covered staff and student work at R.M.C. in the field of chemical engineering; laboratory facilities at R.M.C.; reasons for staff research at R.M.C.; a technical description of the processing of flame thrower fuels; and a technical discussion of solar energy storage.

In his discussion of flame thrower fuels he emphasized the desirable and unusual shear characteristics for a good fuel, and the processing techniques involved in their preparation.

The solar energy talk centred around low level storage media, application to domestic heating, geographical and economic considerations and limitations, and meteorological factors involved.

L. A. Phillips thanked Dr. Hodgins at the end of his talk and opened the meeting to questions and discussion from the audience. A lively question period followed, with most of the dis-

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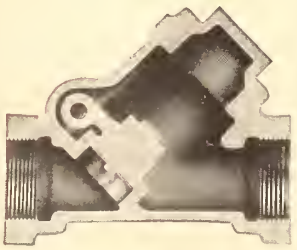

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cussion centred around careers for graduates in chemical engineering in the armed forces.

Principles of Economic Manufacture

M. J. Oldershaw, chairman of the meeting held on Tuesday, December 14, opened the session with introductory remarks on the extensive career of the speaker, Bruce A. C. Hills who is general manager of the Canadian branch of Urwick, Orr and Partners Ltd., consulting specialists in organization and management. Attendance at the meeting was small, due to extremely bad weather.

The subject of Mr. Hills' speech was "Principles of Economic Manufacture" and it can truly be said that he spoke exceptionally well on this subject.

Economic manufacturing can really be summarized by one principle which, in itself, is a basic definition: maximum output of finished goods with minimum resources of raw material, labour, time, equipment and money.

As mentioned by Mr. Hills, all management based on simple fundamentals is too often labelled with complicated names. He stressed that the main point in the application of this rule was that the minimum costs were certainly not obtainable by using all the minima mentioned. Sometimes, a cheap material means more breakage, hence the higher cost. Also, cheap labour is often translated, on closer inspection, which results in higher costs again. The economic solution lies in a perfect balance study of the relative effect of each of the cost constituents of one product. In industry, it is the role of the cost analyst to determine where is the more efficient combination.

Another important point mentioned by Mr. Hills was the use of standardized materials. Often, designers are too lazy to expend the effort of imagination and the time to study materials readily available on the market, and specify some special sizes at a detrimental premium cost. Mr. Hills also mentioned briefly the importance of quality control which is actually a subject in itself.

The relation between indirect labour (office clerks, designers, storekeepers etc.) and direct productive labour (machinery operators), should compare one to one, usually. The rule, in economic manufacture, is to endeavour to obtain, with good machinery, the maximum output from direct labour and simultaneously minimize expenditures incurred by indirect labour.

Emphasis was also given to flow material control which, according to Mr. Hills, is not only useful in plants where quantity production is done but also anywhere a definite product is manufactured.

After a short period of questioning during which the subject of electronic computors in cost analysis was introducer, A. N. Oldfield thanked Mr. Hills.

The St. Lawrence Seaway

A meeting was held on Thursday, January 13, in the auditorium of the Bell Telephone Company building on Beaver Hall Hill.

The subject of the conference, "The St. Lawrence Seaway — A Montreal Problem." and the reputation of the two speakers, C. E. Campeau, assistant director and superintendent of master plan division for the City of Montreal, and George S. Mooney, co-director of Montreal Economic and Tourist Development Bureau, attracted over 350 members. Both speakers were introduced by the chairman, R. K. Thoman.

The talk was divided into four parts: Mr. Campeau spoke first on "Some Historical and General Considerations"; Mr. Mooney then spoke on "The Economic Influence of the Seaway"; and Mr. Campeau on "Some Physical Aspects of the Problem". There was then a question period.

Mr. Campeau told the assembly that ever since 1895 there had been talks on the St. Lawrence Seaway but it was in May 1954 that the American Congress decided to join Canada in the venture.

In the Montreal area, the estimated cost of the project amounts to $122,500,000 not including hydro-electric development. The total project should cost $206,000,000 to Canada plus $186,000,000 to the United States. The capacity of the seaway will be 50,000,000 tons yearly compared with present figure of 10,000,000 tons.

It was stressed by Mr. Campeau that though Montreal has a master plan to govern the immense changes brought about by the seaway, there is, unfortunately, no master plan for the total area affected, to control the industrial expansion, protect residential districts, help traffic conditions, etc.

Mr. Mooney then summarized his views on economic factors likely to affect the future wealth of metropolitan Montreal after the seaway will be complete. There will be some losses, undoubtedly, but also some compensations.

Mr. Mooney's main argument regarding the benefits that Montreal would desire from the St. Lawrence seaway can be briefly summarized thus: The whole of Canada would expand industrially and commercially, and this boom would be reflected on Montreal's economic situation. A second advantage for Montreal lies in the fact that the Laprairie basin, which is expected to become highly industrialized can be considered an extension of metropolitan Montreal.

Finally, Mr. Mooney pointed out a number of basic industries which will not move from Montreal that will become even more prosperous, i.e. iron, oil, aluminum, clothing, etc.

The third part of the meeting, "Physical Aspects of the Seaway", was treated by Mr. Campeau who proved that not only the south shore municipalities were affected by this gigantic enterprise. The importance of the Lachine canal will change, the harbour will have to be modernized, the Laprairie basin will "boom" and finally the shifting towards the south of the metropolitan industrial axis will undoubtedly result in a similar shifting of traffic arteries.

To conclude this interesting meeting, the speakers answered ably a number of questions from the audience, and were in turn thanked by D. B. Armstrong of Dominion Bridge.

Niagara Peninsula

C. E. Williamson, Jr.E.I.C.,
Secretary Treasurer

E. B. Canby, Jr.E.I.C.,
Branch News Editor

Automobile Styling

Fifty-eight members and guests were present for the first monthly meeting of 1955. It was held at the Niagara Falls Public Library, Drummond branch, on Thursday, January 20. The guest speaker was Charles Eder, chief inspector for General Motors, Oshawa. He was introduced by Mr. Scott.

Mr. Eder made a few brief remarks about automobiles, but said he would have more to say after he had presented

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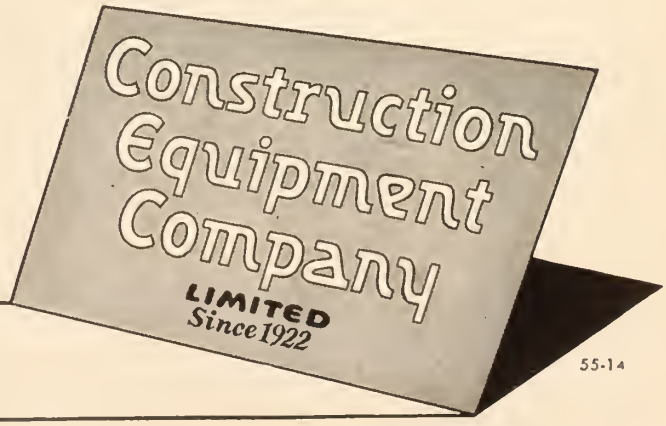

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55-14

two colour films: "Look of Things," that showed how new automobile styles are born. This film traced the normal procedure of artists' sketches, group consideration by the top executives, quarter scale clay models, full sized clay mock ups, and last the working pilot models.

"Sand and Flame" depicted the manufacture of glass and in particular the manufacture of automobile safety glass. The manufacturing process from the selection of high grade sand to today's modern curved automobile windshields was described.

After showing the movies Mr. Eder spoke on some of the factors that will affect the automobiles that will be driven ten years from now. No longer is the automobile the product of a single genius or guiding light, but rather the net result of research and industry working together. Cylinder heads are now made of die cast aluminum parts that are assembled as a sandwich and brazed together by a special process. Tomorrow, engine blocks may be made by a similar process. Catalytic refining of gasoline and similar advances in producing lubricating oil have made today's high compression engines possible.

With the passing of the years automatic transmissions will become cheaper, simpler and almost 100 per cent reliable. Mr. Eder predicted that time would see some spectacular innovations in suspension and ride control, and said that brakes are due for more than casual attention. As a result of rising wool prices after the war the automobile manufacturers have been forced to turn to synthetic fibres for interiors which are today colour harmonized.

He was thanked by Mr. Davidson and the meeting was adjourned.

Ottawa

G. A. Sutherland, M.E.I.C.
Secretary-Treasurer
C. E. Howard, M.E.I.C.
Branch News Editor

Film Night

The Ottawa Branch presented an excellent program of films on November 25, 1954, at the auditorium of the Radio and Electrical Engineering Building, National Research Council.

The following films were presented:

"Breakthrough"—Another film depicting part of the fabulous Kitimat story. It tells of the prodigious feat of tunnelling through 10 miles of solid granite.

"Soils and Foundations"—A colour film showing soil exploration, soil movement, and problems caused by shrinkable clays.

"The Fluoridation Story"—A cartoon giving a brief account of the benefits of fluoridated water in preventing tooth decay.

"Aerated Concrete"—A film produced by the British Building Research Station.

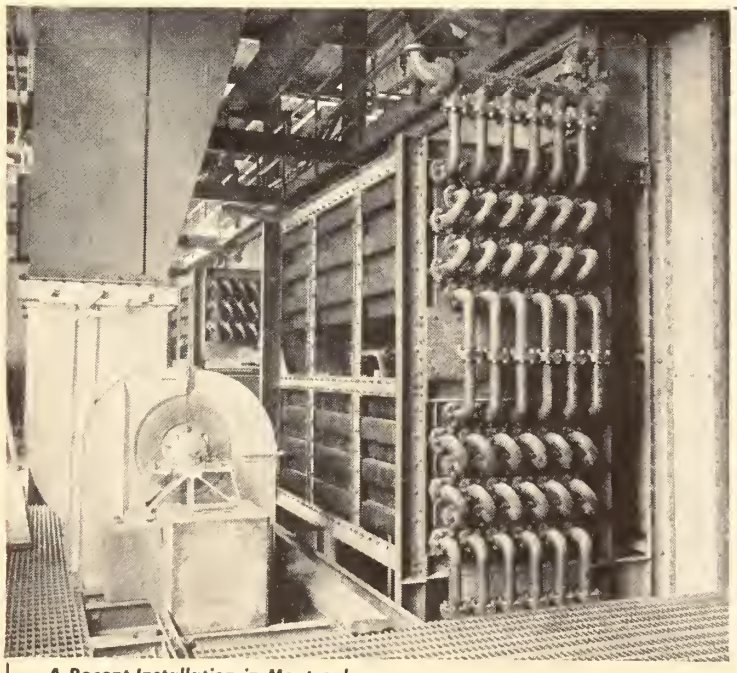
Robert N. Boyd Describes Nylon Plant

The Maitland Works of Dupont of Canada was the subject of an excellent talk given by Robert N. Boyd, supervising design engineer of Dupont of Canada, Montreal, to the Ottawa Branch at a luncheon meeting on December 9, 1954 in the Chateau Laurier.

The function of the Maitland plant is the manufacture of two complex organic chemicals — adipic acid and hexamethylene diamine, the latter commonly known as diamine. These chemicals are called nylon intermediates since they are used principally at the present time for the manufacture of nylon continuous filament and staple yarn.

The operations at Maitland comprise the first step in a four step process in the manufacture of nylon yarn from the basic raw materials. Nylon production in Canada has followed a "reverse order of development", working backwards from the finished product to the domestic production of the required raw materials. When the Kingston nylon yarn plant was first built, equipment was provided for the last step only, and the raw material, in the form of nylon flake, was imported from the United States. Later, as the market expanded, it became economical to manufacture nylon flake here, at which point the imported raw material became nylon salt solution. Still later, with further expansion of the market, the second step, the manufacture of nylon salt solution from nylon intermediates, was added.

With further expansion of the Canadian market it at last became economically justifiable to instal the necessary equipment for the production of nylon intermediates. This step, which is by far the largest, involves complex petrochemical operations and requires



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Quebec Branch Ball

The annual ball of the Quebec Branch on January 21 was scheduled as an event of the Quebec Carnival. Among the branch officers and guests present were: from left to right, Mrs. Robert Painchaud, Mrs. Georges Demers, Hon. Wilfrid Hamel, Mayor of Quebec, Mrs. Guillaume Piette, Mrs. G. E. Sarault and Mrs. R. L. Dunsmore. Standing, Robert Painchaud, director of the Corporation of Professional Engineers of Quebec; Georges Demers, president of the Corporation; Guillaume Piette, chairman of the Branch; G. E. Sarault, past-chairman; and R. L. Dunsmore, chairman of the Montreal Branch.

Left to right: Paul Chaput, president of the Queen's Committee of the Quebec Carnival; Lionel Swift, chairman of the Ball Committee; Miss Marthe Grenier, Ski Queen; Guillaume Piette, Miss Patricia Lewin, Queen of La Chambre de Commerce des Jeunes de Québec; Hon. Wilfrid Hamel, Miss Estelle Côté, Curling Queen; G. E. Sarault, Roger Desjardins, secretary-treasurer of the Branch; and Henri Beique, vice-president of the Quebec Carnival.

A group of engineers, doctors and lawyers attending the Ball.

technical skills of the highest order. The Maitland plant was described by Mr. Boyd.

The plant was wholly designed by the Canadian engineering department with the technical support of E. I. du Pont de Nemours and Company Inc. of the United States. Construction was handled by Fraser-Brace Engineering Company Limited. Design Work began in October 1950, and field work started about a year later. The plant was put into operation progressively from September through November, 1953.

The plant manufactures nylon intermediates from the simplest basic raw material. While nylon can be made from coal, air and water—original processes being based on these materials—in the newer process used at Maitland, air and water continue to be used, but the other raw material becomes cyclohexane. This material, which is derived from crude oil, is a minor constituent of most gasolines on the market today.

Since the products of Maitland Works are consumed at the Kingston plant, an important consideration in our choice of plant site was its proximity to Kingston.

The chemical processes at Maitland are carried out in six main buildings. Two other buildings manufacture nitric acid and hydrogen which are used in the process. The process is controlled by one of the most extensive automatic control installations in Canada.

In the first stage of the process, the cyclohexane is oxidized with air, in the presence of a catalyst. The product of this reaction is a mixture of a ketone and an alcohol, together with several impurities.

The purified ketone-alcohol mixture is then reacted with nitric acid, manufactured on the site from ammonia, to produce a white crystalline solid called adipic acid. Numerous impurities are also formed in this reaction and extensive facilities are provided for the refining of the adipic acid by a two-step crystallization, filtration and centrifuging process, followed by drying. This adipic acid is both one of the products shipped to Kingston and the main raw material for the balance of the Maitland plant. The operations just described occupy three of the six main process buildings.

In the next building, the adipic acid is reacted with ammonia at high temperature to produce crude adiponitrile. Here again the reaction is relatively simple, but the purification requires treatment in a complex system of distillation towers involving repeated pumping operations.

Purified adiponitrile is the main raw material for the next and final stage. This involves the production of diamine by the high pressure hydrogenation of the adiponitrile. The hydrogen is produced at the site by an electrolytic hydrogen plant. Once again, the product of the reaction must be refined in an elaborate series of distillation columns before it is pumped to tank cars for shipment to Kingston.

Mr. Boyd described other installations at Maitland—steam boilers, water pumps, and transformers and central service buildings.

When Maitland Works was developed in an area which has been predominant-

ly agricultural, much thought was devoted to the design and the method of operation. Potential pollution problems were discussed with the Ontario Department of Health, and their assistance was instrumental in the development of the high standards achieved. Atmospheric pollution has been virtually eliminated by the caustic scrubbing of objectionable process fumes. Extensive facilities were also provided for the prevention of river pollution. One of the consultants on this subject was the Philadelphia Academy of Natural Sciences. This organization, prior to plant startup, carried out an extensive biodynamic survey of the St. Lawrence River adjacent to the plant site, and gave the river a clean bill of health. Further surveys, after plant startup, will provide a check on the effectiveness of effluent treatment facilities.

The production and service facilities installed at the Maitland Works occupy about 100 acres of the 1,500 acre plant site which was purchased. There is a high regard for the industrial potential of the St. Lawrence River valley, and the belief that the balance of the property will not be used indefinitely for farming. As a matter of fact, the Company has already announced the start of construction of a second production unit for the site. This is a plant for the manufacture of "Freon" fluorinated hydrocarbons. These materials are used as refrigerants and as aerosol propellents.

The Company, said Mr. Boyd, is pleased to share responsibility for the industrial development of the St. Lawrence River valley. It feels that, by the construction of plants like that at Maitland, it contributes to the rapid industrial progress of the country.

Mr. Boyd was introduced by the chairman, R. E. Hayes, and thanked by T. Foulkes.

W. D. Forrester Speaker at Luncheon

"Transient Transits in the Arctic" was the title of the talk given by W. D. Forrester, of the astronomy section, Geodetic Survey Branch, Department of Mines and Technical Surveys, at the luncheon meeting of the Ottawa Branch in the Chateau Laurier on January 6, 1955. The three fundamental quantities that are determined from the stars in survey work are latitude, longitude, and azimuth. In the remote north the main application of astronomy has been to supply latitude and longitude control for aerial mapping where more precise surveys such as triangulation are as yet impracticable. A little farther south, the stars have been used to settle the boundary between the western provinces and the Northwest Territories, defined as the 60th parallel of north latitude. Further south still, astronomy is used to check the control of azimuth of precise triangulation nets.

Mr. Forrester supplemented his remarks with a series of beautifully coloured lantern slides. These showed the instruments used in taking observations such as the Tavistock theodelite. When equipped with a stride level, it is used to observe azimuth for triangulation control. It is also used to observe latitude and longitude of secondary accuracy, that is, to within about 150 feet. He also showed a Heyde astronomic transit of the broken telescope type. The telescope swings back and forth from North to South to observe stars as they transit across the meridian. With it, latitude and longitude are determined precisely, that is, to within 10 feet or less.

It was further stated that the recording and time signal apparatus consisted of a radio for receiving time signals from Ottawa or Washington; a chronometer; and a chronograph with a rotating drum on which is recorded the time off the chronometer as well as the star record of the observing transit.

Although the field season is generally from the middle of May until about the end of September, sometimes special conditions require that a job be done in winter. In the case of a survey to locate the northern boundary of Alberta and the eastern section of the northern boundary of British Columbia, muskeg rendered cross-country travel in summer impracticable, and the lakes were too shallow for aircraft. Hence, in the winters of 1950 and 1951 the survey party

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went through the bush by tractor train and operated in temperatures as low as —55 degrees.

The observer must stand outside an observing tent, inside which is the transit. Because of refraction, no heat can be provided in the observing tent; the recording apparatus has to be kept warm inside the caboose, however, so that the ink and the batteries do not freeze. This explains the throat microphone and earphones worn by the observer to communicate with the assistant attending the recording apparatus. The American army claims that human efficiency drops 2 per cent for every degree drop below zero. Thus, at —55, the observer is 10 per cent worse than dead, unless the 2 per cent be taken on the diminishing balance.

Mr. Forrester also stated that during the past summer he had accompanied scientists from Canada and the United States on an expedition sponsored by the U.S. Government in the Beaufort Sea area of the Arctic.

R. E. Hayes was chairman of the meeting. Alderman Noel Ogilvie, a former director of the Geodetic Survey thanked Mr. Forrester and referred to Dr. Charles Camsell, a pioneer in the field of astronomic surveying, who was at the meeting.

Nipissing and Upper Ottawa

E. A. Watson, M.E.I.C.,
Secretary-Treasurer

A. T. McKerrall, M.E.I.C.,
Branch News Editor

E. T. Smith Addresses Dinner Meeting

E. T. Smith, of the Canadian General Electric Company, addressed the January meeting of the Nipissing and Upper Ottawa Branch on January 11 in the Manor Hotel.

The dinner meeting was presided over by J. W. Miller, Branch chairman, and 28 members and guests from Temiskaming, Sturgeon Falls and North Bay were present.

The guest speaker was introduced to the meeting by E. Forsythe who pointed out that Mr. Smith obtained his education in mechanical engineering at the University of Utah. Mr. Smith chose as his topic. "The Development of the Diesel Electric Locomotive." With the aid of slides he outlined the history of the locomotive from its primitive stage to the powerful modern diesel electric of today.

H. R. D. Graham, on behalf of those present, thanked Mr. Smith for his interesting talk.

Two sound movies were then shown for which Eric Giles operated the projector. The first one, "The Cummins Diesel Racing Car," followed through the design of a racing car for entrance in the Indianapolis 500 Mile Race. Using a diesel engine similar to that produced on the normal production line, the Cummins Company was able to develop a racing car which set a qualifying record in 1952 of over 138 miles per hour. Fuel supply difficulties forced the car out of the race but the information obtained by the research necessary for the development of the car made the effort worthwhile.

The second film explained pictorially some of the causes of flashover on diesel electric generator commutators.

Sudbury

A. D. Finlayson, Jr.E.I.C.
Secretary-Treasurer

A. Eldridge, M.E.I.C.
Branch News Editor

Brian Judges Addresses Dinner Meeting

The first dinner meeting of the Sudbury Branch for 1955 was held at the Sudbury Granite Club on Thursday, January 6, with 35 members attending. During the business session Bob Crawford described the work of the Educational Committee and Russ Eaton, councillor, reported on headquarters activities.

The guest speaker of the evening, Brian Judges, of the Trane Company, was introduced by Roy Snitch. Mr. Judges spoke on "Air Conditioning and Refrigeration".

The air conditioning field has had very rapid growth in the past few years and the connected load should double by 1957. Air conditioning is closely allied to the construction industry and additional business will come from the remodelling of old buildings as well as from homes and automobiles.

Air conditioning is being widely used in industry. With mechanical refrigeration systems the long term cost is generally lower than with water cooling. In addition, the supply of water can also be a problem, particularly in summer. The refrigerants which have been developed are stable and odourless. In air treatment dust can be removed by filters, or electrostatic charge. Toxic odours are taken out by carbon activated filters and bacteria by ultra-violet light.

Air conditioning can be divided into two classes; comfort and industrial, Examples in the comfort class are:—movie theatres, stores, hotels and railroads. Air conditioning improves a building and increases the return on the investment. With food stores, sales increase in hot weather and spoilage is reduced.

Industrial air conditioning provides controlled atmospheres for gauge rooms and fine instrument assembly. In the textile industry close control of humidity is possible. In numerous industrial applications such as fruit curing, liquor manufacture and storage, pharmaceuticals, etc., a better product is possible if air conditioning is used.

After a question period the speaker, Mr. Judges was thanked by John Quance.

Saint John

J. W. G. Scott, M.E.I.C.,
Secretary-Treasurer

G. E. Graham, M.E.I.C.,
Branch News Editor

Joint Meeting with Associotion

On Thursday, January 27, a joint meeting of The Engineering Institute of Canada, Saint John Branch, and the Association of Professional Engineers of the Province of New Brunswick, was held in the Admiral Beatty Hotel at which T. C. Higginson, Branch chairman, presided.

Mr. Higginson outlined the importance of engineering in the design and production of new products. He mentioned that manufacturing industry was needed in New Brunswick, rather than service industries to advance the economy of the area.

D. O. Turnbull proposed a toast to the Association of Professional Engineers of the province of New Brunswick and D. J. Brewer replied to the toast on behalf of the Association, and stated that the status of the engineer, in the eyes of the general public, has improved greatly in the last 20 years.

A toast to the Engineering Institute of Canada was proposed by R. M. Richardson, who outlined the early history of the Engineering Institute of Canada and its many attempts to form a national body representing engineers in Canada. Mr. H. McFarlane replied to this toast.

Brigadier Jones Guest Speoker

The main speaker of the evening was Brigadier J. R. B. Jones, D.S.O., O.B.E., C.D.

Brigadier Jones said that the military engineer was the first professional engineer. He is hired to provide the engineering needs of his employer. The main engineering branches of the Army are the Royal Canadian Corps of Signals and the Royal Canadian Electrical and Mechanical Engineers and the Royal Canadian Engineers. During the period of emergency, the military engineer builds to meet the tactical requirements of the moment. The main factor of the military engineer's work is time, and the penalty for slowness is defeat. In Canada the Royal Canadian Engineers are responsible for the construction, maintenance, and operation of Army headquarters and depots. Camp Gagetown is a good example of this in New Brunswick.

Army engineers have developed a most accurate and speedy means of survey. This method was used to survey a strip completely across Canada, through mostly unsurveyed regions, and accurate maps to a scale of 1/50,000, with the contour intervals of 25 feet, were produced at the rate of 1,000 square miles a week.

The Army, like every one else, is short of engineers and must have a very high standard of young men coming into the service. The government has authorized scholarships by which selected high school graduates may be completely subsidized all through their university course.

To ensure that Army engineering methods are keeping pace with those of industry and with military engineering of other countries, selected military engineers are given post-graduate training in industry, attachment to the British and American Corps of Engineers and a number of military and technical courses which all must attend nearly every year.

D. J. Brewer thanked Brigadier Jones for his entertaining and instructive talk.

Toronto

L. Bresolin, Jr.E.I.C.
Secretary-Treasurer

H. Fealdman, Jr.E.I.C.,
Branch News Editor

Ladies' Night

Monday, November 22 was the occasion of the annual Ladies' Night held at

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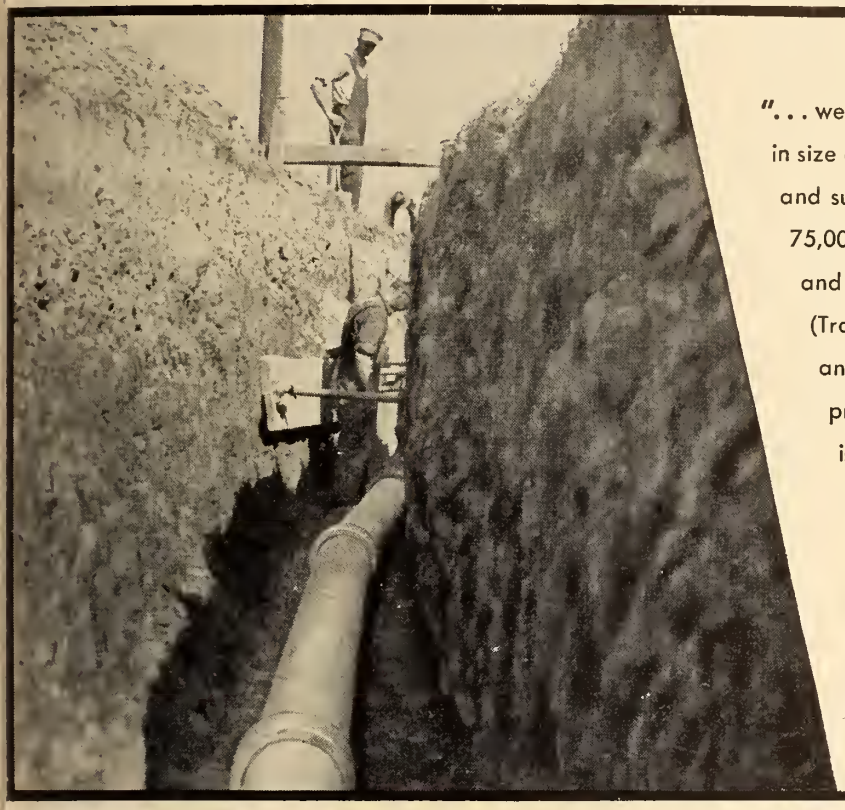

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the Embassy Club, Toronto. About 150 members and ladies turned out to enjoy an excellent dinner followed by first class entertainment and dancing. The promised visit of the president had, unfortunately, to be postponed but is anticipated in mid-February. All branch members are looking forward to this event which promises to be a highlight in the year's activities.

Annual Branch Meeting

The annual meeting of the Toronto Branch was held on Thursday, January 13 in the Northgate Hotel. The after dinner speech was ably presented by E. B. Higgins, senior partner of E. B. Higgins & Associates, who discussed "Some Interesting Aspects of Professional Associations". During the course of this address Mr. Higgins discussed "the ten best ways to wreck your Association" which caused the largest number of red faces seen collectively in Toronto for many a year!

The retiring chairman, McKenzie (Ken) McMurray, sometimes known as 'Malcolm', presented a very satisfactory picture of branch activities and finances during his year of stewardship. Assisted by reports from other members of the executive, Mr. McMurray's summation reflected the hard work put in by members of the executive. A plea for better branch attendances was made, and was well received by his audience.

One aspect of the year's work deserves special mention—the Professional Development courses. These courses, which have been described elsewhere, provide a valuable background for the development of aspiring young engineers. Run almost entirely by the participants themselves, these courses are proving to be the finest project that the Toronto Branch have ever been associated with.

At the end of the evening the election results were announced and the new executive welcomed into office. Chairman for 1955 is Professor Mark W. Huggins, of the department of civil engineering, University of Toronto. Elected as vice-chairman is K. F. Tupper, formerly dean of the faculty of applied science, University of Toronto and now president of Ewbank & Partners (Canada) Ltd. Re-acclaimed as secretary-treasurer is L. F. ("Rolls Royce") Bresolin. Other members of the executive are: R. A. Muller, M. P. Whelen, L. S. Widdifield, J. H. Ingham, H. Fealdman and J. B. Young. Continuing on the executive (elected last year) are M. McMurray (past-chairman), E. R. Davies, R. S. Segsworth, D. R. Burns and R. C. Norgrove.

Toronto Branch Chairman M. McMurray hands over the gavel of office to his successor, Prof. M. W. Huggins.

(Engineering and Contract Record Photo)

Winnipeg

C. S. Landon, M.E.I.C.
Secretary-Treasurer

J. F. Scaife, M.E.I.C.
News Editor

Gordan Carey Speaker

At the regular February meeting of the Civil Section, a paper was presented by Gordon Carey, supervisor of metallurgical services of the Steel Company of Canada, Hamilton, entitled "Metallurgical Views on Steel Problems".

The speaker was introduced by John Davidson, sales representative for the Steel Company of Canada. Mr. Carey gave a very interesting outline of his work as a service metallurgist, in which his job was finding troubles and rectifying them in plants producing steel. He gave an outline of the various difficulties which occur in the production of steel, and also indicated a few simple tests which anyone can make to determine whether they have high carbon or low carbon steel in cases where they are not positive, or where certain sheets of steel have become mixed.

He also gave a simplified talk on certain phases of crystalography, showing differences between body centred and face centred crystals in steel structure. He mentioned such things as fatigue failures, and various causes for them, such as sudden changes in the sections without proper filets, excessive martensite caused by sudden cooling in high carbon steels, and indicated various methods of preventing these troubles.

A question period was held at the conclusion of the talk, the audience indicating their great interest in the speaker by asking numerous questions of him.

Electrical Section

B. F. Webster, M.E.I.C.
News Editor

Seth Witt Addresses Sectian

On Thursday, January 27, the Electrical Section was pleased to hear a talk entitled "A 60 Cycle Network Analyzer", by Seth Witt, system planning engineer for the Northern States Power Company of Minneapolis, Minnesota Mr. Witt was introduced by Professor R. Chant, University of Manitoba.

Mr. Witt prefaced his explanation of a 60 cycle network analyzer as owned and operated by his company with a few explanatory remarks on network analyzers in general. He stressed the fact that the network analyzer was in his particular case a very valuable tool for determining quickly the results of contemplated changes on his utility's system without laborious and time consuming calculations that would otherwise be involved. This network analyzer represents to some scale every basic element of a generation and transmission system. Each analyzer must have as components, counterparts of the generators, transformers, capacitors, synchronous condensers, shunt and series reactors that normally appear on a utility's system. In addition, the analyzer must have an electrical counterpart for the reactance, resistance and capacitance that exists in both long and short transmission lines.

Mr. Witt pointed out that there are various approaches to these problems and that network analyzers took a number of forms. Network analyzers are owned and operated now both by electrical manufacturers and public utilities. However, those anlayzers owned by electrical manufacturers are usually provided with every feature for the rapid solution of system problems on which all data have been previously collated and prepared in suitable form to utilize the machine to its fullest capacity. This type of analyzer is, therefore, almost a production tool and any feature that contributes to giving a faster solution is added.

Mr. Witt stressed, however, that these additional features are quite expensive and the analyzer as used by Northern States Power was manufactured so that commercially available components could be used and thus keep down the cost.

The Northern States Power network analyzer has 21 generators, 220 line/load units and a precise calibrating and metering control panel. The 21 generators with their associated controls as well as the calibration and metering panel are located immediately in front of and are part of the operator's control desk. The balance of the equipment comprising line/load units is rack

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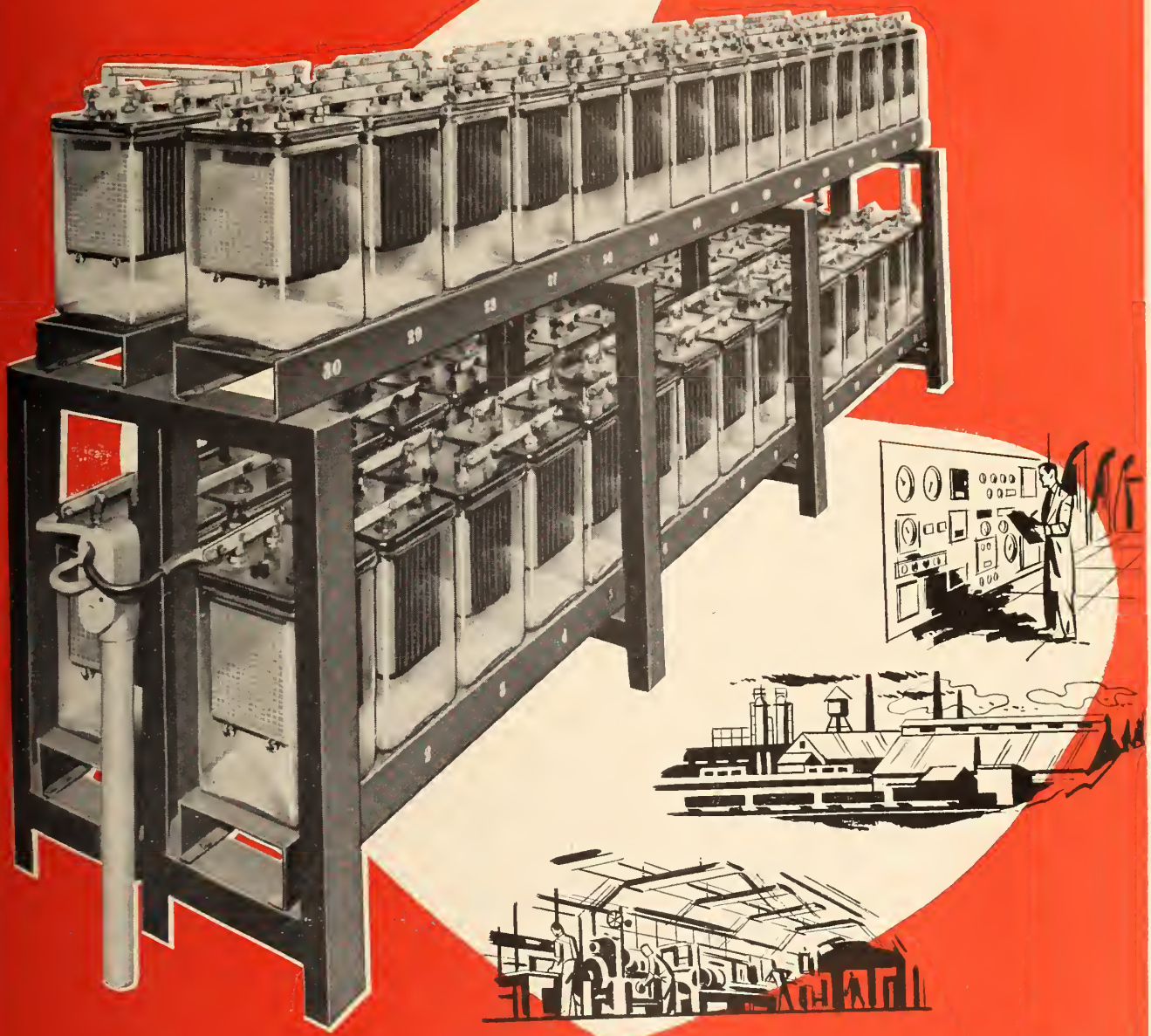

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mounted in free standing cubicles along the wall of the analyzer room.

Although other analyzers are made for operation on 440, 480 or even 10,000 cycles per second, Mr. Witt pointed out that this analyzer was for use on 60 cycles. Base current is ½ amp., base voltage, 50 volts and therefore, base wattage is 25 watts. Base kva. in calculations is 40,000 kva. associated with the analyzer's full base kva. of 25 kva.

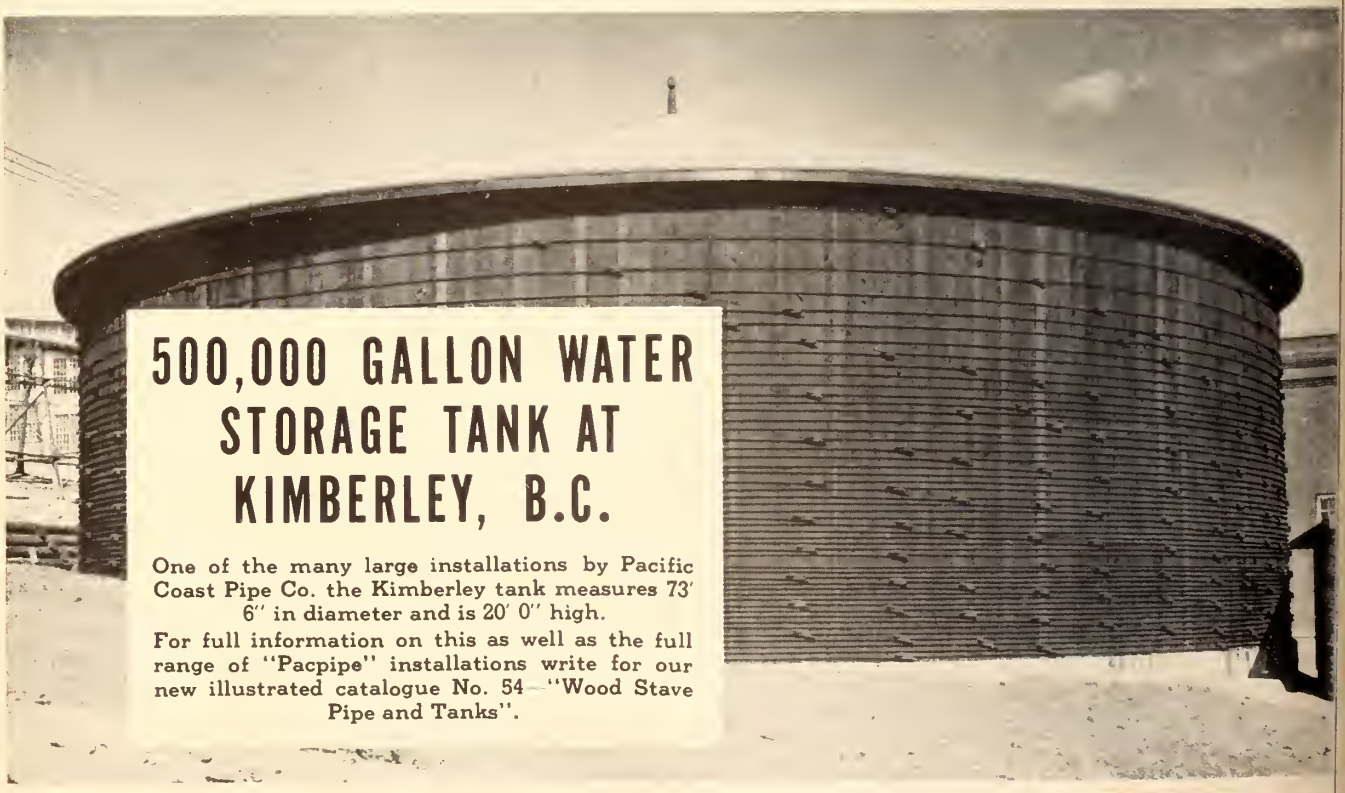
Typical of the analyzer's electrical counterparts was the equipment utilized, say for the generators. The operator's control desk housed an electronic voltage regulator which, in turn, fed a regulated 60 cycle supply of good wave form to 2 - 3 phase transformers. One of these transformers had its primary connected star and the other had its primary connected delta. The secondaries of both these transformers were 6 phase, star and were so connected that the phase voltages were available at every 30 electrical degrees. By means of a tapping switch, therefore, any one of 12 voltages could be obtained, varying in phase angle from 0 to 360 degrees in 30 degree steps. Actually, what is required in an analyzer generator is an output voltage or vector that can be varied either in phase position or in magnitude. The voltage associated with any one of the 12 taps mentioned previously was then fed to an auto transformer complete with a vernier adjustment so that the phase angle could be adjusted even with this 30 degree range. The output from this auto transformer or variac was then fed to a second variac where the magnitude of this phase adjusted voltage could be varied in output. Both these powerstats or variacs are commercially available units and thus presented no unusual expense. This generator output was then fed into a small network comprising uncalibrated resistance and reactance to simulate the values of resistance and reactance encountered in the actual generator and then having passed through this network, the generator voltage vector was available at the output terminal. Both the resistance and reactance used in the generator circuit as well as other resistance and reactance units used in the line/load units were uncalibrated components commercially available with the only requirement being that they had a multitude of taps and had a good temperature co-efficient over the current range and temperature range encountered. Therefore, in order to set up specific values of resistance and reactance, say in a line unit, it was necessary to set the correct values of resistance and reactance on the calibrated panel at the operator's control desk and then by use of an impedance bridge utilizing a cathode ray oscilloscope as a null indicator, set the taps on the reactor and resistor in the line unit itself.

This, of course, was time consuming but was sufficiently fast for Northern State Power's requirements. The calibration facilities for all these components did not introduce too many serious obstacles as it is also necessary in any type of analyzer to be able to meter at any desired point in the system under study, i.e., it might be necessary to meter the internal voltage of a generator or the output current or voltage of a power transformer. To meter at any of these points, it is necessary to cut into the circuit at these points with a set of precise meters and this switching was done by relays of the commercially available type. It was, therefore, only a matter of adding additional contacts to these relays to obtain circuit requirements for calibration.

The connection was made between the various line/load units, generator units, etc., by telephone patch cords which employed silver tip jacks and contacts to keep contact resistance to a minimum.

Mr. Witt during this talk stressed those points that were unique to this analyzer as distinct from other analyzers and evoked considerable interest as evidenced by the question period that followed.

Paul Shane on behalf of the Electrical Section thanked Mr. Witt for his excellent paper and R. T. Harland, chairman of the Section, also thanked Mr. Witt and asked the speaker to extend the Section's gratitude to his company for permitting him to give this talk in Winnipeg.



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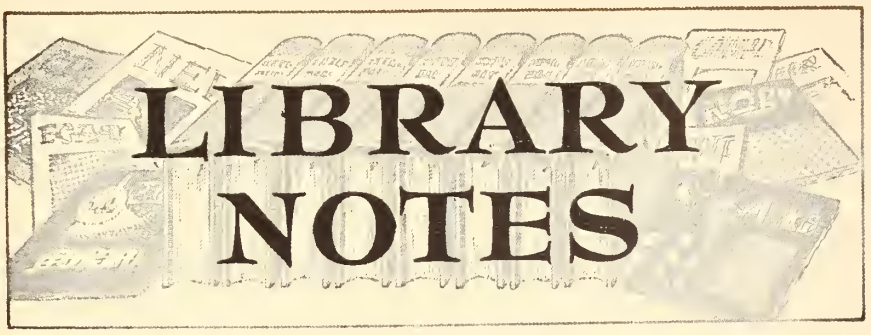

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Plastics engineering handbook, 2nd ed. Society of the plastics industry. New York, Reinhold, 1954. 813 pp., illus., $15.00 (U.S.).

This second edition of the Plastics Engineering Handbook has been three years in preparation, and contains some fifty per cent more material than the first edition which was published in 1947.

The Society has had twenty committees working on the preparation of this volume, their more than two hundred members including engineers and technicians active in the field of plastics engineering. Many of the committees have worked on the revision of the existing material to include the latest advances and developments, while others have been solely concerned with topics which have become important since the first edition was published.

The book is divided into five sections of which the first, materials and processes, covers molding, preforming and preheating, forming, drawing, casting, and embedding. A new chapter in this section is entitled "Tooling with plastics" and describes the use of plastics in production tools for various mass-producing industries. All types of plastic are included in this section, which occupies almost half the book.

The second section is concerned with the design of molded plastic articles, and the design of the molds. A large part of the section presents, in tabular form, standards for tolerances on molded articles of various types of plastic.

The chapters on finishing and assembly include articles on machining, finishing and decorating, cementing and welding, and gluing. There is a short section on testing, and the last section presents the Society's standards, which are voluntary, and cover the testing, rating, certification and labeling of plastics products.

The Handbook is well indexed, and contains numerous illustrations. Two folded charts are included, one on the classification of rigid molding materials, and the other on the types and characteristics of adhesives used in the industry. The compilers have included no bibliography, and very few bibliographical footnotes, but apart from this omission, the handbook will be very valuable to all those concerned in any way with this rapidly expanding industry.

S.C.

BOOK NOTES

Prepared by the Library
The Engineering Institute of Canada

*Review provided through the courtesy of the Engineering Societies Library in New York.

Calcul et exécution des ouvrages en béton armé. t. 4 Ponts (2e partie) 4e éd. V. Forestier. Paris, Dunod, Montreal, Fomac, 1954. 255 pp., diagrs., $6.35.

This, the second part of the work dealing with bridges, is divided into five main sections, and is subtitled "Calculation of the superstructure; examples of calculations for different types of bridges." These sections include: calculation of the factors involved in designing the superstructure of a highway bridge, calculation of the arches, etc. The last section, which occupies more than half the book, is devoted to the presentation of worked examples of calculation for different types of bridges.

There are many tables and illustrations, and a well-elaborated table of contents, although unfortunately there is no index.

Calcul thermique des chaudières et des foyers, 12e éd. Friedrich Nuber. Paris, Dunod, Montreal, Fomac, 1954. 302 pp., figs., $8.70.

This, the 12th edition, has been translated from the German by Leon Thiry, and deals with various types of furnace and boiler. The book is intended to serve as a practical guide by giving an over-all picture of the field under study, and to suggest solutions to problems which beset the worker in the field.

There are many worked examples appearing throughout the book, which is divided into four sections, the fourth of which consists of tables, diagrams, a bibliography and various indexes, including a much-welcomed alphabetical index.

Cobalt in Canada. R. J. Jones. Ottawa, Canada, Dept. of mines and technical surveys, 1954. 96 pp., loose leaf.

The purpose of this report was to collect all available information on cobalt in Canada and to present it in one book together with the most recent developments. Many useful maps of cobalt areas are included.

Canadian mine production of cobalt in the principal districts such as Sudbury and Werner Lake is described as well as lesser Canadian occurrences. This is followed by a chapter on world mine production: Africa, U.S.A., Burma, Russia, Australia, Finland and New Caledonia. The last four chapters cover the metallurgy of cobalt, its consumption and use, foreign trade and international controls connected with this metal.

Coffrages métalliques; emploi, applications. J. Ricouard. Paris, Eyrolles, 1954. 230 pp., illus., 1,950 fr.

The advantages of metal forms over wooden ones in construction are emphasized in this volume. In a thorough treatment of the subject the author first describes the development of metal forms and their increased use. He then discusses the various fields in which they are now commonly used, e.g. bridge construction, tunnels, etc.

The methods of placing the forms are given in detail with the aid of many photographs.

The complete plain words. Sir Ernest Gowers. London, H.M.S.O., Ottawa, United Kingdom Information Office, 1954. 209 pp., $1.25.

This book is largely a re-writing of the author's two earlier books, Plain Words, and the ABC of Plain Words. By combining them into one handy volume, and adding an index, their value is enhanced, and although not intended as a grammar of the English language, the book is now a useful work of reference.

In his preface, the author says his concern is with "the choice and arrangement of words in such a way as to get an idea as exactly as possible out of one mind into another." Sir Ernest expresses most strongly his disapproval of "officialese", and illustrates his points with some most surprising examples he has uncovered during his research.

He deals with such topics as choice of words, the use of words, letter writing, punctuation and grammar.

Nobody who does any writing should fail to read this interesting, amusing, and enlightening book, and it should find its way onto the desks of many executives and government officials.

***Compressed air handbook,** 2nd ed. Compressed air and gas institute. Toronto, McGraw-Hill, 1954. Various paging, illus., $9.95.

The material in this handbook is divided in six sections covering applications in a variety of industries; portable tools and rock drills; the compressed air system; positive-displacement compressors; dynamic-type blowers and compressors; and engineering data and test procedure. The book is designed as a reference manual on the theory, selection, application, installation, testing, and maintenance of pneumatic equipment.

***Conveyors and related equipment,** 3rd ed. W. G. Hudson. New York, Wiley, 1954. 524 pp., illus., $9.00.

Correction

Book Review: The book *Applications of results of research* by Vera Connell reviewed in the January issue is available in Canada from Butterworth, price $5.00.

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Electrical elements of power transmission lines. H. B. Dwight. Toronto, Macmillan, 1954. 188 pp., diagrs., $5.25.

Written on a college level, a great deal of this book is given over to problems which are intended to give practice in solving the types of calculation described.

Among the subjects treated are short transmission lines, hyperbolic solution for long lines, general circuit constants, constant-voltage transmission lines, load studies with networks, traveling waves, skin effect in round conductors, cost of resistance loss, geometric mean distance, reactance, capacitance, and sag calculations.

Electronic measuring instruments. E. H. W. Banner. Toronto, British book service, 1954. 395 pp., illus., $7.75.

This will be a useful guide to the application of electronic technique to specific problems for it covers the main electronic devices used in measurement, the various classes of instrument using these devices and some typical examples of instruments. Some quasi-electronic instruments such as the magnetic amplifier are also included. The author surveys the whole field of electronic measurement for very high and very low values, for remote indication, and for increased accuracy.

Valuable sections on radiation measurement are found in Parts 2 and 3 and other chapters describe cathode-ray instruments, photoelectric measuring instruments and rectifier instruments. Most radio test gear, other than valve voltmeters, is excluded.

Elements of electrical machine design. 3rd ed. Alfred Still and C. S. Siskind. Toronto, McGraw-Hill, 1954. 445 pp., diagrs., $11.00.

After twenty-two years a second revision has been published of this textbook which was originally titled Elements of Electrical Design. All material not directly related to rotating electrical machinery and transformers has been omitted, and improved materials and methods of design are included.

The book covers the design principles of four basic types of machine: d-c and a-c generators, induction motors, and transformers. Derivations of equations are rigid and based on fundamental principles. Illustrative examples follow the design formulas and each section contains discussions relating to materials of construction and the arrangements of these materials.

New chapters include one on direct-current generator design and a ribbon-core, cruciform-section transformer of modern design. Among other additions are the design of a wound-rotor induction motor with the commonly employed wave winding, and basic discussions concerned with stator-rotor slot combinations and rotor-bar skew in induction motors.

Engineering metallurgy. E. M. H. Lips. Eindhoven, Philips, Houston, Elsevier, 1954. 246 pp., illus., $6.25 (U.S.).

Intended for both the metallurgist and the practical engineer, the aim of this book is to relate the study of metals to modern design techniques, and to aid in the choice of the best material for the job.

The author, who is head of Philips' applied metallurgy laboratory in Eindhoven, discusses first the mechanical properties of metals and alloys. Following this are chapters on phase diagrams, iron alloys, non-ferrous metals and alloys, heat treatment of metals, and the working and joining of metals. The chapters are further subdivided, and the book contains a good index and table of contents.

The Financial Post survey of mines, 1955. Toronto, Financial Post, 1954. 374 pp., $3.00.

The 1954 edition of the Financial Post survey of mines reviews the developments in Canadian mining in 1954, and foresees a bright future for the next few years.

This view is based on three factors: substantial expansion of mineral-producing capacity in 1954; current preparations for production at important new mines; and a wide range of discoveries being explored.

New producers in 1954 included Iron Ore Co. of Canada, Opemiska Copper Mines, Rix-Athabasca, and Keymet Mines. Various established mines expanded, and a number of other mines are scheduled to increase production.

This survey gives an interesting list of the price range of Canadian mining stocks and of metals during the year. The greater

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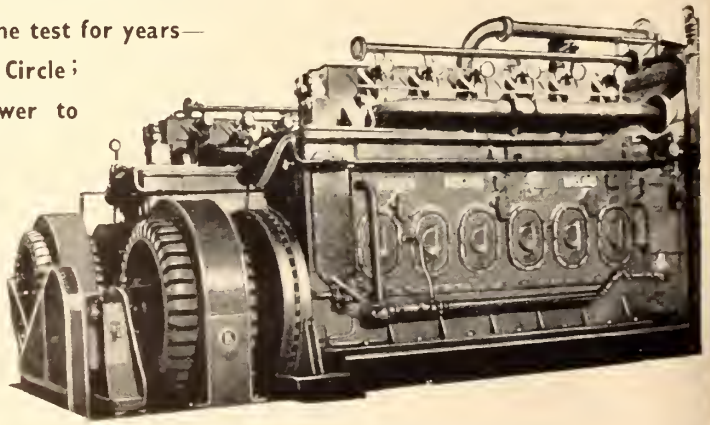

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part of the book consists of a list of the mining companies in Canada, arranged by province. Information is provided relating to capital, earnings, dividends, etc., primarily intended for investors.

A very useful section is devoted to maps of Canadian mineral areas, showing the holdings of the different companies.

For action: the autobiography of a Canadian industrialist. J. E. Hahn. Toronto, Clarke, Irwin, 1954. 305 pp., illus., $3.50.

The life story of a man who has been prominent in so many fields is of interest to a wide variety of readers. Because this man has been a leading Canadian industrialist for over twenty years, has made a valuable contribution to his country in two world wars, and is able to recount his experiences in a manner which captures the reader's full attention, his autobiography will certainly be acclaimed by a great number of people.

Major Hahn has been connected with such well-known Canadian firms as the John Inglis Company and English Electric Company of Canada and was a pioneer in the field of the radio industry. It is interesting to read of the personal and business adjustments which he had to make following both wars for they point up the industrial advances which had taken place in this nation over the years.

In addition to these events, the author writes of his sports interests and of his hobbies, and tells also of his post-World War II travels through India.

Formulas for stress and strain, 3rd ed. R. J. Roark. Toronto, McGraw-Hill, 1954. 381 pp., figs., $9.50.

In this edition, the third, new material has been added, and existing tables of formulae and coefficients have been enlarged. Many of the sections have been rewritten, including those on shear lag, columns, pressure vessels and the chapter on factors of stress concentration.

The author's aim in writing this book was to make available in compact form the formulae, facts and principles relating to the strength of materials. For this reason the derivations of formulae, and detailed explanations, are omitted, but worked examples are included as illustrations of their application. The volume is divided into three parts: definitions and symbols, facts, principles and methods, and formulas and examples.

Extensive bibliographic references are included at the end of each chapter, and the nineteen tables and numerous diagrams increase the value of this useful book.

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Fresh water from the ocean for cities, industry, and irrigation. C. B. Ellis. New York, Ronald, 1954. 217 pp., diagrs., $5.00 (U.S.).

This timely book will find many readers, not only because of the importance of the subject but also because it is written in a fairly non-technical manner which will appeal to those who must plan, evaluate, or decide urgent questions of water supply and development.

The author investigates the possibilities of extracting fresh water from the ocean in terms of 1,000 million gallons per day and keeps the economic factor always present. All such major cost elements as plant construction, operating, labour, maintenance, raw materials, and power are analyzed.

The first chapter presents the basic matter and energy relationships with which any sea-water conversion method must deal. The following chapter headings indicate the scope of the discussion: energy costs; long-range force systems; actions on the container; sieve processes; distillation with conventional fuels; distillation by new heat sources; chemical surface methods; the sale of by-product chemicals, and a 1,000-mgd electric membrane plant.

The friction coefficient for circular pipes at turbulent flow. J. R. Finniecome. Manchester, Emmott, 1954. 125 pp., figs., tables, 10/-.

The main purpose of this little book is to examine already published material, to compare formulae and test results and to correlate, in the form of charts, useful information relating to the pressure drop in smooth and rough pipes.

After a general consideration of the subject there are sections on the friction coefficient of smooth pipes, and of rough pipes. The next chapter contains an analysis of actual tests made on commercial pipelines for steam, methane and water. The dates of all tests are given, and a bibliography is included.

The grinding of steel. E. N. Simons. London, Odhams, Toronto, Nelson, Foster and Scott, 1954. 224 pp., illus., $5.50.

Steel grinding in all its aspects except the coarser processes, such as sand-blasting, shot-blasting and hydro-blasting, is covered by the author is this book.

Four general sections deal with the basic processes; the actual operations; the finishing processes; and the machines. Breaking these main divisions down we find chapters on grinding wheel operation and choice; cylindrical, internal, surface, disc and centreless grinding; grinding rolls, cams, lathes, twist drills, broaches, steel castings and gear teeth; lapping, superfinishing, finishing by abrasive belt, truing and dressing grinding wheels and dressing abrasive wheels by crushing. Examples of the principal groups of grinding and abrasing machines are given in condensed form.

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Heat transmission. 3rd ed. W. H. McAdams. Toronto, McGraw-Hill, 1954. 532 pp., figs., $10.50.

This highly technical volume on heat transfer contains many changes in its 3rd edition, and presents developments which came with the advent of nuclear reactors and jet engines, among other new fields. All material was critically reviewed and modified where necessary.

This edition is again divided into three parts: conduction, radiation and convection. Some of the most important experimental investigations which are reported cover the ranges of available correlations for heating and cooling of gases which have been extended to include many cases of supersonic compressible flow inside tubes and outside objects of various shapes. The introduction of molten metals as practical heat-transfer media in high-performance applications is discussed.

Among the new techniques described are the use of fluidized beds for the contacting of fluids and solids, and the development of highly compact plate-and-fin and finned-tube exchangers. Incremental methods for the computation of transient heat conduction have been further developed and explained.

Induction and dielectric heating. J. W. Cable. New York, Reinhold, 1954. 576 pp., illus., $12.50 (U.S.).

This book on the latest uses and applications of high-frequency heating in industry is intended for metallurgists, engineers, designers and all those concerned with production and research.

The work falls naturally into two parts, as induction and dielectric heating are two different applications of high-frequency energy for heating, although similar in some respects. In each section an analysis of the theory of the type of heating under consideration is followed by a discussion of the sources of electrical energy used. Successive chapters give information on the applications of the different types of heating. In the case of induction heating these include brazing and welding, soft soldering, forging, and melting. Also considered in this section are the importance of jigs and fixtures and machine design in induction heating.

Dielectric heating is considered in relation to the plastics industry, the fields of woodworking, food-processing, sterilization, and moisture removal.

This is essentially a practical book, but contains sufficient theory to give the reader an understanding of the principles applicable to both methods of heating.

***The light metals handbook.** G. A. Pagonis. Toronto, Van Nostrand, 1954. 2 v., tables, $9.25.

Included for various classes of aluminum and magnesium base alloys are data on mechanical properties at room, low and elevated temperatures; physical properties; choice of alloys; casting; formability; heat treatment; corrosion; machinability; joining methods; and detailed properties of individual compositions. Volume one presents the text; volume two, tables.

La machine-outil. t. 2, Usinage par tours. A. R. Métral, éd. Paris, Dunod, Montreal, Fomac, 1954. 372 pp., illus., $21.00.

La machine-outil, which is edited by A. R. Métral, has been appearing in parts, its object being to make known the best methods of utilizing different machine tools.

Also written by a group of specialists, volume two of this work is concerned with lathes. There are six sections dealing with the study and use of parallel and special lathes, semi-automatic, automatic and multiple tool lathes, copying and vertical lathes.

Each type of lathe is fully treated and profusely illustrated with both line drawings and photographs.

***Magnetic control of industrial motors,** 2nd ed. G. W. Heumann. New York, Wiley, 1954. 714 pp., illus., $9.50.

Provides exhaustive coverage of electric motor performance, control device characteristics, and functions of commonly-used control circuits, with emphasis on considerations governing the selection of controllers for specific purposes. The text has been revised in line with present day practices and includes new materials on adjustable voltage and regulating systems. Obsolete designs have been eliminated, and tables and diagrams have been changed to conform to the latest industrial standards.

Management education for itself and its employees. Part 1—Management education in American business. L. F. Urwick. **Part 2—A survey of management development.** J. M. Trickett. **Part 3—Case studies in management development.** R. G. Simpson. **Part 4—The education of employees: a status report.** New York, American management assoc., 1954. 4 parts, illus., pt. 1 $2.50; pt. 2 $1.25; pt. 3 $1.50; pt. 4 $1.25.

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The first section of this important study deals with business education as it is practiced by a fairly wide cross-section of management in the United States. An historical background of the subject is followed by a description of the best type of executive and a discussion of such problems as recruitment of the right type of person and the practical factors involved in management education.

Part 2 is concerned with the basic questions of what American organizations of various types and sizes are doing or will do to educate their management employees; what techniques, methods, and information are now being used; how well these companies feel they are achieving their objectives. Much of the data is factual but there are also interpretations and interrelations of the information.

Ten representative companies were selected for the case studies which are reported in Part 3. The companies are of different sizes and types, and have been interested in the development of management personnel over a number of years. This is a factual report of the investigations and no attempt has been made to appraise or evaluate the different practices described.

The last part of the survey is a summing up of the education of employees in American business concerns. It also determines what has been done on the subject of evaluating employee education and recommends the type of research program most needed in this field with a discussion of how such a program can be carried out most effectively.

Materials for product development, 1954. New York, Clapp and Poliak, 1954. 159 pp., illus., $7.50 (U.S.).

This book contains the proceedings of the Basic Materials Conference held in Chicago in May 1954 in conjunction with the second Basic Materials Exposition.

The thirteen papers included are divided into six sections, each of which contains a report of the question and answer period which followed the presentation of the papers in any one group.

Each section was devoted to a particular problem. These were: Materials of the future; new metal forming processes, including precision casting, powder metallurgy and forging, extrusion and stamping; non-metallic materials, plastics, carbon-graphite, ceramics and glass; joining; corrosion protection and materials management, the setting up and operating of a materials department.

Materials handling. J. R. Immer. Toronto, McGraw-Hill, 1953. 591 pp., illus., $8.00.

It was estimated in 1950 that industry in the United States could save two billion dollars a year by improving methods of materials handling. Very often it is only by improving this phase of manufacture that production costs can be reduced.

This textbook on materials handling is intended not only for those studying industrial engineering at an undergraduate level, but also for those experienced in the field who still have felt the need of a book bringing together the organizational, financial and managerial aspects of the subject.

In writing the book, the author has received the co-operation of many companies and individuals who have done research on the subject, and he has tried to present the best practices as they have developed to date.

After a brief account of the history and principles of materials handling, the author discusses the simplification of product manufacture, different types of equipment, packaging methods, analysis of handling problems, organization of a materials handling programme, and various special problems.

The book is well illustrated, and the appendices include an excellent bibliography of books, government publications, periodicals and periodical articles, both general and those related to specific industries, and films. Another appendix includes a classification scheme for materials handling information and equipment adapted from that originally developed by the Westinghouse Electric Corporation.

Metallurgy of welding. W. H. Bruckner. Toronto, Pitman, 1954. 290 pp., illus., $6.00.

Another in this publisher's series on welding, this volume is concerned primarily with welding from the metallurgical viewpoint, and is intended to point out the problems involved in the welding of metals, although the author states in his preface that the student can best grasp the significance of development of welding engineering by attempting to do some welding himself, or by watching a skilled operator.

Some of the topics covered are: surface treatments, residual stresses, weldability of metals, economics of welding, and various types of welding, including metallic arc, torch, arc, pressure, thermit and resistance.

The author includes a list of the publications of the American Welding Society, and also gives a general bibiliography.

Nuclear engineering. Symposium held June 1954. F. J. van Antwerpen, ed. New York, American institute of chemical engineers, 1954. 3 vols., illus., $4.25 per vol. (U.S.) (Chemical engineering progress symposium series, vol. 50, nos. 11-13).

The papers in these volumes were presented at a meeting on nuclear engineering sponsored by the American Institute of Chemical Engineers and the University of Michigan. This was the first international congress devoted to discussion of the peacetime uses of atomic energy. More than 1,200 people attended, coming from most of the countries of the West, and India and Japan. The papers presented dealt with nuclear engineering progress in twelve different countries.

A wide variety of topics was covered, including reactors, radiation, heavy water, research, engineering education, the effect of atomic energy on health, the individual, religion, law, etc.

The papers are indexed by both subject and author, and form a very useful survey of present day knowledge on the uses of atomic energy.

Proceedings of the ninth meeting of the national conference on industrial hydraulics, 1953. Chicago, The Conference, 1953. 234 pp., illus., $4.50 (U.S.).

This volume consists of the papers presented at the ten sessions held at the conference, together with the panel discussion conducted at each.

Although relatively new, industrial hydraulics are now of primary importance in modern industry, and the majority of the new machine tools are powered or controlled by oil hydraulics.

The sessions considered hydraulics in relation to a variety of topics; automobiles, presses, pumps, aircraft, machine tools and tractors. Sessions were also held on industrial nonflammable fluids and instrumentation.

The publication of this symposium will be of interest to all those concerned with this subject who were unable to attend the conference.

Résolution pratique des équations différentielles. J. Legras. Paris, Dunod, Montreal, Fomac, 1954. 112 pp., $4.15.

Written for engineers, this is a summary of the integration of ordinary differential equations. Its aim is to show the essentials of the various techniques by outlining the methods used for each type of equation so as to provide a working tool rather than a theoretical treatise.

This book deals with such topics as the Fournier series, linear equations with

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constant coefficients, linear and quasi-linear equations, and also has a chapter on non-linear types.

There is a bibliography and the book is very well indexed.

Les soudures; technique-contrôle, soudabilité des métaux, 2e éd. D. Séférian. Paris, Dunod, Montreal, Fomac, 1954. 428 pp., illus., $16.25.

This second edition of this work on welding includes four additional chapters. These present material on arc welding, resistance welding, hardfacing by welding and stud welding. There are also newer treatments of such subjects as: coated electrodes, the metallurgical role of the coating, the testing of solders, etc. There are also new tables, flowsheets, and illustrations.

The book deals with both theoretical and practical aspects of the subject, and includes an extensive bibliography.

A large part of this work has already appeared in English in the form of articles in the periodical Sheet Metals.

Statistical tables on aluminium, lead, copper . . . mercury and silver, 42nd annual issue, 1938, 1946-1953. Frankfurt, Metallgesellschaft A.G., 1954. 199 pp., tables.

This volume gives a review of production and consumption for 1953 and early 1954 for aluminium, lead, copper, zinc, cadmium, nickel, mercury and silver, covering the western world.

The major part of the volume is concerned with a variety of data dealing with these metals for the years 1938 and 1946-1953. This material is grouped in two main sections. The first is arranged by country and includes such topics as production, consumption, imports and exports for the first five metals listed. The second deals with prices for these years for all the metals listed.

As may be expected this review reflects the troubled times since 1938 and various footnotes are required to cover the resulting contingencies. Evidently few recent statistics were available covering these metals in China and countries in the Soviet sphere.

BOOKS RECEIVED

Advanced television servicing techniques. RETMA Pilot Training Course Teaching Staff. New York, Rider, 1954. 163 pp., diagrs., $3.60 (U.S.)

Advanced television servicing techniques (laboratory workbook). RETMA Pilot Training Course Teaching Staff. New York, Rider, 1954. 46 pp., $0.95 (U.S.)

Air pollution: a bibliography. S. J. Davenport and G. G. Morgis. Washington, U.S. Bureau of Mines, 1954. 448 pp., $1.75 (U.S.) (Bulletin no. 537).

Air pollution. Report of committee on. London, H.M.S.O., Ottawa, United Kingdom Information Office, 1954. 80 pp., 65¢. (Cmd. 9322).

American concrete institute book of standards—1954. Detroit, The Institute, 1954. Various paging, $3.50 (U.S.)

Atoms in the family: my life with Enrico Fermi. Laura Fermi. Toronto, University Press, 1954. 265 pp., illus., $4.00.

Automatic digital calculators. A. D. Booth and K. H. V. Booth. Toronto, Butterworth, 1953. 230 pp., illus., $6.00.

Basic electricity. Van Valkenburgh, Nooger & Neville, Inc. New York, Rider, 1954. 5 vols., illus., $9.00 (U.S.) a set.

Bibliography on unionization of professional engineers. Engineering Societies Library. New York, The library, 1954. 8 pp., mimeog. $2.00 (U.S.) (ESL bibliography no. 10)

Canada's flying heritage. F. H. Ellis. Toronto, University Press, 1954. 388 pp., illus., $7.95.

Chemical process principles. Part 1 Material and energy balances, 2nd ed. O. A. Hougen, K. M. Watson and R. A. Ragatz. New York, Wiley, 1954. 504 pp., diagrs., $8.50.

Concrete roads. F. N. Sparkes and A. F. Smith. London, Arnold, Toronto, Macmillan, 1952. 492 pp., illus., $16.00.

Electrical year book, 1955. Manchester, Emmott, 1954. 360 pp., illus., tables, 3/–.

Elevated-temperature properties of selected super-strength alloys. Report. American society for testing materials. Philadelphia, The Society, 1954. 208 pp., pa., $4.75 (U.S.) (Special technical publication no. 160).

Engineering dynamics. v. 1. Theory of elasticity: analytical and experimental methods. C. B. Bienzo and R. Grammel. London, Blackie, 1955. 307 pp., diagrs., 50/–.

The English windmill. Rex Wailes. Toronto, British Book Service, 1954. 246 pp., illus., $7.00.

Fluoridation as a public health measure. American association for the advancement of science. Washington, The Association, 1954. 232 pp., illus., $4.50 (U.S.)

Fundamentals of color television. W. F. Boyce. Indianapolis, Sams, 1954. 232 pp., pa., $2.00 (U.S.)

Machine drawing and design, 6th ed. W. Abbott. London, Blackie, 1954. 253 pp., illus., 15/–.

Magnetic-amplifier circuits. W. A. Geyger. Toronto, McGraw-Hill, 1954 277 pp., diagrs., $7.50.

Mechanical and electrical equipment for buildings, 3rd ed. C. M. Gay, C. de V. Fawcett and W. J. McGuiness. New York, Wiley, 1955. 564 pp., illus., $8.50.

Mechanical world year book, 1955. Manchester, Emmott, 1954. 240 + 254 pp., illus., tables, 3/6.

Nuclear geology: a symposium on nuclear phenomena in the earth sciences. H. Faul, ed. New York, Wiley, 1954. 414 pp., diagrs., $7.00.

Pioneer and pacemaker: the story of Firestone. Akron, The Firestone Tire and Rubber Company, 1955. 64 pp., illus., pa.

Prestressed concrete, 3rd ed. Gustave Magnel. Toronto, McGraw-Hill, 1954. 345 pp., illus., $9.75.

SAE handbook, 1954. New York, Society of automotive engineers, 1954. 1096 pp., illus., tables, $20.00 (U.S.)

Selected references on urban planning methods and techniques. Chapel Hill, North Carolina. University, 1954. 20 pp., mimeog., $2.00 (U.S.)

Simplified design of structural steel, 2nd ed. Harry Parker. New York, Wiley, 1955. 244 pp., diagrs., $5.75.

Single sideband for the radio amateur. West Hartford, American radio relay league, 1954. 208 pp., illus., $1.75 (U.S.)

Sonics. T. F. Hueter and R. H. Bolt. New York, Wiley, 1955. 456 pp., illus., $10.00.

TV field service manual with tube locations, v. 3. Harold Alsberg, ed. New York, Rider, 1954. 121 pp., diagrs., spiral binding, $2.10 (U.S.)

TV manufacturers' receiver trouble cures, v. 6. M. S. Snitzer. New York, Rider, 1954. 120 pp., diagrs., pa., $1.80 (U.S.)

The testing of bituminous mixtures, 2nd ed. D. C. Broome. London, Arnold, Toronto, Macmillan, 1949. 396 pp., illus., $8.00.

Transistor audio amplifiers. R. F. Shea. New York, Wiley, 1955. 219 pp., diagrs., $6.50.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

American road builders' association. Technical bulletins:

No. 209—Symposium on road equipment. No. 211—Winter maintenance of roads.

American welding society. Tentative specification:

A5.11—54T—Nickel and nickel-base alloy covered welding electrodes (ASTM B295—54T).

American welding society:

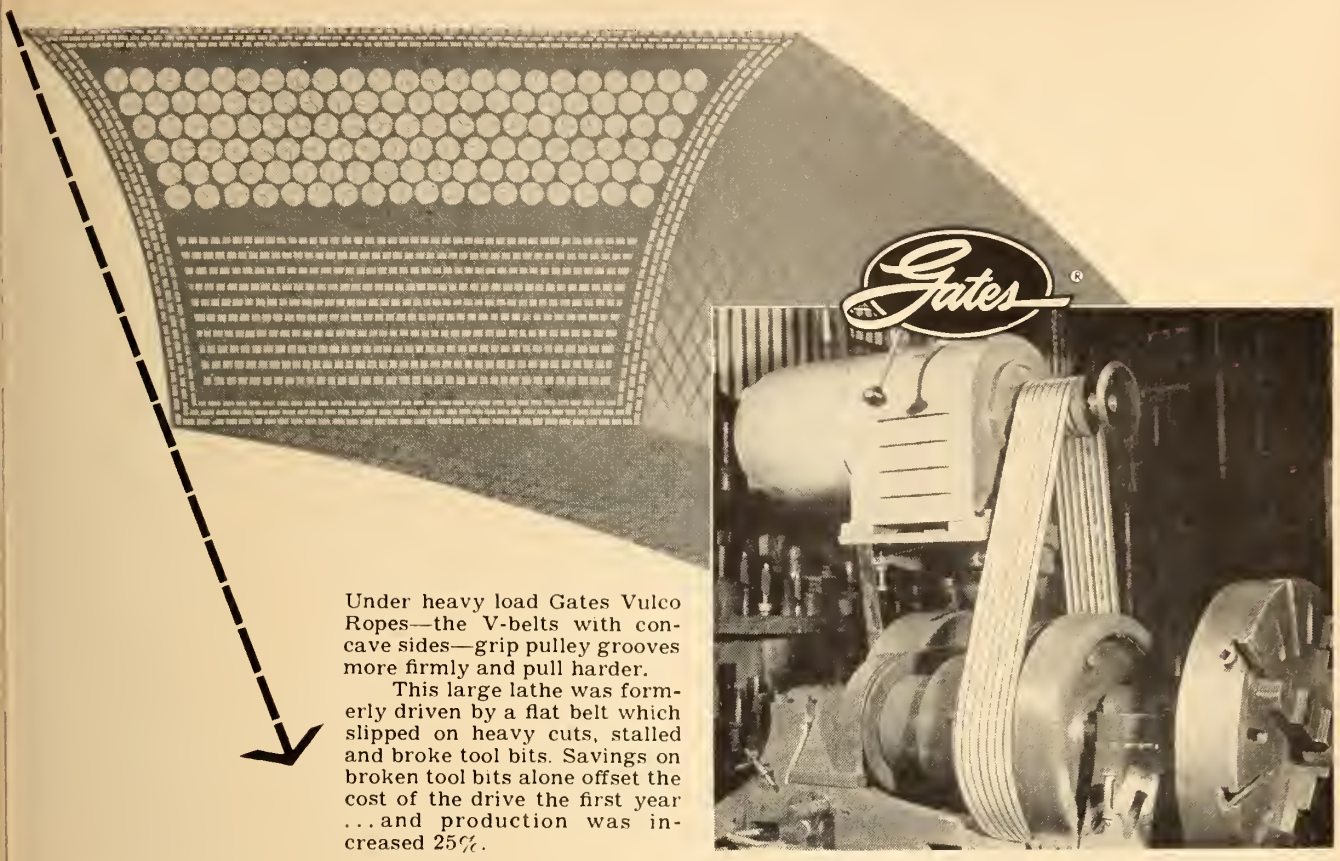
C.2.3-54T — Recommended practices for metallizing: Part 1C—Application of metallized coatings to protect against heat corrosion. (Tentative).

Bell telephone system. Monographs:

No. 2226—Reflection coefficients of irregular terrain, by K. Bullington. No. 2228—A theorem concerning noise in electron streams, by J. R. Pierce. No. 2299—Differential phase and gain measurements in color television systems, by H. P. Kelly. No. 2311—Self-powered semiconductor amplifier, by C. G. B. Garrett and W. H. Brattain. No. 2332—The absorption of gases and vapors on germanium, by J. T. Law and E. E. Francois.

British electrical and allied industries research association. Technical reports:

No. G/T260—Note on the nature of gases liberated during arcing in oil circuit-breakers, by C. E. R. Bruce. No. G/T281—Series breaks in circuit-breakers: a technique for the measurement of voltage distribution, by F. O. Mason. No. L/T289—Oriented polystyrene film capacitors: a major cause of premature breakdown, by H. F. Church. No. L/T296—The dielectric properties of silicone liquids and greases—III, by E. Rushton and J. V. L. Parry. No. L/T305—An investigation on aluminium electrolytic capacitors and the development of a new type of aluminium oxide capacitor, by G. C. Robinson. No. O/T12—Deposits on overhead line insulators exposed to wind-borne salt spray, by G. Mole.



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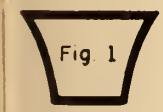

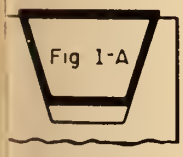

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Simple test proves value of concave sides

Bend a straight-sided belt (Fig. 2) and feel the sides *bulge out* around the bend. The bulging sides prevent the belt from fitting evenly in the pulley groove (Fig. 2-A). Uneven contact causes uneven wear...shortens belt life...increases costs.

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GATES VULCO ROPE DRIVES

British electrical and allied industries research association. Technical reports:

No. L/T294—Some experiments on d.c. positive point-to-plane corona discharges, by H. M. Gaunt and J. D. Craggs. No. L/T 298—Review of ferroelectricity and antiferroelectricity in the perovskites, by A. F. Devonshire. No. L/T301—Negative ion formation in gases of high dielectric strength, by J. W. Marriott and J. D. Craggs. No. L/T302—The dielectric properties of ketone resins, by E. Rushton. No. L/T308—Negative ion formation in gases of high dielectric strength. Part II—The Lozier apparatus, by J. W. Marriott and J. D. Craggs. No. L/T309—Water sorption in polystyrene and cellulose triacetate, by A. G. Day.

British rubber development board:

Latex foam in furniture.

Natural rubber latex and its applications—No. 4—The preparation of latex foam products, by C. F. Flint.

Canada. Department of labour. Economics and research branch:

Survey of industrial requirements for professional personnel, 1952-1956.

Canada. National research council. Canadian government specifications board. Specifications:

9-GP-6—Paper; ammunition, lead-free. 53-GP-6—Ribbons; typewriter, cotton. 1-GP-40P—Primer; structural steel, alkyd type (Provisional).

Canada. National research council. Division of building research. Technical paper:

Permafrost investigations at Aklavik: 1953 (Drilling and sampling) by J. A. Pihlainen and G. H. Johnston.

Canada. National research council. Division of building research. Technical papers:

No. 14—Winter design temperature data for sixty-six Canadian stations, by M. K. Thomas and D. W. Boyd.

No. 17—Effect of the 1950 Winnipeg flood on house foundations, by A. Baracos. (N.R.C. No. 3342). No. 19—Control of water vapour in dwellings, by N. B. Hutcheon. (N.R.C. No. 3343).

Canada. National research council. Division of mechanical engineering. Report:

No. ME-208—The design of power plant ducting, by H. S. Fowler.

Edison electrical institute:

Blowing out main turbine steam lines before initial operation (Publication no. 54-17). Specifications for electrical workers insulating safety headgear (No. AP-1 1954).

Institution of mechanical engineers:

Guided missiles, by G. W. H. Gardner.

Institution of mechanical engineers. Automobile division:

The skid-resisting properties of roads and tyres, by G. Grime and C. G. Giles. Experimental investigations on the braking performance of motor vehicles, by H. J. H. Starks and R. D. Lister.

Kansas. University. Publications:

Transactions of the fourth annual soil mechanics and foundation engineering conference (Bulletin of engineering and architecture, no. 31).

North-east coast institution of engineers and shipbuilders:

The partnership of science and engineering, by Sir Edward Appleton.

North-east coast institution of engineers and shipbuilders:

Instrumentation in engineering research—with particular reference to marine turbine machinery, by B. J. Terrell. The use of a digital computer with particular reference to the analysis of structures, by R. K. Livesley and T. M. Charlton.

Ontario. Hydro-electric power commission:

Forty-sixth annual report, 1953.

Portland cement association. Research and development laboratories:

Influence of soil volume change and vegetation on highway engineering, by E. J. Felt.

Purdue university. Engineering extension department. Engineering bulletin:

Proceedings of the 40th annual road school.

Tin research institute:

Improved aluminium-tin bearing alloys, by J. W. Cuthbertson and E. C. Ellwood. Some aspects of tinning by immersion processes, by D. E. Weimer and J. W. Price.

Underwriters' laboratories of Canada:

Proposed revision of standard for hydrants for private and municipal fire department service.

United States. National research council. Highway research board. Bulletin:

No. 90—Vertical sand drains. (Publication no. 326).

No. 91—Highway accidents and related factors. (Publication no. 334).

United States. National research council. Highway research board. Bulletins:

No. 92—Highway-user taxation. (Publication no. 340). No. 93—Soil density and stability. (Publication no. 341).

Washington. University:

Proceedings 1954 northwest conference on road building. 88 pp.

STANDARDS REVIEWED

A.S.T.M. standards, American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.T.M. standards on metallic electrical conductors, $3.25 (U.S.).

This is a compilation of all the standards relating to metallic conductors for use in insulated or uninsulated, covered or uncovered form. These include wire, stranded conductors, rods, bars and shapes, and pipes and tubes of copper, copper alloy and copper-covered steel; aluminum wire and other aluminum conductors; and various types of galvanized iron and steel conductors. Among the new standards added to this edition is a test method relating to copper wire for magnet wire fabrication and specifications for copper used in hookup wire for electronic equipment.

A.S.T.M. standards on textile materials (with related information), $5.50 (U.S.).

These 111 standards cover asbestos, bast and leaf fibres, cotton, glass textiles, etc., and general fibres, fabrics, yarns, threads, and cordage. Information is included on identification, analysis, resistance to insects, testing machines, and other subjects. Twenty-five of the test methods recorded in the earlier edition have been revised, while seven of the standards are new.

British standards, British standards institution, 2 Park Street, London, W. 1. British standards are available from the Canadian standards association, National research building, Ottawa, Canada.

B.S. 1557:1954—Polythene-insulated cables sheathed with p.v.c. for electric power & lighting up to 250 volts. 5/-.

The various types of polythene-insulated polyvinyl-chloride compound-sheathed cables here specified are single-core cables, flat twin cables, flat twin cables with earth-continuity conductor, flat three-core cables, circular twin cables and circular three-core cables. The principal feature of this new edition is the reduction in insulation and sheath thickness which has been found possible since the first edition was published in 1949. Also included are quality requirements and tests for the p.v.c. sheath and a method for the determination of the grade of the polythene insulation.

B.S. 2502:1954—Manufacture and testing of sectional cold rooms (walk-in type). 3/-.

The two standards are intended to make provision for large commercial and industrial refrigerators, viz., cabinets of 12 to 100 cu. ft. net capacity, and sectional cold rooms of 100 to 1,500 cu. ft. gross capacity. No attempt has been made to recommend standard sizes; conditions of manufacture and testing have, however, been prescribed which should ensure a competitive high quality for commercial refrigerators.

Canadian standards, Canadian standards association, National research building, Ottawa, Canada.

C.S.A. C92.1—1954—Canadian standard practice for industrial lighting, 2nd ed. $0.50.

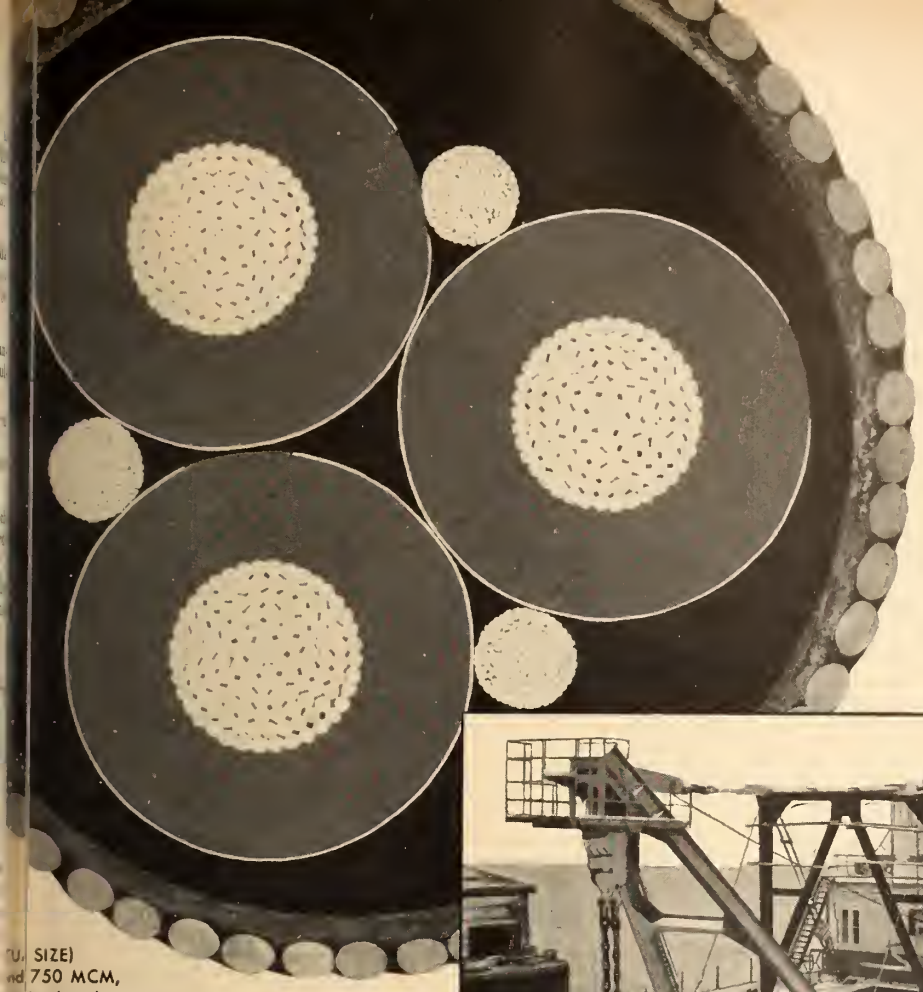
This new edition is based on the American Standard Practice for Industrial Lighting and covers these subjects: factors affecting the seeing tasks of industry, factors of good illumination, influence of environmental factors, daylighting, artificial lighting, lighting methods for industrial areas and industrial lighting maintenance. The Appendix discusses the advantages of good illumination and the Preface includes material on progress in lighting application, development of new techniques and safe working conditions.

C.S.A. B125—1954—Plumbing brass. $1.00.

This Specification applies to present conventional types and forms of plumbing brass and their modifications. It covers single and double lavatory faucets, straight and angle stops with and without drain, sink and bath faucets, lavatory waste fittings, lavatory traps, sediment and lawn faucets, closet tank float valves, flush valves for low toilets, etc.

GIANT CABLES...

for Steep Rock Lake



...U. SIZE)
...nd 750 MCM,
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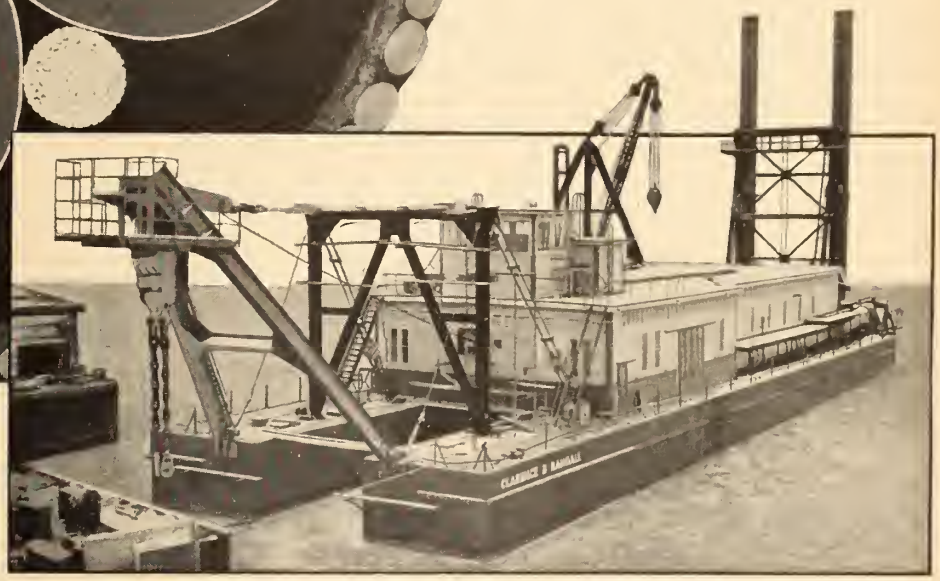


. . . to feed two 10,000 hp dredges.

The name "Steep Rock" has come to be synonomous ...h major engineering feats. Exposing the rich deposits of ...n ore buried in the bed of this Ontario lake, has proven ...nique challenge to engineering skill.

To-day, the third stage of baring the lake bed is under ...y as dredging of the vast Falls Bay area begins. Two of ...largest hydraulic pipe-line dredges in the world have ...t been built. The power to drive their pumps and cutter-...ads is carried from shore by rubber-insulated, steel-wire ...noured cables, larger in size and weight than any other ... their type ever made.

Over 5½" in diameter and weighing more than 27 ...unds a foot, these cables were manufactured by Northern ...ctric to meet the exacting demands of the installation. ...ey will operate at 13,800 volts, 24 hours a day, through ...e heat of summer and the intense cold of winter. Their ...gged construction is designed to withstand damage from ...cks, underwater land-slides, and ice-floes. Large portions ... the cable will be immersed continually in lake-water.

Northern Electric's wire and cable plant at Lachine, Que. has all the facilities to manufacture such cables—modern machinery, versatile handling equipment, extensive laboratories and, most significant of all, skilled personnel with a heritage of over 50 years of cable-making experience.

For more details of this unusual cable write to Northern Electric Company Limited, Dept. 55, 1600 Notre Dame St. W., Montreal, Quebec and ask for Product News No. 31 entitled "Dredge Cable for Steep Rock Lake".

3055-1

Northern Electric

COMPANY LIMITED

Business & Industrial Briefs

A Digest of Information

received by

The Editor

Appointments and Transfers

Changes at Pacific Coast Pipe.—Following a recent meeting of the board of directors, the company announced the appointment of T. A. Kennedy, R.I.A., to the position of vice-president and managing-director. Mr. Kennedy replaces H. C. Fitz-James, M.E.I.C., who has retired after 40 years of service. As reported elsewhere in these columns the appointment of D. D. Reeve, M.E.I.C., as chief engineer was also announced, replacing J. B. Holdcroft, who has retired from active service but will continue in the capacity of consulting engineer.

●

Phillips Electrical Co. (1953) Limited.—Following the recent appointments of T. A. Lindsay as executive vice-president and F. W. Barnhouse as general sales manager, it was announced that the latter will be assisted by E. M. Lloyd, marketing manager, and D. C. Brazier, sales manager. Mr. Lloyd had been with British Insulated Callender's Cables Limited for many years before joining Phillips in 1953. Mr. Brazier has an extensive knowledge of the industry and has been with the company more than ten years.

●

Winnipeg Street Lighting. — Max Spigelman has been appointed engineer in charge of the street lighting division, City of Winnipeg Hydro-Electric System, to succeed C. A. Midwinter who retired on pension last December.

Mr. Spigelman was born in Winnipeg in 1912 and received his early education in Winnipeg public schools. In 1933, he graduated from the University of Manitoba with the degree of B.Sc. in electrical engineering.

He joined the City of Winnipeg Hydro in 1938 and served in the Power Plants Division until 1941. He then joined the R.C.A.F. and for the next four years, served as a flight lieutenant with the Aeronautical Engineering Branch. He was also at Air Force Headquarters, Ottawa and with the Canadian Joint Staff at Washington, D.C. as technical liaison officer with the U.S. Armed Services. After the war, he rejoined the City of Winnipeg Hydro as street lighting engineer.

Mr. Spigelman is a member of the Association of Professional Engineers, Province of Manitoba, and a member of the Illuminating Engineering Society of America.

●

B. F. Goodrich Changes Name.—It was announced by Ira G. Needles, president of the company, that B. F. Goodrich Canada Limited will be the new name of The B. F. Goodrich Rubber Company of Canada, Limited.

The change in name was designed to keep pace with their accelerated activities in fields other than rubber, such as chemicals, vinyl plastics and rigid plastic material. At the same time, they recognized a need to streamline the company name and provide a shorter title. Official permission to change the name had been received and the new name would be effective immediately.

●

Geological Survey of Canada.—Mines Minister George Prudham has announced the recent appointment by the Civil Service Commission of Dr. Clifford S. Lord as chief geologist of the Geological Survey of Canada. He succeeds Dr. George Hanson who became director of the Survey in October 1953.

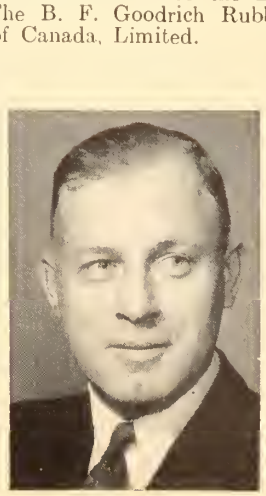
In his new post Dr. Lord will be responsible mainly for organizing and directing the field work of the Survey, a task of increasing importance in view of the rapid growth of mining in Canada. He has been employed continuously by the Survey since June 1937 and in the two previous seasons he had served as chief of party on Survey field assignments. In recent years he has had immediate charge of the work of the Survey in the mainland portion of the Northwest Territories. It was in this capacity that he organized and directed in 1952 a project known as "Operation Keewatin" whereby, for the first time in Canada, helicopters were used for extensive systematic geological mapping. As a result of new techniques developed for the project the geological mapping of northern Canada is now proceeding more economically and at a far greater pace than was previously thought possible.

Dr. Lord was born in New Westminster, British Columbia, and received his early education in that city. He is a graduate of the University of British Columbia, receiving a bachelor degree in applied science in 1929 and a master's degree in geological engineering in 1933. He continued his studies at the Massachusetts Institute of Technology where he obtained his Ph.D. in 1937, specializing in economic geology.

He is a fellow of several professional organizations, including the Royal Society of Canada, the Geological Society of America, the Geological Association

F. W. Barnhouse

E. M. Lloyd



D. C. Brazier

Cranes such as these are in a sense "travelling bridges". Each of those shown, for example, travels nearly 4,000 miles per year (*One 8 hour shift per day*) and moves annually many thousands of tons of steel.

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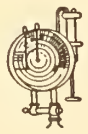


Channels for Telemetering and Supervisory Control

THE BELL TELEPHONE COMPANY OF CANADA

of Canada, and the Arctic Institute of North America, and a member of the Canadian Institute of Mining and Metallurgy, in which he served as councillor of District 3 during 1952-53.

•

National Carbon Company. — The latest move in an expansion program was revealed this week in the announcement by A. A. Cumming, president of National Carbon Company, Division of Union Carbide Canada Limited, of the formation of a Development Organization. J. S. Dewar is appointed manager. H. M. Brown is in charge of product and process development of "Eveready" Batteries, "Prestone" Anti-Freeze and "National" Carbon and Graphite Products. C.W. Galbraith, is responsible for the development of new industrial and automotive products and R. G. Leckey, for new consumer products. The purpose of the new organization is to investigate new business opportunities originating within the Company or, alternatively, made available from sources outside.

•

Standard Steel Appointment.—According to a recent announcement by the Standard Steel Construction Company, Port Robinson, Ontario, L. Harrison has been appointed Toronto area sales representative for the company.

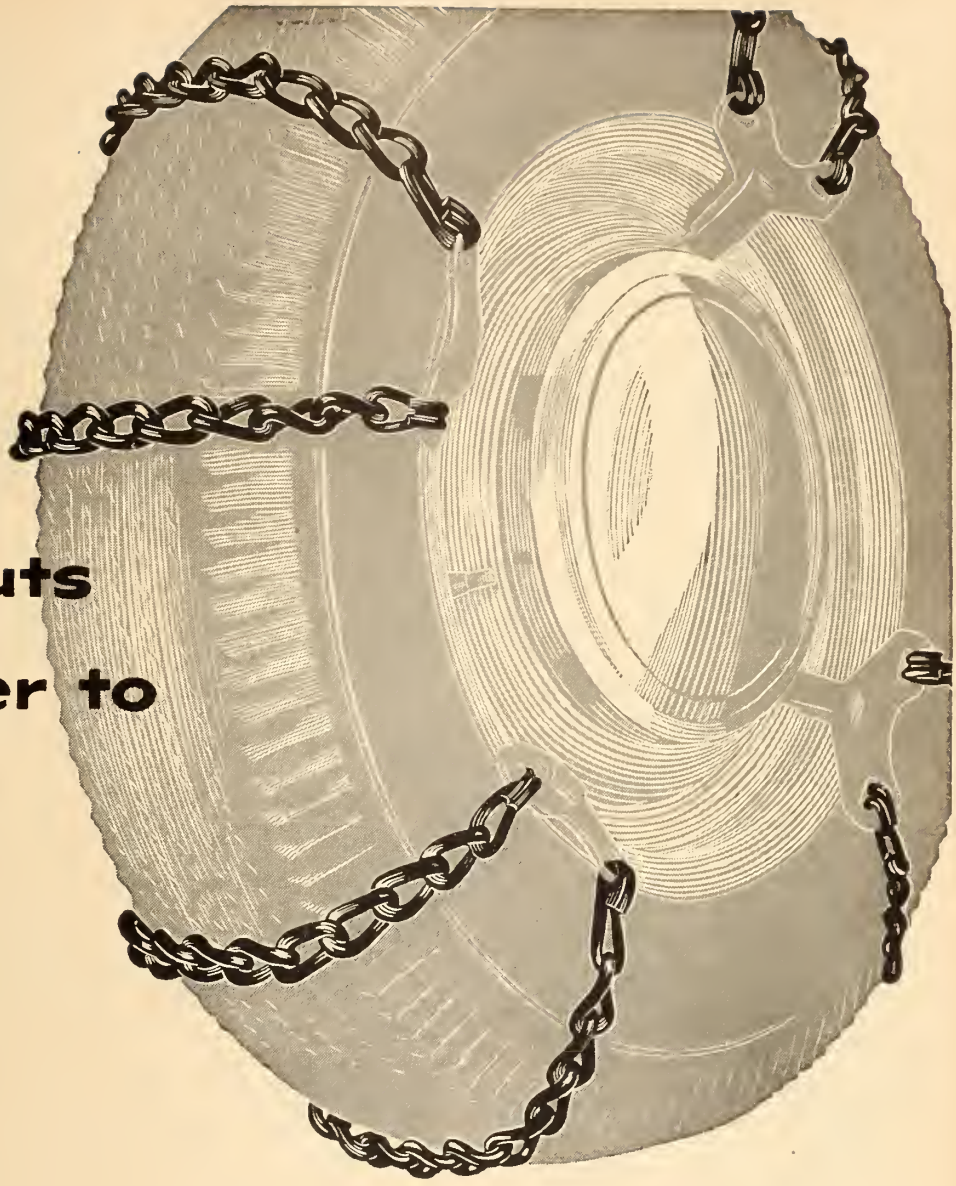
Mr. Harrison graduated in structural engineering from Constantine Technical

L. Harrison

College in 1939 and since that time has gained considerable experience as a structural steel engineer in England. Mr. Harrison arrived in Canada in 1951 where he joined the firm of Chemical Construction (Inter-American) Limited as senior structural engineer, a position he recently left to take up his present duties.

•

Addition to N.R.C. Staff.—Dr. Peter M. Millman, formerly chief of the Stellar Physics Division of the Dominion Observatory, has joined the staff of the National Research Council of



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Canada to lead their section on upper atmosphere research, in N.R.C.'s Division of Radio and Electrical Engineering.

Dr. Millman was born in Toronto in 1906. He received the B.A. degree from the University of Toronto in 1929, the A.M. degree from Harvard University in 1931, and the Ph.D. from Harvard in 1932, all in astronomy.

He was on the staff of the David Dunlap Observatory and lecturer in astronomy, University of Toronto, from 1933 to 1945.

He was in the R.C.A.F. from 1941 to 1946, first as navigation instructor, later in charge of operational research for the R.C.A.F., and he retired with the rank of squadron leader. One of his last duties in the Services was to plan the research reporting procedures, for the Air Force, on winter Exercise Musk Ox in 1946.

He was on the staff of the Dominion Observatory from 1946 to 1955, and has been chief of their Stellar Physics Division since 1951.

Dr. Millman's work for the past twenty years has been concerned mainly with meteors and meteorites, but he has also worked in the field of stellar radial velocities, and in the observation of solar eclipses from the air.

●

Vancouver Appointment.—The directors of Vancouver Machinery Depot Ltd. and Vancouver Iron Works Ltd.

Donald B. Grant

have announced the appointment of Donald B. Grant as president and general manager of both companies. Mr. Grant has been associated with Vancouver Machinery Depot since 1946 as secretary treasurer and latterly as executive vice-president.

●

Public Works Staff Change.—The Department of Public Works announced today the transfer of E. C. Martel of Ottawa, to the new post of assistant director (administration), Building Construction Branch. During the past two and one-half years Mr. Martel was executive assistant to the deputy minister of Public Works and, prior to that, departmental chief of personnel for three years. He has been a member of the Department since 1946.

Fenco Director.—Lloyd Montgomery Pidgeon, M.B.E., has been appointed to the board of directors of Foundation of Canada Engineering Corporation Limited of Toronto and Montreal.

Dr. Pidgeon is head of the department of metallurgical engineering of the University of Toronto, which position he has held since 1943 and is a consultant in the field of chemistry and metallurgy. It was he who developed a process for the production of metallic magnesium which is employed by one plant in Canada and five plants in the U.S.A. He is the author of numerous scientific publications.

Dr. Pidgeon is a Fellow of the Royal Society of Canada and a Member of the Order of the British Empire. He is a member of the Canadian Institute of Mining and Metallurgy, the American Institute of Mining and Metallurgy, and of the Association of Professional Engineers of Ontario.

L. M. Pidgeon

New Equipment and Developments

Electric Motors in Industry.—Today electric motors are performing a multitude of tasks in practically every Canadian industry from B.C. to Newfoundland. Most of their functions are of an everyday nature but now and then a unique application comes to light.

That's the case at Black Lake in Quebec where 50 million tons of asbestos-containing ore lies beneath 50 feet of water and 30 million cubic yards of clay, sand, gravel and silt.

To get at the deposits the lake will be drained, and helping to do the job will be two Canadian Westinghouse 6000 horsepower motors, an 800 horsepower unit and associated controls and switchgear.

The mud and water will be pumped to a disposal area three miles away after a river running into Black Lake has been diverted. On a dredge, powered by the 800 h.p. motor, a device similar to a propellor will stir up the lake bottom and then the 6000 hp. units will power the pumps doing the disposal job. It is estimated that the operation will take about three years to complete.

●

Expansion at Shell Oil.—A four million dollar expansion program at Shell Oil Company of Canada's Montreal East refinery was announced recently by Dr. D. M. Morrison, vice-president, manufacturing. The extensions scheduled for completion late in 1955, are intermediate steps in an overall program designed to ultimately increase the refinery's capacity from 44,000 to 55,000 barrels of crude oil per day.

The current expansion includes the addition of a new vacuum flasher and an increase in the capacity of the catalytic cracking unit from 16,500 to 19,500 barrels per day. A contract for the construction of the vacuum flasher has been awarded to Arthur G. McKee Company of Canada, Limited, a firm which shared in the last major expansion and modernization program at the refinery in 1950. Work on the catalytic cracker is being undertaken by Shell's engineering staff.

Dr. Morrison stated that the cat cracker capacity is being increased through the installation of a new furnace and a novel internal regenerator cooler, the first of its kind in Canada. Upon the completion of the vacuum flasher the combined capacities of the new and existing units will be raised 32,500 barrels daily.

●

Rock Bolts a Stelco Safety Device.—Combatting the risks of the physical factors in mining, tunnelling, rock cuts on railway rights-of-way, canal development and highway construction are certain engineering problems. To overcome these problems there is an ever-growing fund of accumulated experience, knowledge and engineering devices such that can safely predict an increasing practical control over such physical hazards as bad ground, rock bursts or improper handling of explosives.

One such device, now being produced by The Steel Company of Canada, Limited, Montreal, is known as "mine roof bolts." Through their diversified use they might more properly be termed "rock bolts".

Mine roof bolts have proved themselves superior to timbers in many instances in mine roof control. Experience has shown that in both coal and metal mining the use of mine roof bolts has materially reduced roof-fall accidents (a worthwhile achievement in itself), and has improved operating efficiency by: reduced timber costs and storage, speeding up loading and haulage, providing greater clearances, laterally and overhead, improving air conditions.

Stelco is now offering two types of mine bolts — the expansion type and the slotted type. For full information contact The Steel Company of Canada, Limited, Heavy Bolt Division, 525 Dominion Street, Montreal or any Stelco office coast to coast.

●

Contract Awarded by Alcan. — The Aluminum Company of Canada has awarded the construction contract for the aluminum smelter expansion at Kitimat to the Saguenay-Kitimat Company, a newly organized subsidiary. Construction started in February. It is planned that the additional smelter will start in operation in early 1956.

The Saguenay-Kitimat Company's operating headquarters will be Kitimat, B.C. Its head office will be 1700 Sun Life Building, Montreal, P.Q. A tempor-

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ary branch office will be opened in Vancouver, B.C.

Mr. McNeely DuBose, M.E.I.C., is president of the Saguenay-Kitimat Company and Mr. F. T. Matthias has been appointed general manager. Key staff appointments are: construction manager, H. C. Jenkinson; construction superintendent, John B. Whitton; purchasing agent, D. T. Lynch; personnel director, R. L. Auger.

The presently planned expansion program involves additional smelter capacity of 60,000 tons of aluminum per year.

●

New, Smaller Air Starting Motor.—Ingersoll-Rand, the originator of air starting motors for diesel and large gasoline engines, announces a third size starting motor in their line. This new starting motor is known as the Size 5BM and is designed for starting service on gasoline engines with from 750 to 1750 cu. in. displacement and for diesel engines from 300 to 700 cu. in. displacement.

This new starting motor incorporates the time proven Ingersoll-Rand Multi-Vane air motor as the power source, and is directly connected by means of a splined shaft to the Bendix drive unit. This design eliminates gears and assures minimum maintenance. The bearings in the air motor are sealed to keep grease in and dirt out.

Smaller and more compact than equivalent electric starters, the air starting motor gives reliable starting service at all times. It eliminates the necessity of generators, banks of storage batteries, and the cost of battery maintenance and replacement. It is not affected by climate conditions, which often injure the insulation of electric starting motors because of deterioration of windings.

The new 5BM air starting motor joins the Ingersoll-Rand line including the larger Size 9BM and the largest Size 20BM, thus providing air starting advantages for the complete range of heavy-duty internal-combustion engine starting requirements.

For more information write Canadian Ingersoll-Rand Company Ltd., 800 Birks Building, 620 Cathcart Street, Montreal, or your nearest C-I-R Branch Office.

●

New SKF Building.—With the official opening on February 15 of Canadian SKF Company warehouse and office, at the junction of Metropolitan Boulevard and Upper Lachine Road, another very modern one-storey building became part of the rapidly expanding industrial development taking place in Montreal West. Of buff brick construction, the building is of advanced design. One of its outstanding features is the glass and aluminum tower-shaped corner entrance. Floor space is 12,000 square feet. There is sufficient room for expansion as needed and there are ample parking facilities, one of the reasons why SKF and other companies are finding it advantageous to build in suburban developments.

Mr. Gunnar Wester, president of Canadian SKF Company, officially opened the building, which he said had been planned for Montreal in accordance with company policy of keeping abreast of industrial growth in the Province of Quebec and in Canada as a whole.

The first Montreal Office was opened 36 years ago, two years after the company's establishment in Canada. Four years ago, a new head office and manufacturing division were opened at Scarborough, Ont.

●

Canadian Liquid Air Expands.—A $500,000 expansion of its manufacturing and distributing facilities has been launched in B.C. by Canadian Liquid Air Company Ltd., with construction of new plants at Victoria and Kitimat.

They bring to five the number of Canadian Liquid Air plants in B.C. Besides plants in Vancouver, North Vancouver and Cranbrook, the company has 19 other oxygen and 12 acetylene plants across Canada. At Montreal, the company operates plants for manufacturing medical gases, oxy-acetylene welding and cutting equipment, and electrodes for arc welding, as well as design and manufacturing shops for the building of low temperature gas separation plants. A research laboratory is also maintained in that city.

The company's Kitimat plant is the first independent manufacturing operation to be established at the Aluminum Company of Canada's huge smelter centre.

●

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The revenue derived from the sale of advertising space assists the Institute in publishing the *Journal* on a regular monthly basis. Listed below are the names of the Companies and Individuals whose advertisements appear in this Issue.

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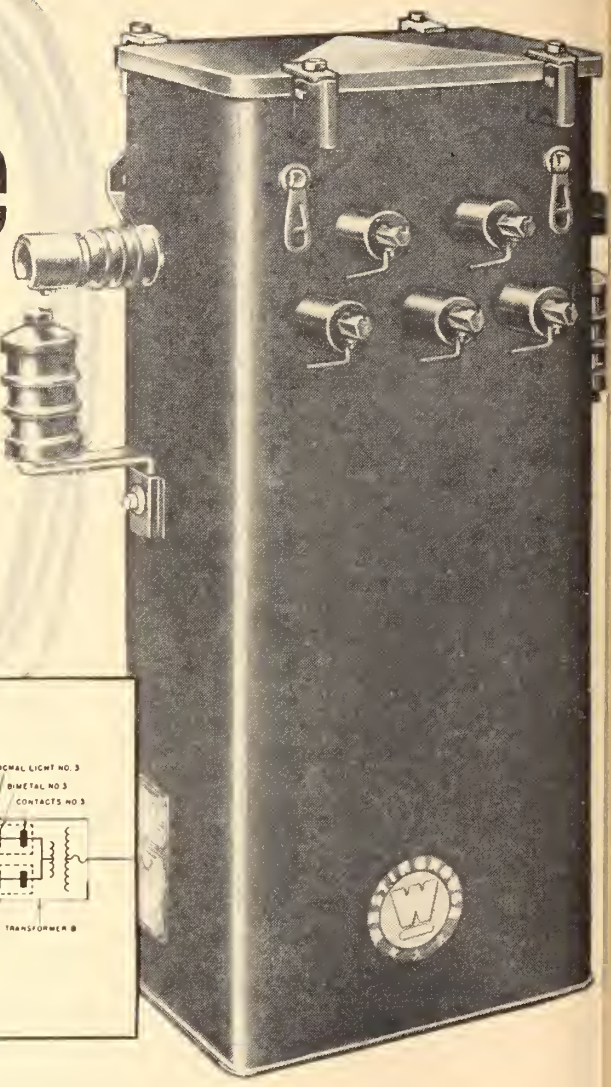

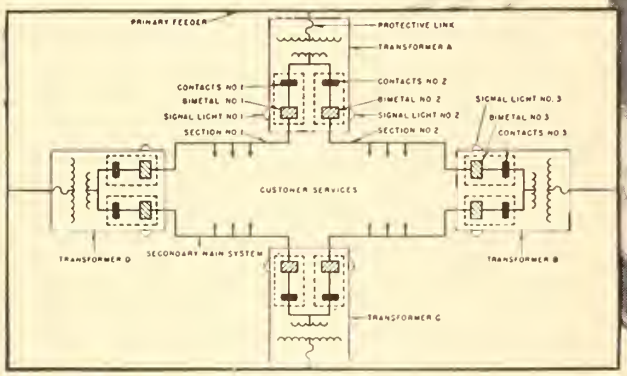

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Recent Developments in the Design and Manufacture in Canada of

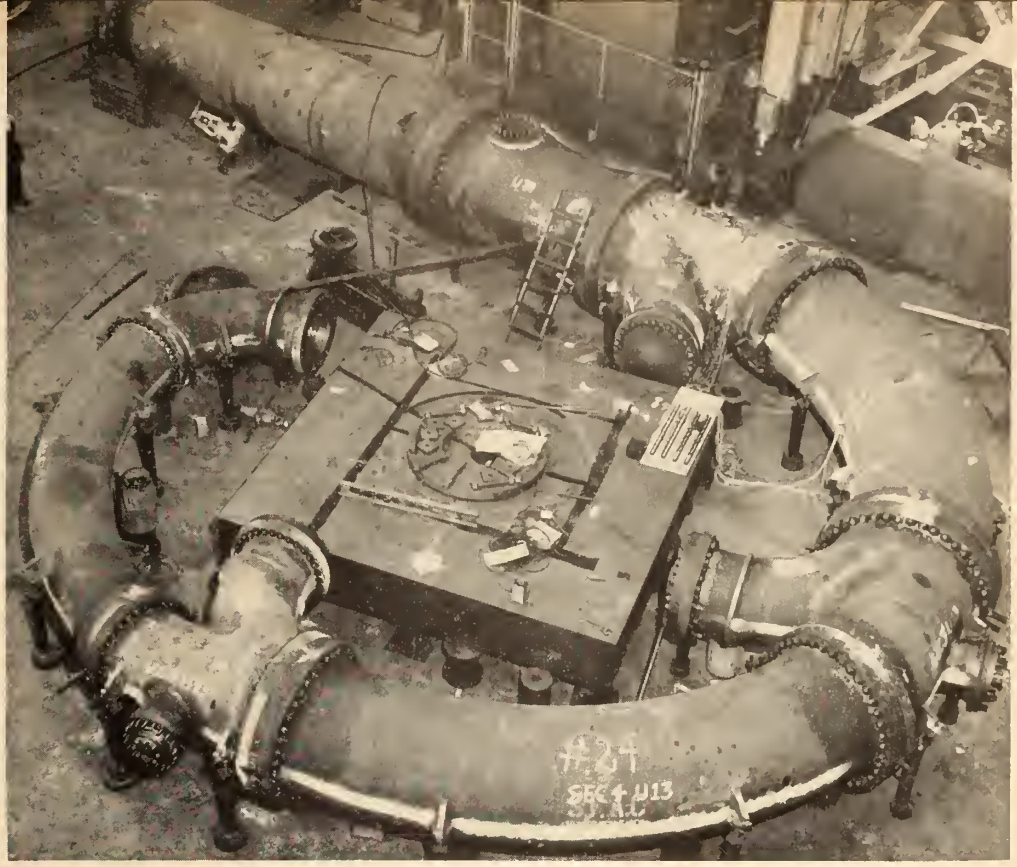


Fig. 18. Manifold assembly; note the strain gauges on the branch at upper right.

Large Capacity Hydraulic Turbines

by

R. S. Sproule, M.E.I.C.

Manager, Hydraulic Division.
Dominion Engineering Works, Ltd.,
Montreal.

A paper to be presented before the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

The development of hydroelectric power in Canada since about 1945 has been spectacular, though it has not attracted as much attention as other developments more in the public eye, e.g., television. Canadian manufacturers have managed to get most of the orders for the turbines required and also to supply some for export, but only by supporting generous research programs and by improving designs and manufacturing methods. This paper discusses postwar trends and gives a number of examples of today's practices.

Since the end of World War II installed hydroelectric power in Canada has increased from 10 million to over 17 million horsepower. Of the total increase only one major turbine was foreign built, and over 60 percent of the horsepower was completely designed in Canada. Further, more than one and a half million horsepower has been designed and built in Canada for operation in foreign countries since the war. The table lists the major hydraulic turbines designed and manufactured or manufactured in Canada during the period under consideration. Included are many spectacular and some record-breaking achievements, but one important feature of the list has received little publicity: that is, the large number of big turbines reliably turning out power at high-load factors. As an example, the 13 Beauharnois turbines developed 35 x 10^8 kwh. (this figure allows for the generator efficiency) in 1954, or 76 percent of the turbine rating operating full time. At the Chute à la Savanne plant, 1954 production by the five turbines was 15 x 10^8 kwh. or 81 percent of full load.

The dimensionless quantity "specific speed", $N_s = N\sqrt{H.P}\,/\,H^{5/4}$, is used to classify turbine runner design. There is a strong incentive to increase the specific speed of turbines installed under any given head, because higher speeds lead to lower generator costs and to reduced powerhouse dimensions. Figure 1 is a plot of turbine specific speed against head for the Francis turbines listed in the table, the number on the graph corresponding to the reference number in the table. If values from this plot are compared with those of prewar practice in Canada it will be found that there is an appreciable increase in specific speed throughout the head range shown.

One point in Figure 1 which requires explanation is No. 8, referring to the Paulo Afonzo plant of the Cia Hidro Electrica do Sao Francisco in Brazil, having a specific speed of 53.5 and a head of 266 feet.

This is in an underground powerhouse with the centre line of turbine distributors set 15 feet below minimum tail water level. The low setting was selected because of the rock structure and is suitable for the relatively high speed chosen. The smaller size of the turbines and generators made possible by the higher speed resulted in economies of excavation as well as of machinery costs. (1).

A great deal of unpublicized design and research work has been done in Canada since World War II with the object of raising the efficiency of hydraulic turbines to optimum values. Fig. 2 and 3 show some results of this work. Fig. 2 is a sheet showing the results of the field test of the eight 62,000 hp. Des Joachims turbines of the Hydro-Electric Power Commission of Ontario. The lower curve is the average of the first four units equipped with a prewar runner design, while the upper curve is the average of the last four units, using a runner design which has been developed recently by the author's company. The efficiency increase shown by these field tests is about the same as the differential in the laboratory tests of the model runners.

Figure 3 illustrates some of the postwar work done on model Francis runners in the author's company's hydraulic laboratory. Each curve is a plot of efficiency against power for a runner of one foot throat diameter operating under a head of one foot. These curves show the performance of 16-in. or smaller diameter model runners for only a few of the many tests made. Most of these model runners were tested with many design modifications, including variations of inlet diameter and outflow area to establish the ranges of specific speed and unit power for which they are suitable.

Closely allied to the development of high efficiency runners is cavitation testing. This is not altogether a new development in Canada; as early as 1926 a cavitation laboratory was operated at Shawinigan Falls by the Shawinigan Water and Power Company and the Dominion Engineering Works. This laboratory

Major Hydraulic Turbines Manufactured in Canada since World War II

Ref. No.	Name of plant	Operated by	Unit Capacity horsepower	Head, feet	r.p m	No. of Units	Made by *
1	Kemano	Aluminum Co. of Canada	150,000	2485	327	1	CAC
2	Kemano	Aluminum Co. of Canada	150,000	2485	327	1	DEW
3	Kemano	Aluminum Co. of Canada	150,000	2485	327	1	VEW
4	Waneta	Consolidated Mining & Smelting Co.	120,000	210	120	2	DEW
5	Sir Adam Beck, Niagara No. 2	H.E.P.C. of Ontario	105,000	292	150	12	DEW
6	Cubatao Underground	Sao Paulo Light & Power Co.	88,000	2243	450	4	DEW
7	Nilo Pecanha	Rio de Janeiro T.L. & P. Co.	88,000	995	375 450	3	DEW
8	Paulo Afonzo	Sao Francisco Hydro-Electric Co.	83,000	266	200	3	DEW
9	Wahleach Lake	B.C. Electric Co.	82,000	1880	360	1	VEW
10	Decew Falls	H.E.P.C. of Ontario	75,000	265	265	1	CAC
11	Lake Buntzen	B.C. Electric Co.	70,000	400	240	1	VEW
12	Shawinigan No. 3	Shawinigan Water & Power Co.	65,000	145	120	3	DEW
13	Trenche	Shawinigan Water & Power Co.	65,000	159	128	6	DEW
14	Ilha dos Pombos	Rio de Janeiro T.L. & P. Co.	62,000	106	93	1	DEW
15	Des Joachims	H.E.P.C. of Ontario	62,000	130	105	8	DEW
16	Spray	Calgary Power Co.	62,000	875	450	1	DEW
17	Chute à la Savanne	Aluminum Co. of Canada	57,000	110	105	5	DEW
18	Beauharnois	Hydro-Quebec	56,500	80	75	6	CAC
19	McCormick	Manicouagan Power Co.	56,200	124	112	2	MSC
20	Chute au Diable	Aluminum Co. of Canada	56,000	110	105	5	CAC
21	Roxburgh	New Zealand State Hydro	56,000	136	62	4	DEW
22	Peixoto	Cia Paulista de Forca e Luz	56,000	128	55	2	DEW
23	Beauharnois	Hydro-Quebec	55,000	78	75	6	DEW
24	Beauharnois	Hydro-Quebec	53,000	80	75	1	DEW
25	Plant X	U.S.S R.	46,000	106	107	2	DEW
26	Pine Portage	H.E.P.C. of Ontario	45,000	105	109	1	MSC
27	Pine Portage	H.E.P.C. of Ontario	41,000	105	109	2	CAC
28	Seven Sisters	Manitoba H.E. Board	37,500	66	138	1	CAC
29	Seven Sisters	Manitoba H.E. Board	37,500	66	138	1	MSC
30	Seven Sisters	Manitoba Hydro	37,500	66	128	3	DEW
31	Brilliant	Consolidated Mining & Smelting Co.	37,000	90	100	1	DEW
32	Quinze	Northern Quebec Power Co.	35,000	90	107	1	CAC
33	Jim Gray	Price Brothers	35,000	338	277	2	CAC
34	Puntledge	Calgary Power Co.	35,000	340	277	1	CAC
35	Whakamaru	New Zealand State Hydro	35,000	123	136	4	DEW
36	Otto Holden	H.E.P.C. of Ontario	33,000	77	94	4	CAC
37	Otto Holden	H.E.P.C. of Ontario	33,000	77	94	4	EEC
38	Ghost	Calgary Power Co.	30,000	107	150	1	EEC
39	Tunnel	H.E.P.C. of Ontario	29,000	210	211	2	CAC
40	Stewartville	H.E.P.C. of Ontario	28,000	148	163	2	CAC
41	John Hart	B.C. Power Commission	28,000	390	327	6	DEW
42	Agusabon	H.E.P.C. of Ontario	27,500	290	257	2	DEW
43	Bryson	Gatineau Power Co.	27,000	60	120	1	DEW
44	Lois River	Powell River Co.	25,000	380	333	1	DEW
45	Farmers Rapids	Gatineau Power Co.	24,000	135	225	1	DEW
46	Rundle	Calgary Power Co	23,000	318	300	1	DEW
47	Chenaux	H.E.P.C. of Ontario	21,000	40	94	8	DEW

CAC	Canadian Allis Chalmers	1,349,500 hp.
DEW	Dominion Engineering Works	5,599,500
EEC	English Electric Canada	165,000
MSC	S. Morgan Smith of Canada	194,000
VEW	Vancouver Engineering Works	202,000
		7,510,900 hp

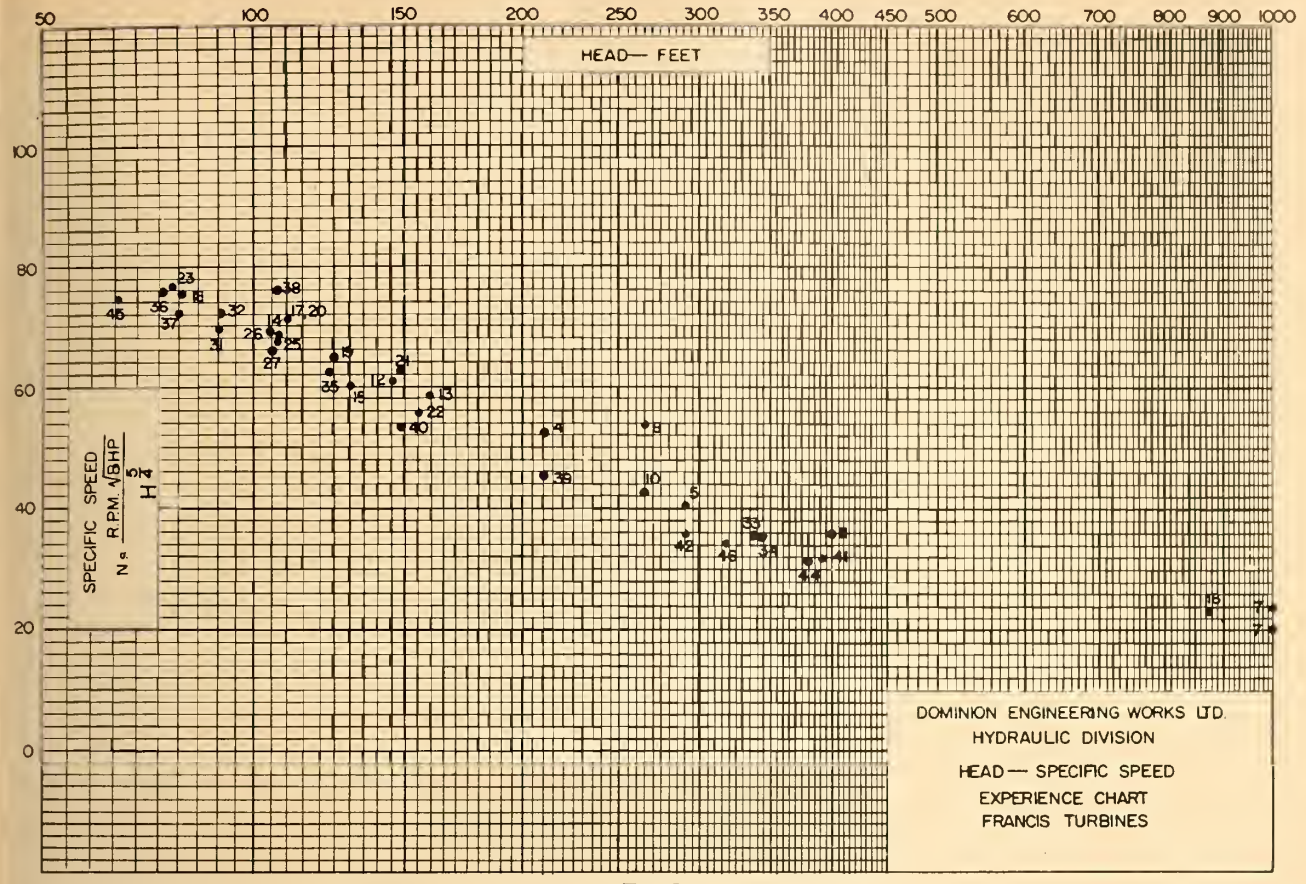

HEAD— FEET
SPECIFIC SPEED
Ns = R.P.M. √BHP / H^5/4
DOMINION ENGINEERING WORKS LTD.
HYDRAULIC DIVISION
HEAD — SPECIFIC SPEED
EXPERIENCE CHART
FRANCIS TURBINES

Fig. 1.

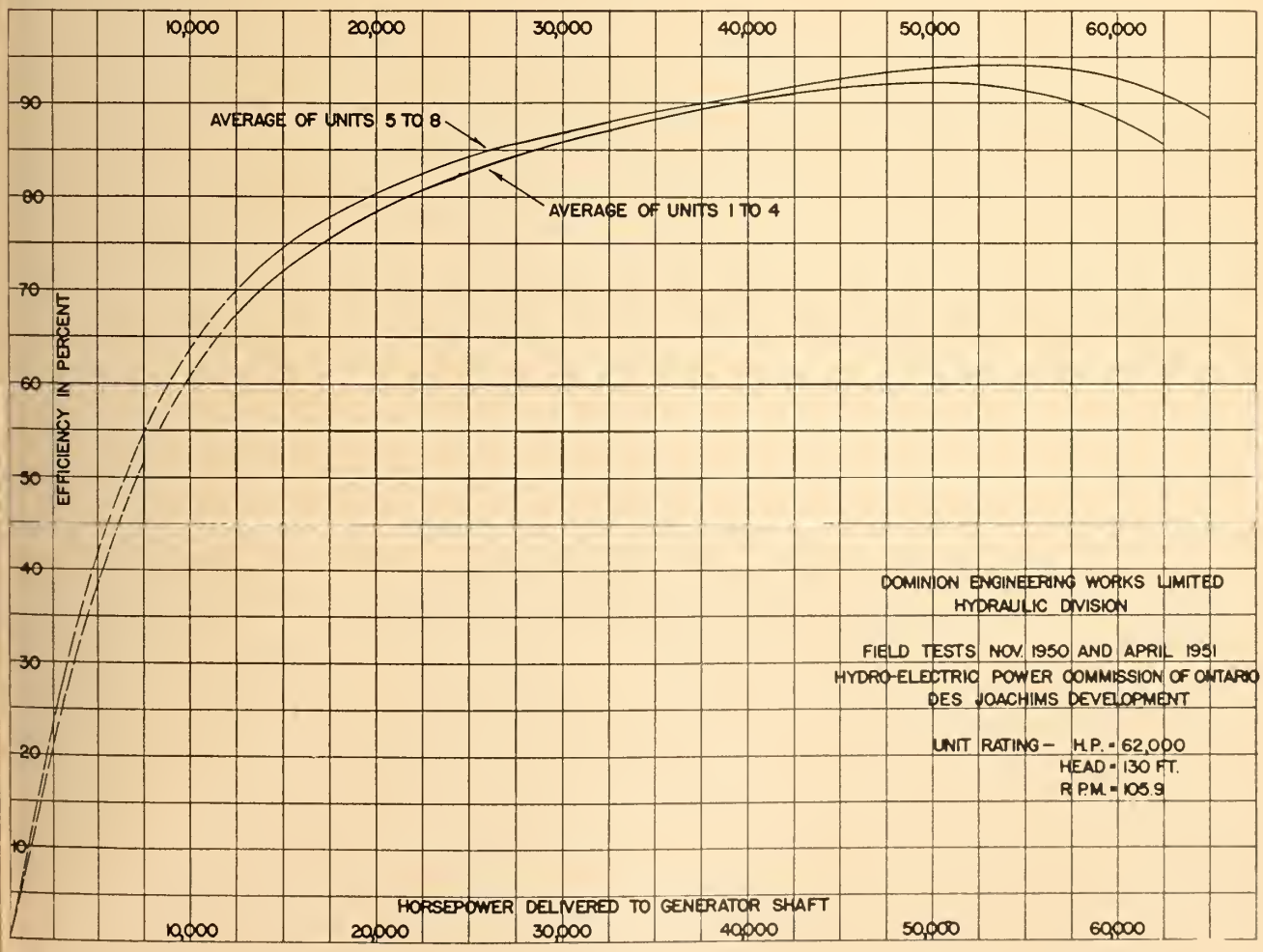

AVERAGE OF UNITS 5 TO 8
AVERAGE OF UNITS 1 TO 4
EFFICIENCY IN PERCENT
HORSEPOWER DELIVERED TO GENERATOR SHAFT
DOMINION ENGINEERING WORKS LIMITED
HYDRAULIC DIVISION
FIELD TESTS NOV. 1950 AND APRIL 1951
HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO
DES JOACHIMS DEVELOPMENT
UNIT RATING — H.P. = 62,000
HEAD = 130 FT.
R.P.M. = 105.9

Fig. 2.

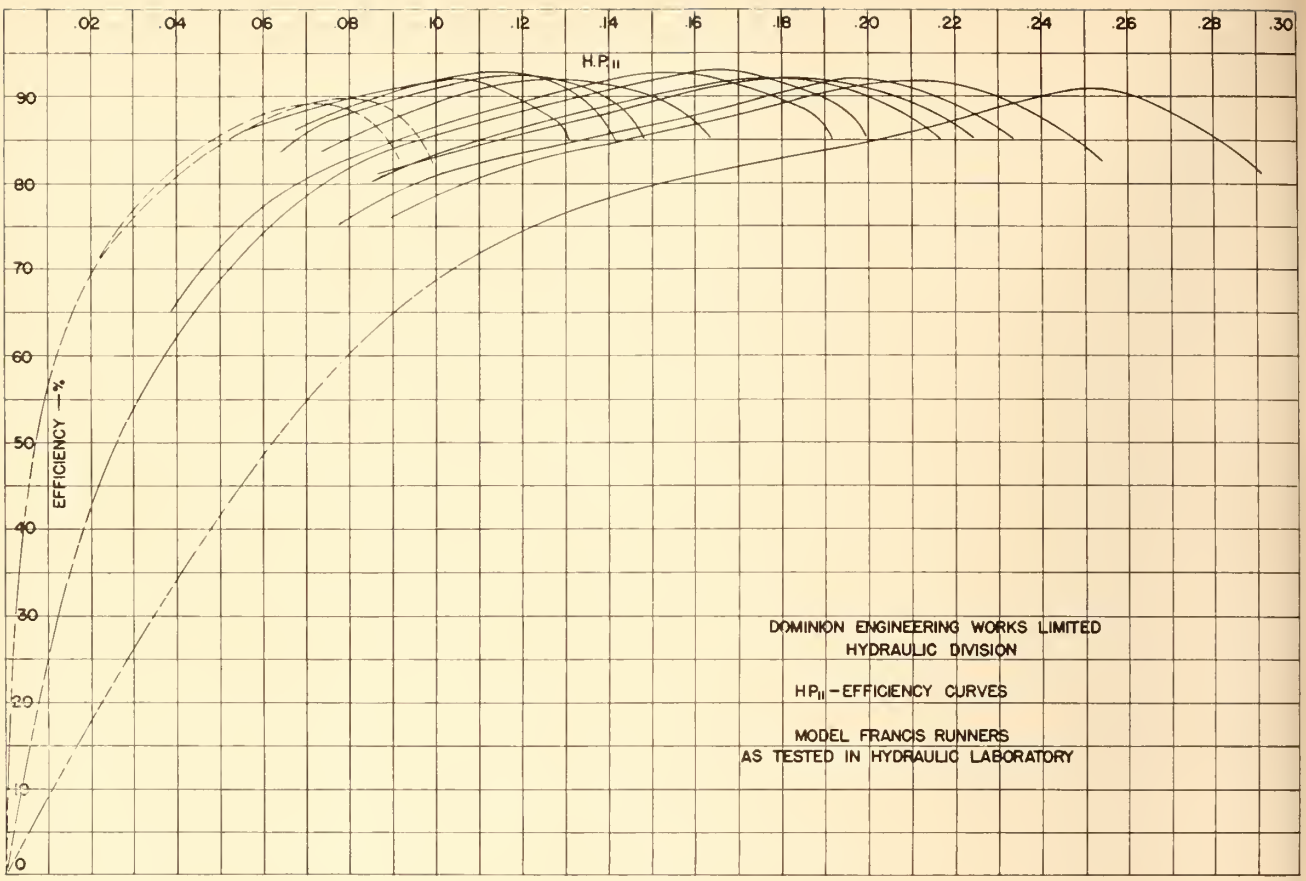

.02
.04
.06
.08
.10
.12
.14
.16
.18
.20
.22
.24
.26
.28
.30
H.P.11
90
80
70
60
50
40
30
20
10
0
EFFICIENCY — %
DOMINION ENGINEERING WORKS LIMITED
HYDRAULIC DIVISION
H.P.11 — EFFICIENCY CURVES
MODEL FRANCIS RUNNERS
AS TESTED IN HYDRAULIC LABORATORY

Fig. 3.

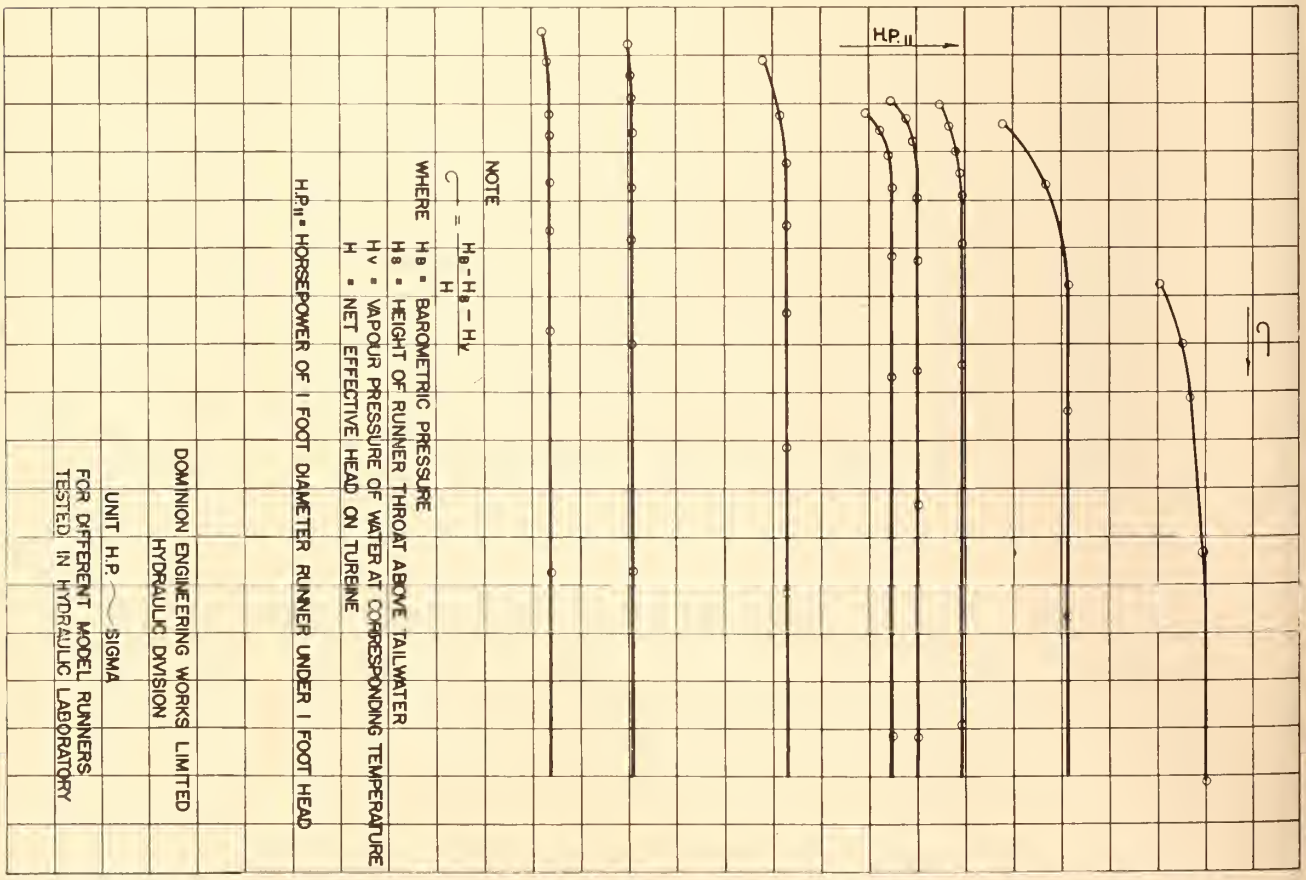

H.P.11
NOTE
σ = (Hb − Hs − Hv) / H
WHERE Hb = BAROMETRIC PRESSURE
Hs = HEIGHT OF RUNNER THROAT ABOVE TAILWATER
Hv = VAPOUR PRESSURE OF WATER AT CORRESPONDING TEMPERATURE
H = NET EFFECTIVE HEAD ON TURBINE
H.P.11 = HORSEPOWER OF 1 FOOT DIAMETER RUNNER UNDER 1 FOOT HEAD
DOMINION ENGINEERING WORKS LIMITED
HYDRAULIC DIVISION
UNIT H.P. ~ SIGMA
FOR DIFFERENT MODEL RUNNERS
TESTED IN HYDRAULIC LABORATORY

Fig. 4.

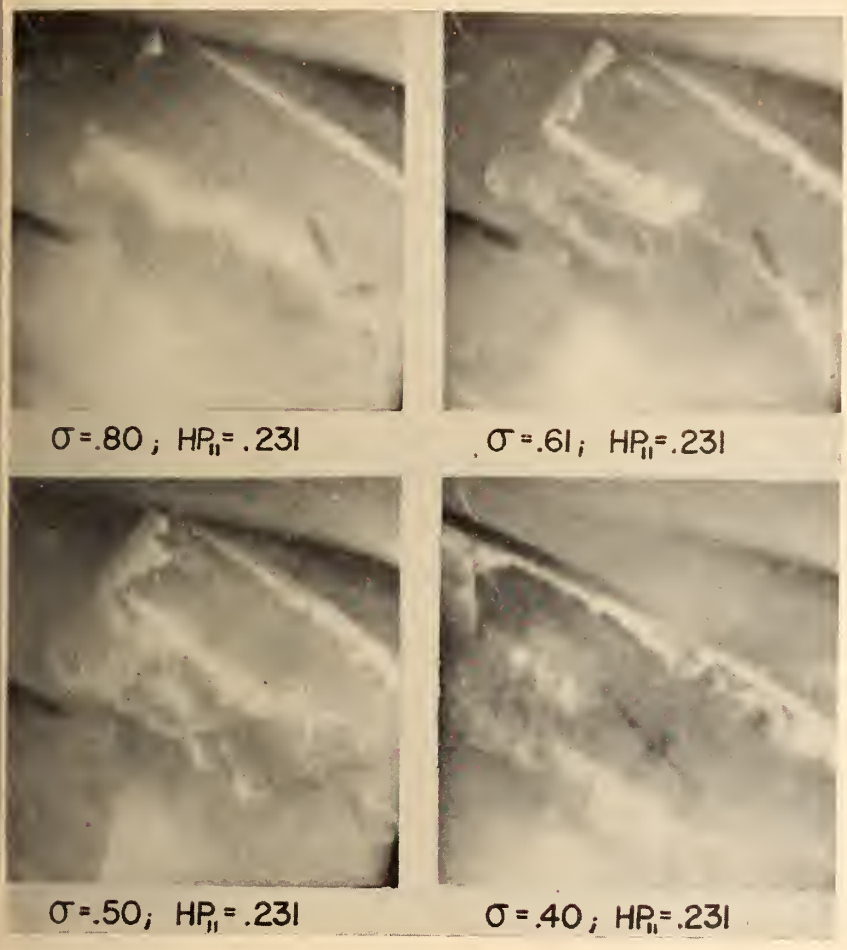


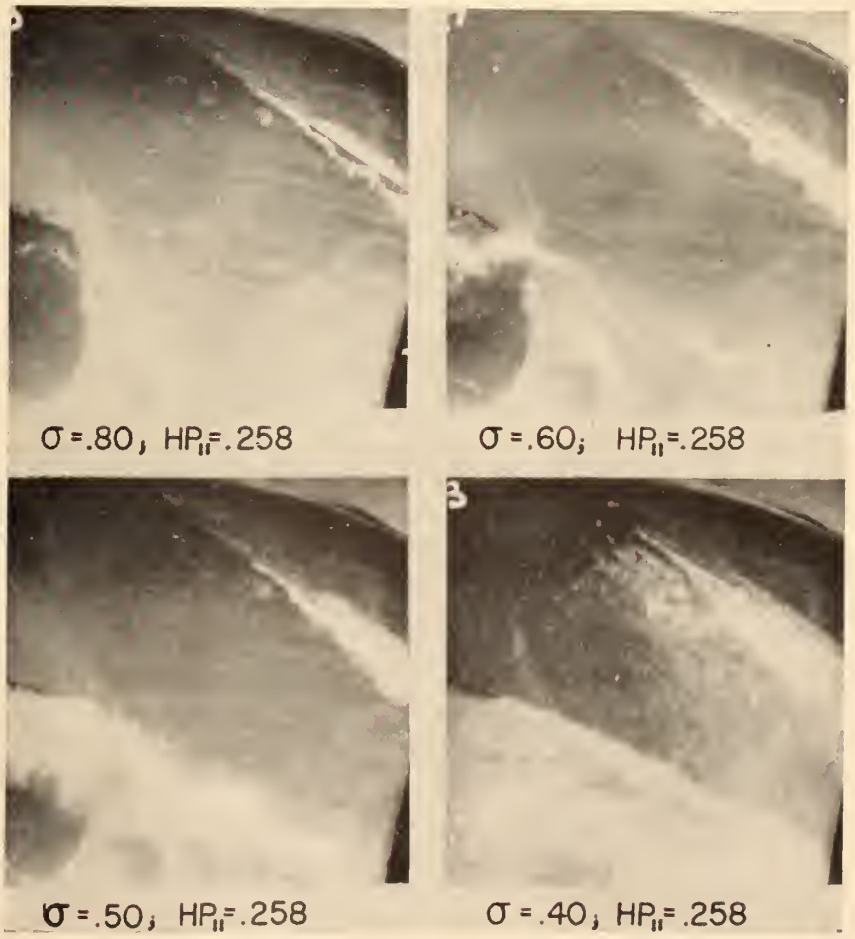
Fig. 5. (Above) Model A; Sigma variation at $\phi = 1.37$.

used a natural head of water with provision for wide variations in the tail water level. However, it is fair to say that the great stress put on eavitation testing sinee the war and the building of a large cavitation laboratory by the author's Company are new developments. This laboratory has been described elsewhere. (2), (3).

Figure 4 is a plot of unit power against the eavitation parameter sigma (σ) for some of the runners whose effieieney eurves are shown in Fig. 3. For any runner shown in Fig. 4, the curve represents a test at best effieiency, power and speed and at eonstant head. The break in the eurve shows the point at whieh cavitation becomes sufficiently serious to affeet the performance. The sigma value at this break may be used to decide how high a runner of any design tested should be set in relation to tail water level. It must be admitted, however, that there have been eases where serious cavitation damage has occurred to turbines, even though they were set at a sigma value well above the break in the power eurve established by eavitation tests of a homologous model runner. Such oeeurrences raise doubts as to the value of cavitation testing and also raise various queries regarding the margin of safety whieh should be used in applying cavitation test data.

Local cavitation of sufficient severity to cause serious pitting can be present in a turbine without involving any appreciable impairment of the capacity and efficiency of the unit. In many cases local cavitation may be accompanied by an increase in efficiency, particularly at part gate openings of fixed blade runners, but this does not make cavitation damage acceptable to the user. The desirable solution is to modify the design to eliminate or to reduce the severity of local eavitation. One practieal method of doing this is to study the cavitation phenomena by visual and photographie means so as to determine the effect of design changes over the usual range of operating conditions. The possibilities of this procedure can be readily demonstrated in the case of propeller model turbines equipped with a transparent housing around the runner.

Fig. 6. (Below) Model B; Sigma variation at $\phi = 1.37$.



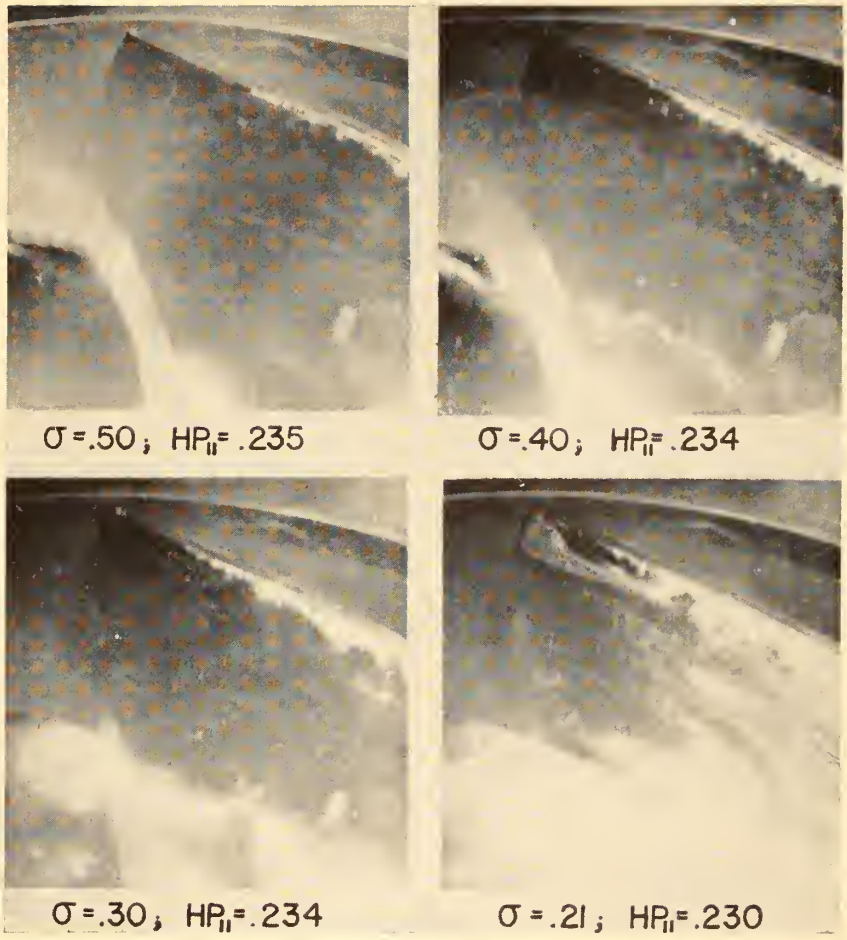


Fig. 7. (Above) Model C; Sigma variation at $\phi = 1.40$.

Cavitation phenomena are affected importantly by the following variable faetors:

The eavitation parameter sigma (σ) defined in Fig. 4.

The unit speed, which may be expressed as phi (ϕ), the ratio of the peripheral velocity at a seleeted point on the runner to the spouting veloeity for the operating head.

The position of the movable wieket gates which eontrol the quantity of water flowing through the runner.

The design of the runner and of the adjacent water passages.

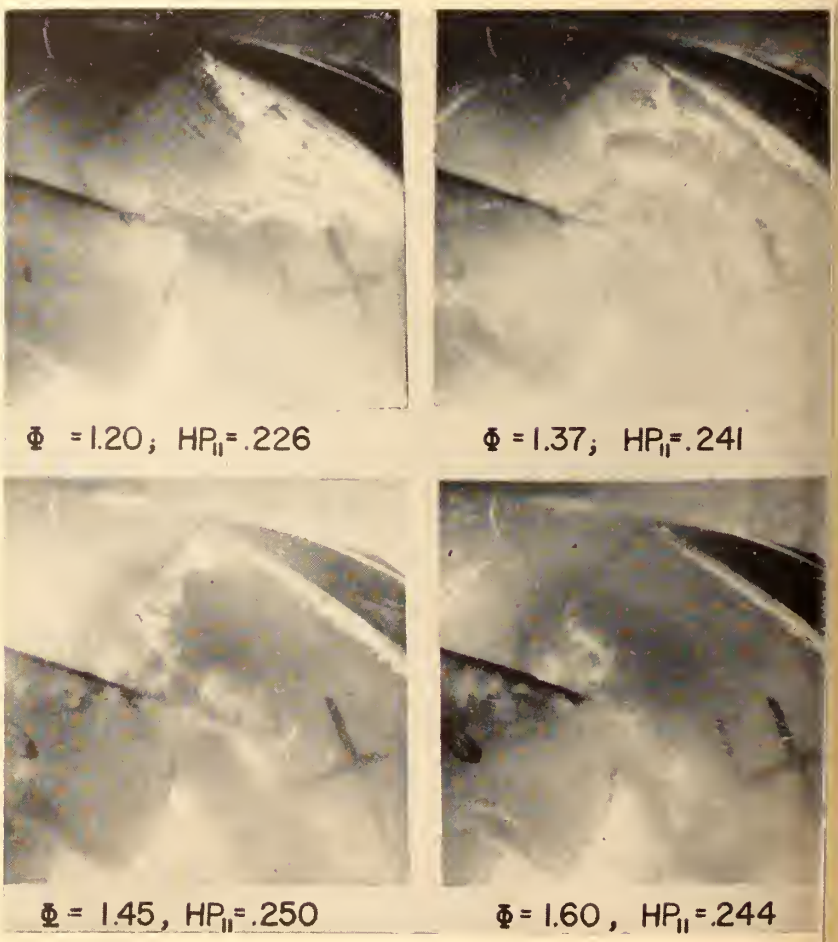
The nature of the effect of eaeh of these variables ean be observed most readily by ehanging one faetor at a time, with the others remaining substantially constant. Some examples of this procedure are shown here by flash photographs of fixed blade propeller turbine model runners looking inwards and upwards at the low pressure surfaees of the blades. The value of A noted on the figures is an indieation of the runner blade angle. Inereasing values of A show steeper blade angles with respect to a plane perpendicular to the turbine shaft.

Figures 5, 6 and 7 show the effect of sigma variation on three different models designated as A, B and C. For Figs. 5 and 6 the sigma range is from 0.8 to 0.4 and for Fig. 7 from 0.5 to 0.21.

Model A, Fig. 5, is a prewar design of relatively high specific speed, with minor modifications for operation at lower speed. It shows peripheral clearanee cavitation and entranee edge eavitation increasing in severity with reducing sigma. In this test the sharp break in the sigma vs. power eurve began at sigma 0.36, so that this is a good example of extensive eavitation above the eritical sigma.

Model B, Fig. 6, is a recent design having greater blade curvature than Model A, with the blade length increased near the hub and decreased near the periphery. This test shows no appreciable entranee edge cavitation throughout the sigma range tested. The clearanee eavitation is heavy at the lower sigma values and general eavitation over most of the blade surfaee is present at

Fig. 8. (Below) Model A; Speed variation at $\sigma = 0.50$.



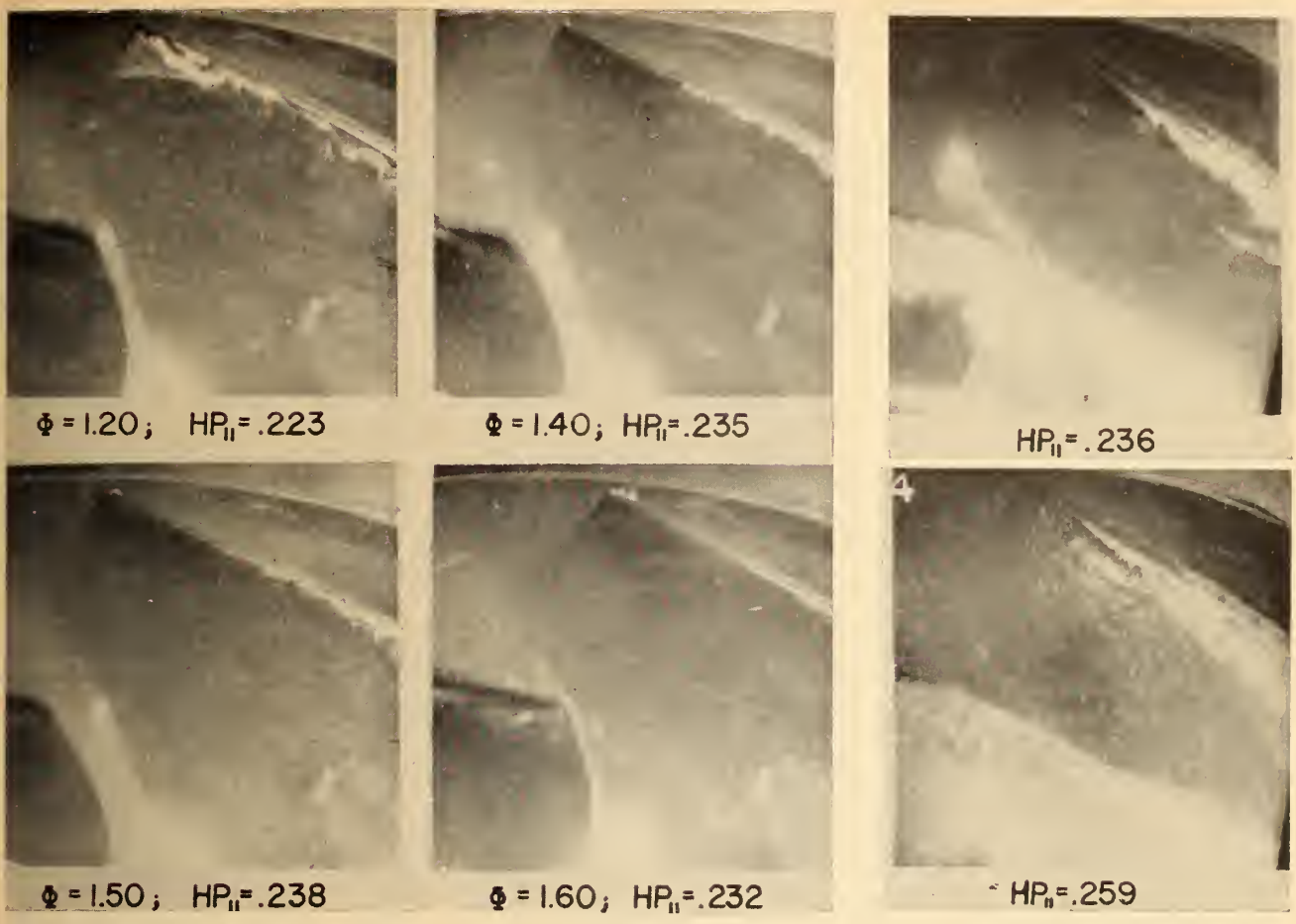


Fig. 9. (Above) Model C; Speed variation at $\sigma = 0.50$.

Fig. 10. Model B; Gate variation at $\phi = 1.37$ and $\sigma = 0.40$.

the lowest sigma, 0.4. At sigma values 0.8 and 0.6 this model shows another form of cavitation near the runner hub and entirely clear of the blade surface. It may be seen slightly above the blade in the lower centre of the parts of Fig. 6, showing $\sigma = 80$ and $\sigma = 60$. It is also present at the lower sigma values, but is hidden by the heavier clearance cavitation. In this test the sharp break in the sigma vs. efficiency curve started at sigma 0.5, but the power remained normal down to a sigma of 0.4 by virtue of an increase in discharge of about 4 per cent from sigma 0.5 to 0.4.

Model C, Fig. 7, is another recent design having greatly improved cavitation characteristics. Again the clearance cavitation increases as the sigma value is decreased. General blade surface cavitation has developed at sigma 0.21, but none is present for sigma 0.3 and higher. In this test the sharp breaks in the sigma vs. power and sigma vs. effi-

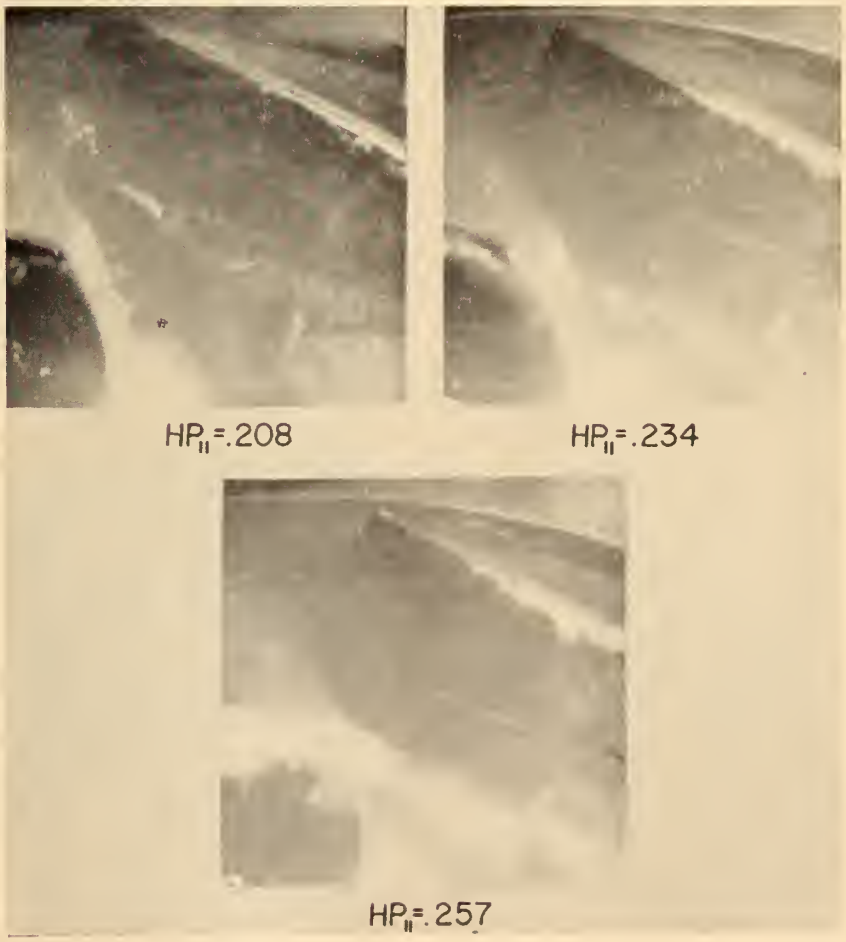


Fig. 11. (At right) Model C; Gate variation at $\phi = 1.40$ and $\sigma = 0.40$.

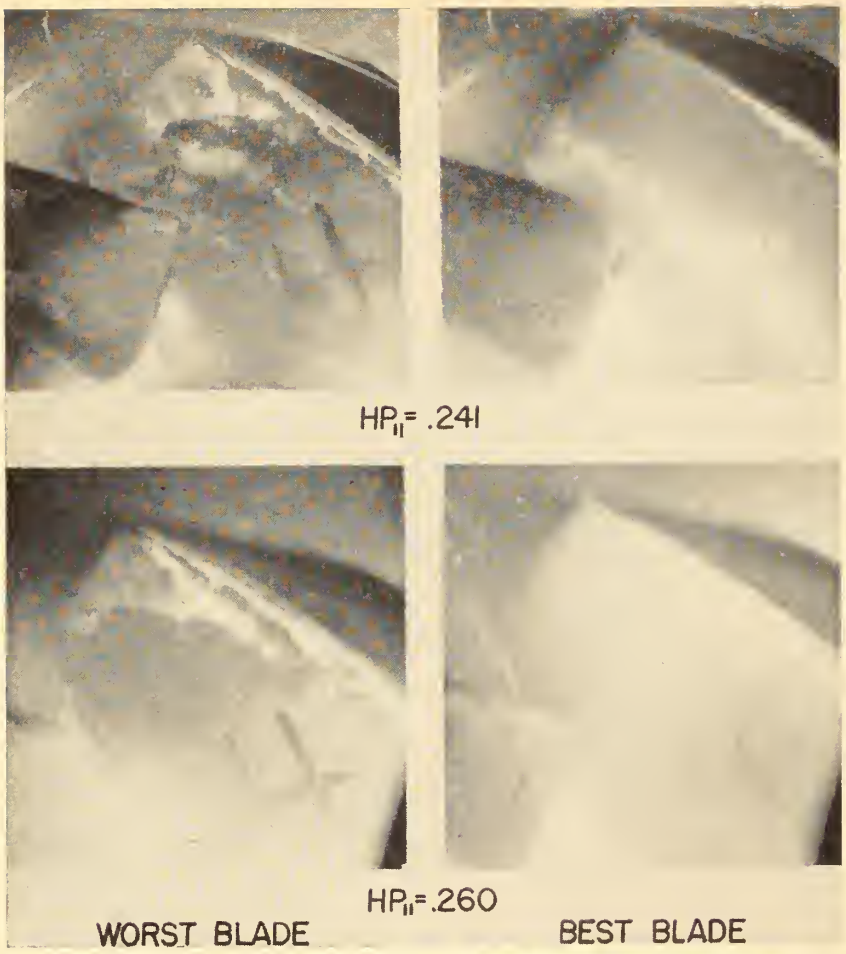


Fig. 12. (Above) Model A; Blade shape variation at ϕ = 1.39 and σ = 0.50.

ciency curves started at about sigma 0.25.

Figs. 8 and 9 show for one blade each of Models A and C how local cavitation is affected by speed change with constant sigma value and gate opening. It will be noted that the leading edge cavitation decreases greatly as the speed is increased. This occurs frequently in conjunction with an increase in power with increasing speed. For both of these runners the phi value for best efficiency is about 1.4 so that the lowest speed shown is well outside the normal operating range.

Figures 10 and 11 show for one blade each of Model B and C, when operating at sigma value of 0.4, how the cavitation may alter with gate opening. In both cases the clearance cavitation increases with increasing gate opening. Model B, Fig. 10, also shows a marked change in the character and magnitude of the blade surface cavitation, whereas Model C, Fig. 11, shows little change in this respect.

Figs. 12 and 13 show some very interesting comparisons of cavitation variation with different designs of runner blades. Fig. 12 shows the extreme variations of cavitation on the blades of Model A at constant sigma 0.51 and two gate openings, best efficiency gate and full gate. The blade castings are from the same pattern and the difference in cavitation is due to small variations in the finished blade surface near the leading edge. Fig. 13 shows the relative cavitation for Models A, B and C at sigma 0.4 and at substantially the same speed and unit power. It also shows for Model C the effect of increasing the unit power about 7 per cent by using a steeper blade angle. This change increases the clearance cavitation slightly without any other visible change.

These photographs clearly demonstrate that the most important factors affecting cavitation on propeller runners are the cavitation parameter sigma and the design of the runner blades. The number of runner blades and their length at the periphery have an important

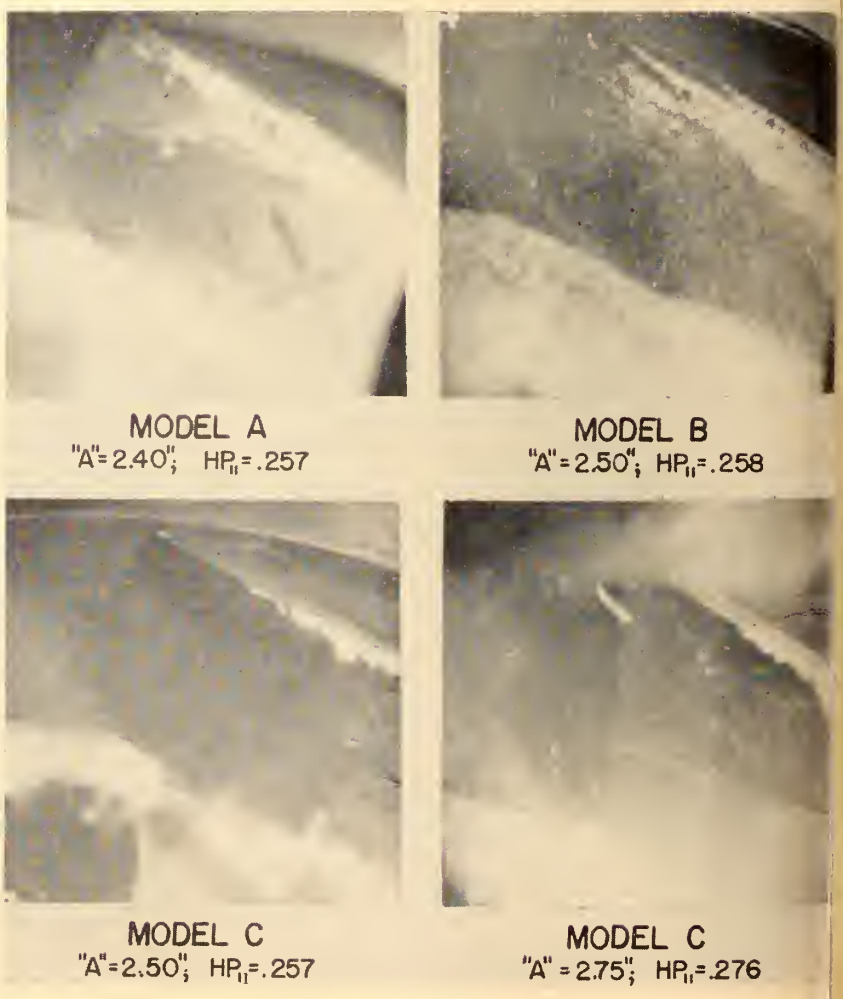


Fig. 13. (Below) Blade shape and angle variation at ϕ = 1.40 and σ = 0.40.

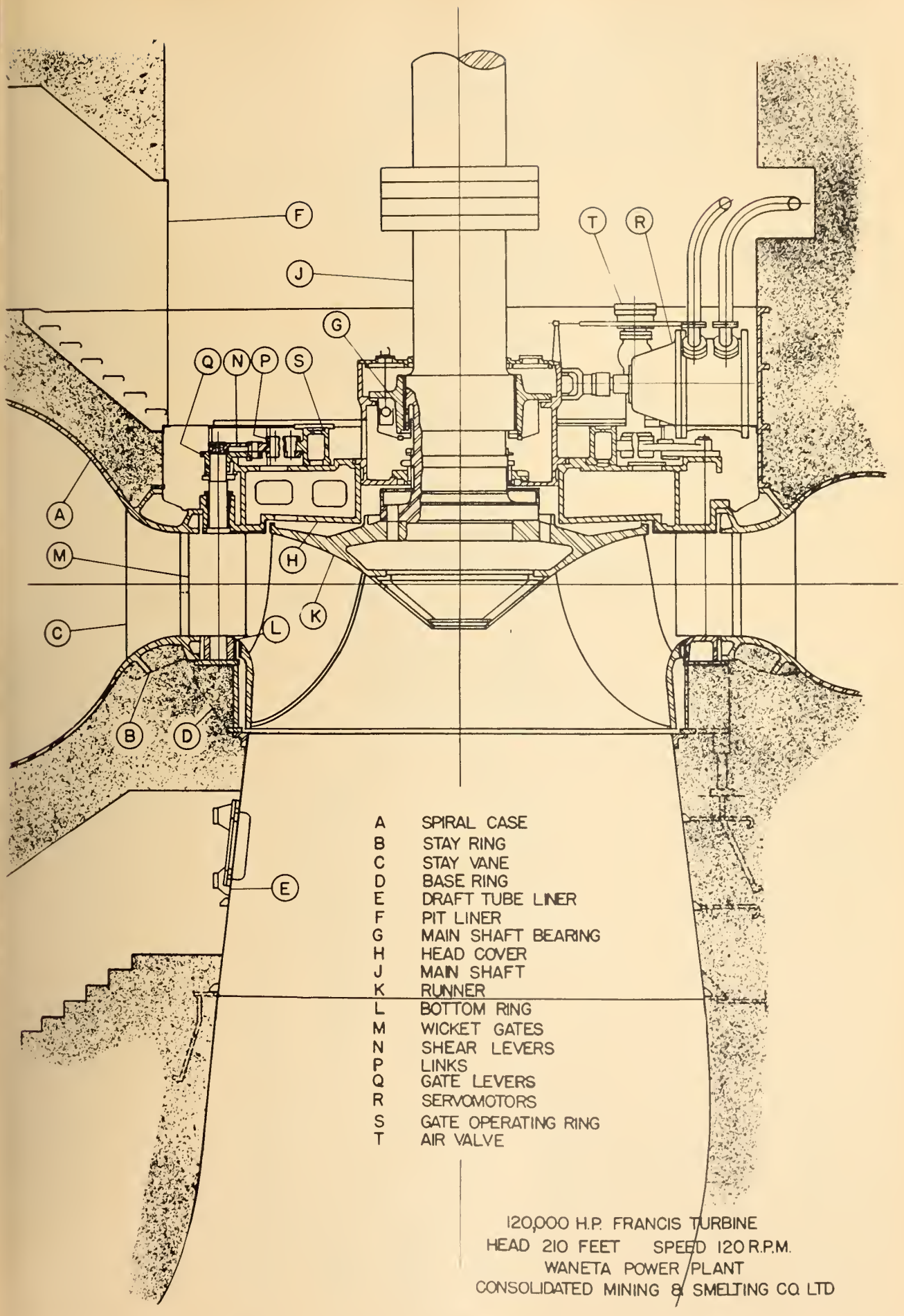
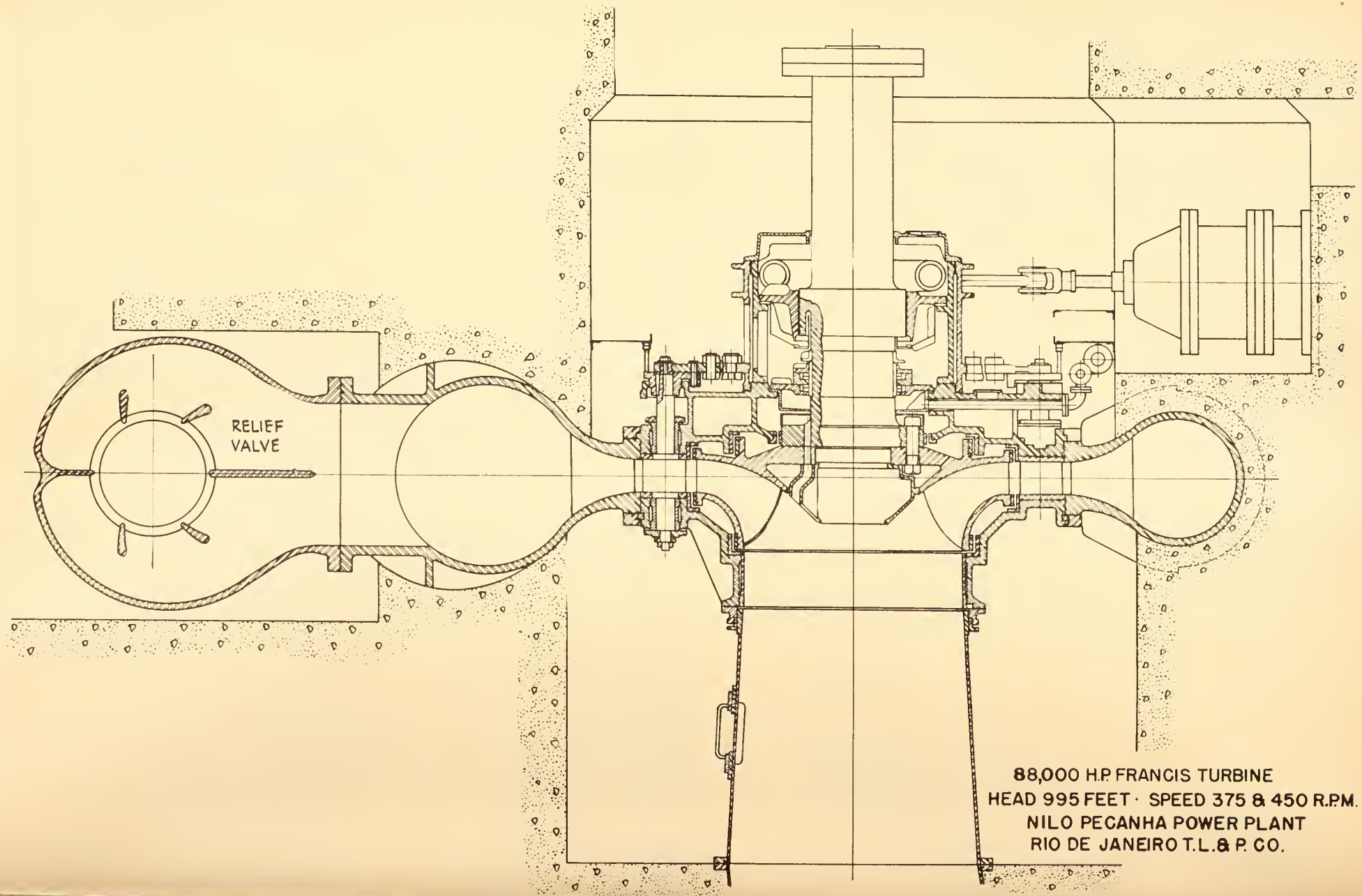

A SPIRAL CASE
B STAY RING
C STAY VANE
D BASE RING
E DRAFT TUBE LINER
F PIT LINER
G MAIN SHAFT BEARING
H HEAD COVER
J MAIN SHAFT
K RUNNER
L BOTTOM RING
M WICKET GATES
N SHEAR LEVERS
P LINKS
Q GATE LEVERS
R SERVOMOTORS
S GATE OPERATING RING
T AIR VALVE
120,000 H.P. FRANCIS TURBINE
HEAD 210 FEET SPEED 120 R.P.M.
WANETA POWER PLANT
CONSOLIDATED MINING & SMELTING CO. LTD

Fig. 11.



88,000 H.P. FRANCIS TURBINE
HEAD 995 FEET · SPEED 375 & 450 R.P.M.
NILO PEÇANHA POWER PLANT
RIO DE JANEIRO T.L. & P. CO.

effect on clearance cavitation. Proper limitation of the maximum gate opening is also important. The most severe operating condition is a combination of full gate opening and maximum head which results in minimum sigma and phi values.

Possibly the best way to discuss recent developments in mechanical design would be to show a cross section of a typical turbine and to describe the machine briefly for the benefit of those who are not familiar with this type of machinery, as well as to point out items which may be of interest even to engineers who habitually work with hydraulic turbines.

Figure 14 is a vertical cross section of one of two 120,000 hp. vertical shaft Francis turbines installed in the Waneta power station of the Consolidated Mining and Smelting Company in British Columbia. The plate steel spiral case is field welded to the cast steel stay ring. The integrally cast stay vanes join the upper and lower parts of the stay ring and are designed to resist the bursting pressure of the water in the spiral case, to carry their part of the weight of the superimposed concrete and of the generator and to lead the water to the wicket gates with a whirling velocity.

The wicket gates further control the water, imparting to it the correct whirl at the peak efficiency point of the turbine and regulating the quantity of flow from full load to shutoff. In the shutoff position the wicket gates close against one another on machined surfaces.

From the wicket gates the water enters the runner which transmits the whirl energy and the remaining pressure energy of the water to the shaft, which is directly connected to the generator above it. The water leaves the runner to the draft tube and thence to waste, with only enough remaining energy to carry it away.

The draft tube liner serves as protection for the concrete where there is a combination of high velocity and low pressure immediately below the runner. Its upper flange also acts as a support for the runner when it is disconnected from the generator. The base ring ties the draft tube liner and the stay ring together as well as acting as a support for the bottom ring and as a protection for the concrete around the runner band. The bottom ring is the lower support for the wicket gates, while the head cover forms the top support and also carries the main shaft bearing and the wicket gate operating mechanism.

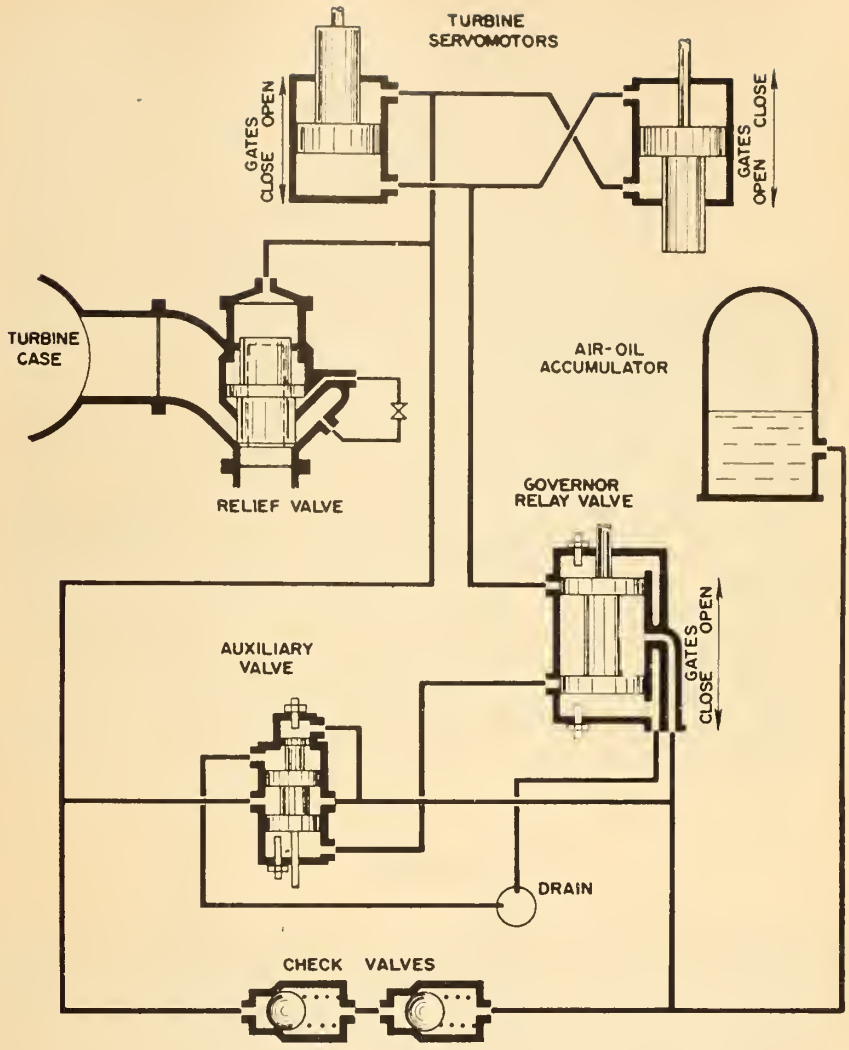


Fig. 16. Schematic diagram of Francis turbine relief valve.

There are two double acting servomotors operated by oil pressure from the governor. These servomotors are connected to the operating ring, which, in turn, is connected by links to the shear levers which operate the gate levers keyed to the upper wicket gate stems. The shear levers are so named because each one is connected to its gate lever through a shear pin, which is designed to break if the wicket gate is stopped by an obstruction.

The main shaft bearing is of the self lubricating type, wherein the lower part of the bearing is always submerged in a bath of oil and the oil is pumped by its own viscosity through grooves in the bearing surface as the shaft rotates. The lubricating oil from the bearing overflows into a cooling sump in the head cover and is pumped back into the bearing sump by a motor-driven pump. This is an unusual arrangement; usually the cooling coils are in the bearing housing and no pumps are used in the lubricating system.

The wicket gate stems are protected from rusting by stainless steel sleeves in the way of the bearings and packing boxes. This is a feature not common before the war, but now considered to be valuable in reducing maintenance costs.

The cast iron head cover is protected in the region of high water velocity above the wicket gates and at the runner periphery by a steel wearing plate and wearing ring which can be repaired by welding or replaced when maintenance becomes necessary. The runner crown and band are both protected by removeable carbon steel wearing rings at the points of minimum clearance with the head cover and bottom ring respectively. This is an unusual feature usually reserved for sites where the water carries abrasive particles and field repairs are impracticable. The cast steel bottom ring is also provided with a renewable carbon steel wearing ring.

The main shaft is protected in the way of the stuffing box by a renewable stainless steel sleeve. The wicket

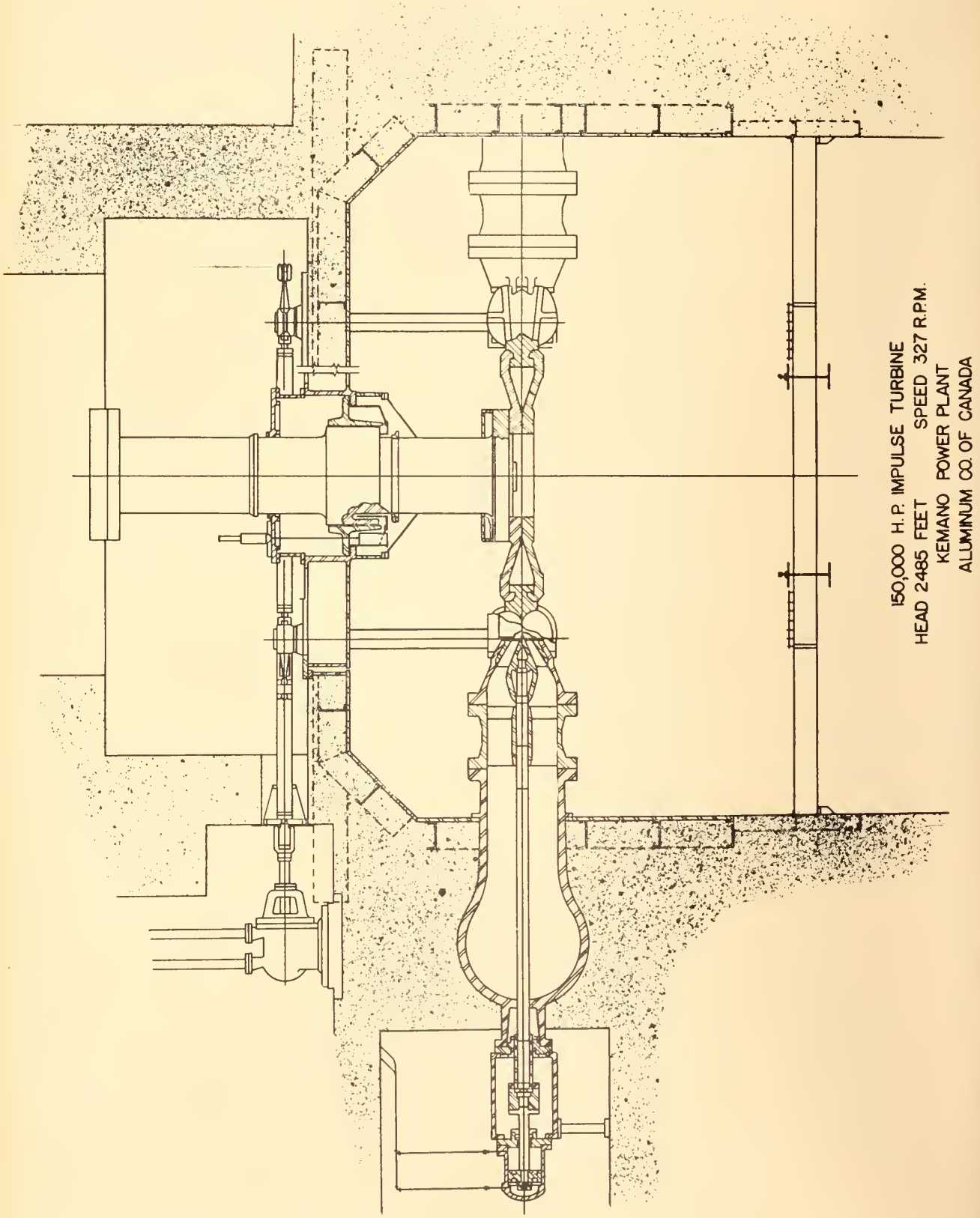

150,000 H.P. IMPULSE TURBINE
HEAD 2485 FEET SPEED 327 R.P.M.
KEMANO POWER PLANT
ALUMINUM CO. OF CANADA

Fig. 17.

gate packings are of the split, V-ring type and are easily replaceable. The glands are bolted tightly against the head cover with no adjustment for packing wear. This is a valuable improvement over the old stuffing boxes, which could be over-tightened, causing heavy wear on the packing and on the wicket gate stems.

An air valve is provided to admit air through the head cover to the runner cone to prevent rough running at low loads, when there is violent and frequently unstable forward whirl in the draft tube. The air valve is connected to the servomotors so that it automatically opens at light load.

The convex part of each runner blade near the band is covered with one coat of welded stainless steel, as a precaution against cavitation pitting in this area.

The servomotors are designed to operate at oil pressures between 175 and 200 p.s.i. This was common practice in Canada until recently but it is more common now to supply governing systems designed to

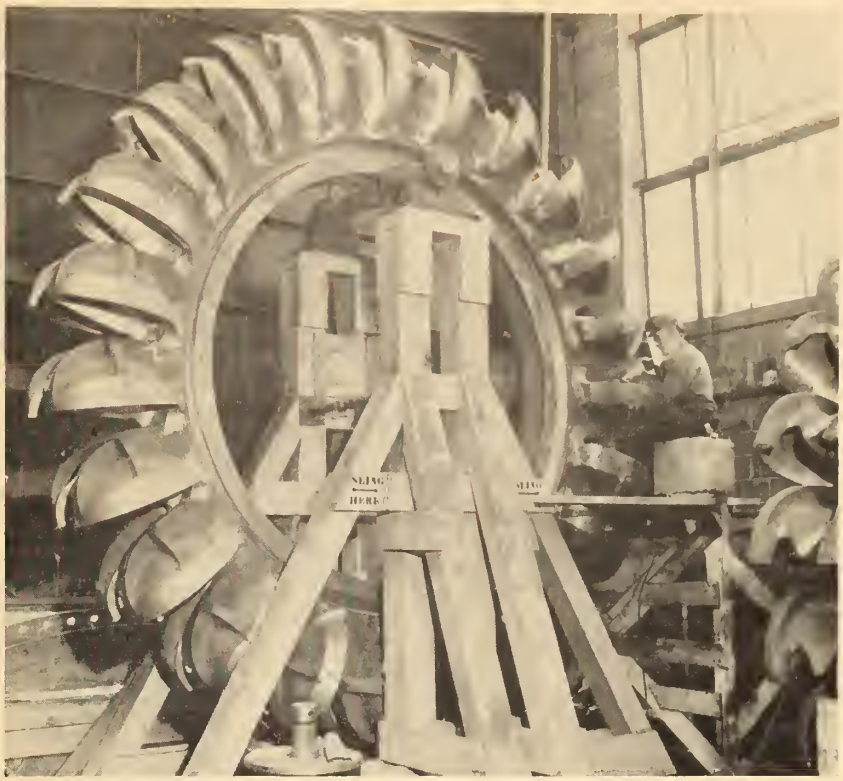


Fig. 19. Hand finishing the runner for the Kemano 150,000 hp. turbine.

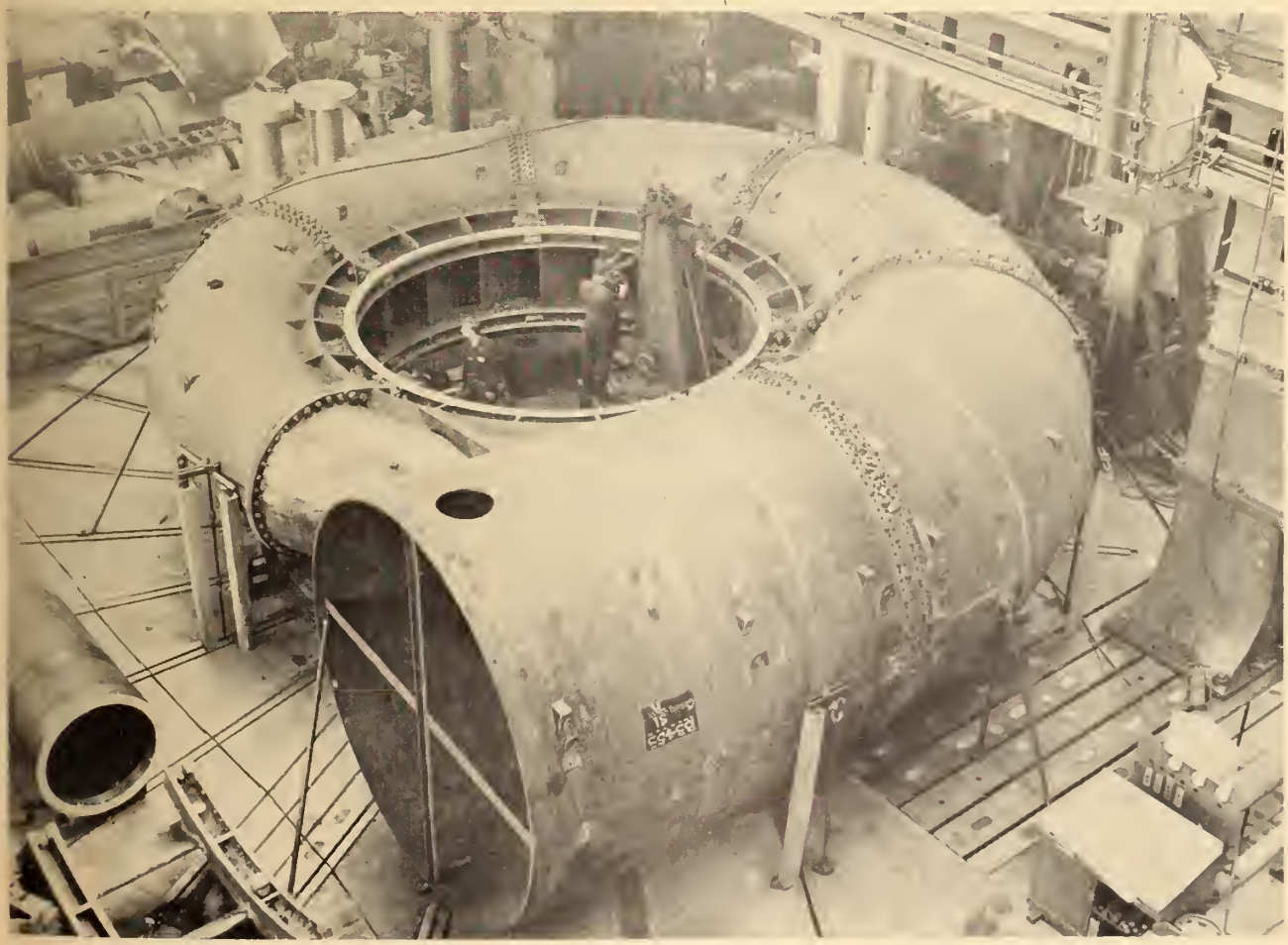


Fig. 20. Finish boring the case for a 105,000 hp. Francis turbine.

operate at pressures up to 300 p.s.i.

The turbine governors at Waneta are cabinet type actuators manufactured by the Woodward Governor Company while the oil pressure system was supplied by the turbine manufacturer.

Figure 15 is a cross section of one of three 88,000 horsepower turbines designed and built by the author's company for the Nilo Peçanha plant of the Rio de Janeiro Tramway Light and Power Company Limited. The rated head is 995 feet and the turbine is designed to run at both 375 and 450 r.p.m. to suit the 50 cycle frequency of Rio de Janeiro and the 60 cycle frequency of Sao Paulo. A feature of this turbine is the provision of stainless steel passages from the exit of the cast steel spiral case to the end of the renewable throat ring below the runner. The runner is cast 18/8 stainless steel, the wicket gates are cast 12 per cent chromium steel, the upper and lower distributor plates and the throat rings are stainless clad plate steel, while the moveable and fixed wearing rings are also stainless steel, mating rings being of dissimilar materials.

The head cover and the bottom cover have separate flanges so they may be lifted through the bore of the generator stator. The movable portion of the draft tube liner, the bottom cover and the runner are also removable from below.

The main shaft packing box consists of two double sets of carbon rings bearing against a stainless steel sleeve on the shaft. Lubricating water is introduced between the two sets of rings.

To permit short governor response time without excessive penstock pressure rise on load rejection, relief valves are provided with the Nilo Peçanha turbines. Fig. 16 is a diagramatic representation of the relief valve arrangement which was developed especially for this installation. The outstanding feature of this relief valve is new to Canadian design; the operating force to move the turbine wicket gates for fast closing comes from oil provided by the relief valve as it opens, so that if something goes wrong and the relief valve does not open, the worst that can happen is that the wicket gates will not close rapidly. In this way the penstock is completely protected from unexpected sudden pressure rises.

Figure 17 is a sectional elevation of a 150,000-hp. vertical shaft impulse turbine operating in the Kemano Plant of the Aluminum Company of Canada. Although vertical shaft impulse turbines are not a postwar development, they are new to Canada: the turbines for the Bridge River Plant of the B.C. Electric Co. have been well described elsewhere (④). The turbine shown here is one of three in the Kemano plant and is the one with which the author is most familiar. Credit must be given to the French firm of Neyrpic for the hydraulic design of the manifold and of the runner and for consultation on mechanical details.

The runner is of stainless steel of the integrally cast type which eliminates the bolted bucket attachments which have been the cause of trouble in other high head impulse turbine plants. A complete stainless steel casting of the shape and size of this runner was not looked upon optimistically by the casting suppliers, but a ring of integrally cast buckets on a heavy rim was considered a relatively easy project, so the runner was designed with separate discs connecting the buckets to the shaft coupling. This design has a further advantage in materially reducing the cost of spare runners. The bucket ring is clamped between two discs by a large number of bolts. The clamping is sufficiently tight to drive the shaft by friction between the clamping discs and the bucket ring. The heavy plate steel housing is octagonal and strongly ribbed to provide a rigid bond with the concrete. An inspection and servicing platform is provided below the runner, with rails for a car onto which the runner may be lowered for removal and replacement without disturbing the other parts of the turbine or generator.

The four nozzles are equipped with regulating needles with stainless steel points which seat in the closed position against stainless steel nozzle tip liners. The needle stems are protected with renewable stainless steel sleeves in way of the guide bearings. Each needle has an individual servomotor operated by its own control valve in the governor.

For large rejections of load the water supply to the turbine runner is cut off by deflectors which are operated by the governor. The deflectors may be operated in as short a time as two seconds to reject full load, while the needles follow to cut down the size of the jet at a slower rate, which will not cause excessive pressure rise in the penstocks and tunnels.

An interesting feature of the Kemano turbines is that, due to the nature of the load, it is sometimes necessary to increase the load from zero to full load instantaneously. If it were necessary to wait while the needles opened and the water in the penstock was accelerated, the drop in speed would be unacceptable. To meet this problem a special device has been incorporated in the governor so that the needles may be opened fully while the deflectors maintain the unit at synchronous speed even with no load on the generator. As soon as the load is thrown on the generator, the deflectors automatically open at their maximum rate to permit the turbine to assume the load.

Some interesting features of recent Canadian designed turbines may best be illustrated by the following photographs.

Figure 18 shows the assembly of the manifold for one of the four 88,000 horsepower turbines for the Sao Paulo Light and Power Company. During this assembly a pressure test was made to 1,500 p.s.i. and strain gauge readings were made to obtain information for use in future designs. Taking such readings during a shop pressure test has become a routine procedure to add to knowledge of the stresses and strains in component parts of the turbine. This knowledge contributes to the economy of manufacture.

Figure 19 shows the stainless steel bucket ring for the Kemano turbine. High head impulse turbine runners must be painstakingly hand finished. Finally, Fig. 20, shows the finish boring operation on the assembled stay ring for one of 12—105,000 horsepower turbines for the Sir Adam Beck Niagara No. 2 generating station. The turbine case is mounted on the floor around the table of a boring mill with a 52-foot diameter capacity. The cutting tool is mounted on the boring mill table.

The help of Mr. H. S. Van Patter has been of great value in preparing this paper. The writer also wishes to thank Mr. W. S. McIlquham and the staff of the hydraulic division, Dominion Engineering Works.

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Niagara Remedial Works

by

Dr. Otto Holden, M.E.I.C.

Chief Engineer,
Hydro Electric Power Commission of Ontario,
Toronto

A paper to be presented before the 69th annual general and professional meeting of The Engineering Institute of Canada at Toronto, Ont., May 11, 1955.

This paper outlines the important work presently in progress at Niagara, Ont., under direction of the Niagara Falls Engineering Board, of building remedial works above the Falls to arrest erosion and preserve their natural scenic beauty.

Relating the several unusual methods resorted to for surveying the river, using helicopters, balloons and searchlights, the author tells how hydraulic studies were undertaken with scale models, both at the U.S. Corps of Engineers Waterways Experimental Station at Vicksburg, Mississippi, and at the Ontario Hydro's Hydraulic Laboratory at Islington, Ont. Findings from the tests on these models are recorded. In conclusion, descriptions are given of the design of the remedial structures and how the construction is being carried out.

Fig. 1. Field survey coverage for the Niagara River model at Islington.

There are under construction on the Niagara River, remedial works designed to preserve and enhance the scenic spectacle of the Falls and Rapids. The unusually uniform flow of the river and the concentration of fall at Niagara have created a scenic spectacle of rare beauty and a power resource of great value. The works now under construction are designed to preserve and enhance the former and permit greater utilization of the latter resouree.

By the terms of Article II of the Niagara Treaty of 1950, the United States of America and Canada agreed to complete, in accordance with the objectives envisaged in a report (of 1929) by the Special International Niagara Board, the remedial works that are necessary to enhance the beauty of the Falls, and to request the International Joint Commission to make recommendations as to the nature and extent of the remedial works and related matters.

Upon receipt of the Reference, the Commission created the Niagara Falls Engineering Board, drawn from the technical agencies of Canada and the United States, and directed it to make the necessary investigations and thereafter prepare a report setting forth the Board's findings and recommendations. A Working Committee appointed by the Board utilized the regular field

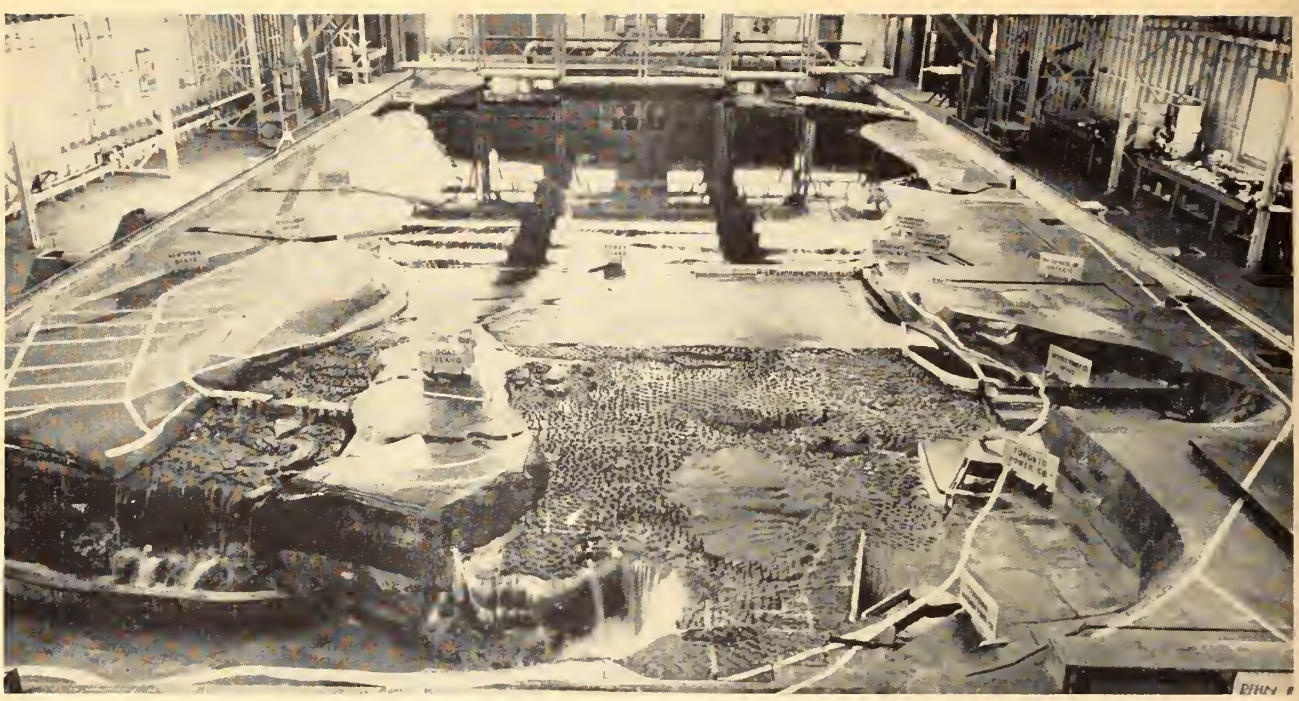

Fig. 2. The Niagara River model at Islington.

organization of appropriate agencies to perform the needed surveys and studies, thus ensuring that the services of specialists available in both countries were used on various aspects of the problem as required.

A description of the river and the nature and extent of the problem are set out so clearly and succinctly in the report of the Commission that the writer, as a preface to his description of the investigations and design and construction of the works, has taken the liberty of quoting certain items directly from the report:

"The Niagara River, about 36 miles in length, connects Lake Erie and Lake Ontario. The river carries the outflow from the four upper lakes of the Great Lakes system averaging about 200,000 cubic feet per second. The fall from lake to lake is 326 feet, about half of which is concentrated at Niagara Falls, 21.6 miles below the head of the river.

"In the one-mile reach immediately above the Falls, the river drops about 50 feet through cascades and rapids. Goat Island divides the river into two parts, the larger leading to the Horseshoe Falls on the Canadian side and the smaller to the American Falls.

"The distance from shore to shore at the Horseshoe Falls is 1,200 feet but the total length of crest around the "horseshoe" is 2,500 feet. The central portion of the crest has been receding faster than the flanks, with the result that in the last 100 years the crest length has increased about 100 feet. The depth of water flowing over the crest near each shore is less than one foot and this portion of the falling sheet of water usually appears white. Toward the center of the Horseshoe, the crest depth increases to a maximum of 12 feet and the falling sheet of water has a darker, greenish appearance.

"The American Falls has a relatively low flow, distributed quite evenly along its 1,100 feet of crest and has receded very slowly as compared with the Horseshoe Falls."

Development of power, as it has progressed during the past eighty years, has focused attention on the necessity of maintaining scenic values and, furthermore, rentals received from power licenses have enabled the great extension and improvement of the park systems adjacent to the river, so appealing to visitors to the area.

"In the Boundary Waters Treaty of 11th of January, 1909, the two countries agreed to permit diversion of up to 56,000 cubic feet per second of the Niagara River flow for power purposes. To forestall possible adverse effects on the scenic beauty, a Special International Niagara Board was formed in 1926 to consider the problem. The Board recommended early construction of an initial phase of remedial works, and outlined the further measures to be considered for preservation of the beauty of the falls under conditions which would permit more complete utilization of the hydroelectric potential.

"With the growing need for power for defense activities the Governments of Canada and the United States concluded agreements in 1940 and 1941 to utilize on a temporary basis and additional 26,500 cubic feet per second of Niagara flow for power purposes. Pursuant to these agreements, the initial phase of remedial works recommended by the Special International Niagara Board proceeded by the construction of a submerged weir in the Niagara River about one mile above the Horseshoe Falls during the period 1942 to 1947. The weir has substantially compensated for the lowering effect of the power diversions on the Chippawa-Grass Island Pool and has greatly increased the flow over the American Falls; but, of course, it has not improved the conditions on the flanks of the Horseshoe Falls.

"In 1944 and 1948 the earlier agreements were modified to provide for additional temporary diversions, and discussions which led to the Treaty of February 27,

1950, were commenced. By means of this Treaty the two Governments put into effect a revised permanent schedule of permissible power diversions under which the flow over the Falls may be reduced to not less than 100,000 cubic feet per second during the daylight hours of the tourist season and to not less than 50,000 cubic feet per second at any other time."

It will be observed that the Treaty of 1909 permitted definite quantities to be diverted for the generation of power, but that the Treaty of 1950 gives precedence to scenic requirements and limits the power diversions to the excess flow available in the river after these scenic requirements have been satisfied.

Approach to Investigations

Hydraulic models were indicated as a suitable tool for the study and design of the works. Experienced personnel to conduct such investigations by means of models were available in the staffs of the Engineering Branch of The Hydro-Electric Power Commission of Ontario and of the Waterways Experiment Station of the Corps of Engineers, U.S. Army. These two organizations, working in close co-operation, built two models of the river, complementary in coverage and providing a means of checking various tests over the full range of river conditions and for numerous possible variations of remedial works.

One of the models was built in a new laboratory of The Hydro-Electric Power Commission of Ontario at Islington, near Toronto, and reproduced that part of the river from the downstream end of Grand Island to the Rainbow Bridge below the Falls. The other model, which was built at the Waterways Experiment Station at Vicksburg, Mississippi, was on a slightly smaller scale of model to prototype, but reproduced the whole river from Lake Erie to the Rainbow Bridge. A description of the models and of the experimental work carried out in each forms a later section of this paper.

Surveys

Complete survey data over the entire water area and banks of the river from Lake Erie to the Falls was a prerequisite to the construction of the models. Hydrometric data available from earlier investigations had to be amplified for many parts of the river.

Primary controls of a high order for horizontal and vertical measurements were available from the records of the International Boundary Commission and the precise level networks of the U.S. Lake Survey. Using these as a basis, control surveys, soundings and topography covering about 80 miles of shore were made by four field parties from the Buffalo District office of the Corps of Engineers and two parties from the U.S. Lake Survey.

The bed of the Chippawa-Grass Island Pool extending from Buckhorn Island downstream for three miles was surveyed by The Hydro-Electric Power Commission of Ontario by echo sounding. The same method was used to sound the lower portion of the Pool in the swifter and more dangerous waters, the sounding craft being allowed to drift downstream on a line from an anchored tug. Wire soundings in greater detail were also made for about 400 feet from shore from the mouth of the Welland River to a point a few hundred feet above the Remedial Weir.

These surveys were by conventional methods but certain others in the Cascade area extending to the crest of the Falls utilized methods

Fig. 3. Aerial photograph of the Cascades and Horseshoe Falls showing streamlines, December 29, 1950. Combined Falls discharge 113,000 cubic feet per second.

Fig. 4. Islington model showing streamlines, Horseshoe Falls flow 115,000 cubic feet per second.

to whieh more extensive referenee is warranted.

Soundings by Helicopter

It will be appreciated that soundings in the Rapids above the Falls, and measurement of magnitudes and direetion of the eurrents were matters of great importanee, and also diffieult to obtain. Survey methods radically different from those eommonly used in the study of rivers were developed. In order to secure soundings in the Rapids, helieopters were utilized, and seeured soundings by means of speeially designed sounding weights suspended by wire from the helieopter and loeated in vertical and horizontal position by means of transit stations loeated on the shore.

For the soundings by means of the helicopter, 1,500 feet of steel musie wire of 0.026-ineh diameter was wound on a nearly frietionless aluminum reel having an outside diameter of seven inehes. To the free end of the wire was attaehed a discus-shaped lead weight weighing approximately 12 pounds. This apparatus was then mounted on the right side of the helieopter within easy reaeh of the co-pilot.

The helicopter was then flown to a predetermined position over the Caseades where it was made to hover at a height of about 2,000 feet, whereupon the eo-pilot lowered the sounding weight by releasing a hand brake affixed to the reel. At a point in the wire exactly 50 feet from the bottom of the 12-pound weight, a target resembling a wind soek was attaehed to the wire.

After unreeling the entire 1,500 feet of wire, a counterweight was attaehed to the end and the wire suspended over the reel in a 0.040-ineh groove machined in the eireumference of the reel so that it eould also serve as a pulley. The helieopter was then lowered until the 12-pound weight touched the bottom and the eounterweight began to descend. At

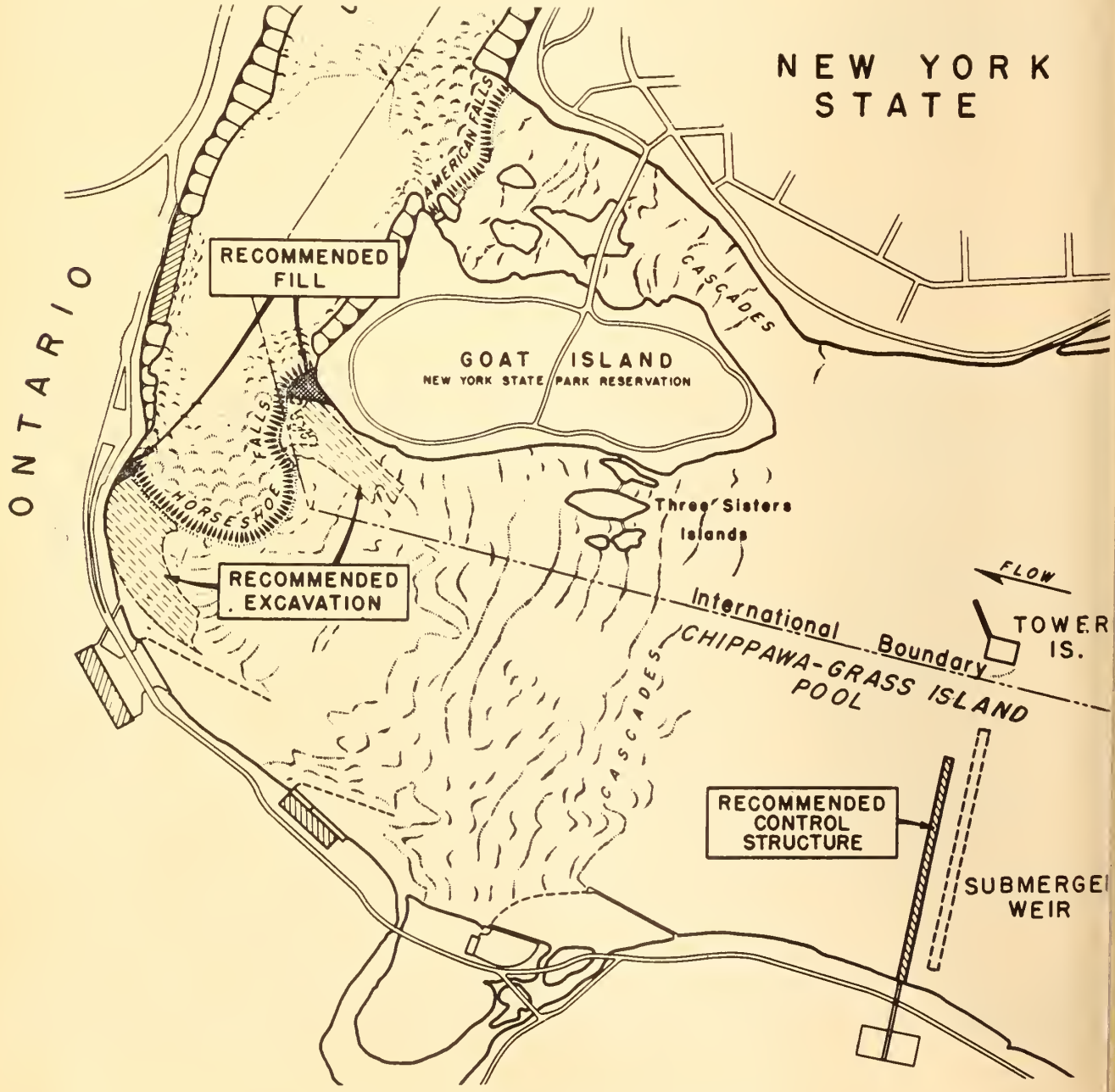

Fig. 5. Plan of recommended remedial works.

the instant the sounding weight touched the river bottom, the co-pilot signaled each of four transitmen over an air-to-ground radio network.

The target was maintained in position for about 15 seconds to allow the instrumentmen to read both horizontal and vertical angles and the helicopter was then elevated until the sounding weight was clear of the water, after which it was moved approximately 300 feet horizontally and the procedure repeated. Each run was limited to about one-half hour by extreme cold since the door was removed from the helicopter.

The horizontal angles were plotted for each sounding and the location fixed at intersection of the four angles. At least three of the vertical angles to each target position resulted in computed elevations which checked within 0.2 foot. In all, 252 elevations were obtained in the Canadian channel between December 7 and December 27, 1950, in 21 hours of actual flying time. Check readings over an area previously covered by conventional survey methods indicated that the results obtained by helicopter were correct within one-half foot.

Kytoon Survey of Cascades

Elevations over the Cascades in the American Channel upstream from the crest could not be obtained by helicopter because heavy tree growth along the banks made an emergency landing impossible. Therefore, another method was employed using dirigible-shaped balloons called "kytoons", consisting of a nylon-covered rubber bladders inflated with helium. Two 40 cubic foot capacity kytoons fastened together side by side, with an 80 cubic foot capacity kytoon bridled above the other two, would lift a six pound weight in about a 10-mile wind.

Nylon cord, having a tensile strength of 100 pounds, served as a satisfactory flying line when used double. The same type line, used singly, was used to control the sounding lead. Music wire of 0.016-inch diameter was used in the 30 feet immediately above the sounding lead in order to keep the resistance to the strong current to a minimum.

For vertical and horizontal locations of the soundings, transits were used as in the helicopter method, all operations being synchronized by radio. Approximately 500 points on the river bottom were located vertically and horizontally during January and February 1951. As the construction of the scale models progressed, it was found that greater detail was required in certain sections of the Cascades in the Canadian channel, and in November and December 1951, approximately 500 additional soundings were taken by the kytoon method.

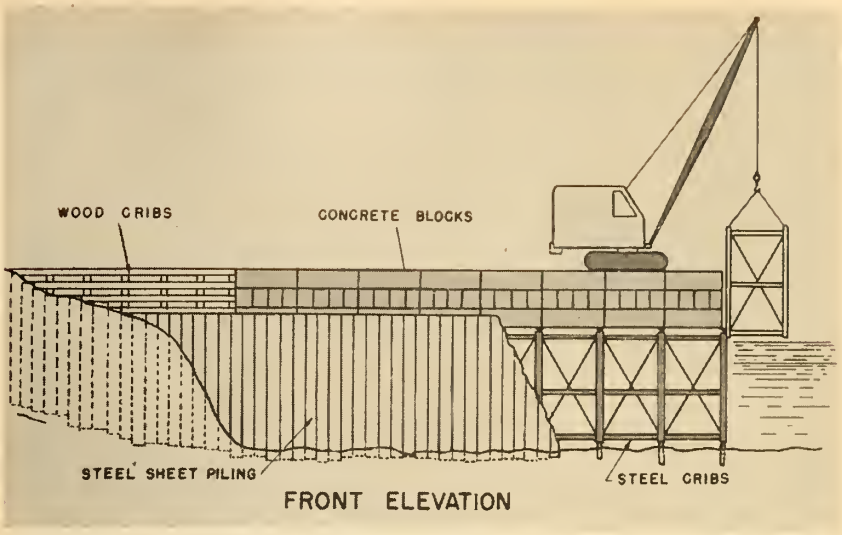

Fig. 6. Diagrammatic sketch showing construction of cofferdam for control dam.

Searchlight Survey of Cascades

Personnel from the Buffalo District and the Hydro-Electric Power Commission of Ontario, working in two separate groups, made a detailed survey of the water surface of the Canadian Cascades using a new and unique method in the Fall of 1951. Two 800,000,000-candle power lights, one for each group, were set up at several carefully selected stations on the Canadian shore and on Goat Island.

Then, with the beam directed approximately horizontally across the Cascades in a definite orientation, vertical angles were read from three different transit stations with the transits also definitely oriented. The light beam was held in position until each transitman had read vertical angles to the beam reflection on the water surface at about five-degree horizontal increments along the light beam.

After all transitmen had completed an angular crossing along the light beam, the beam was moved horizontally two degrees and 30 minutes and another set of transit readings were made. This operation was continued until the entire area was covered. The method was checked in an area where the water surface elevation was known and the results found to be accurate within 0.10 foot. In all, approximately 6,000 elevations were obtained in two nights, working from dusk to daylight.

Hydraulic Studies

Prior to and throughout the investigation, extensive hydraulic studies were made by the staff of The Dominion Water Resources Division, relating river flow, diversions and water levels at various points and the effect of the Remedial Weir. The technique developed and the results secured in connection with the work in earlier years was of immense value at this time.

Numerous studies were also conducted by the Buffalo office of the U.S. Corps of Engineers, particularly those related to the investigations at Vicksburg, and by the staff of the Hydro-Electric Power Commission in connection with the work at Islington.

Description of the Models

The model investigations were such an essential factor leading to the decisions reached regarding the remedial measures that a description of the models and the tests made in them is given in some detail.

The Niagara River model at Islington was constructed in a building erected specially for this purpose. The floor of the model consists of a reinforced concrete slab, with supports running down to hardpan to prevent shifting or settlement. Surrounding the model on three sides is a concrete wall, resting on this floor and, below floor level, a sump into which the various model outlets discharge.

Pumps at the head end of the building circulate the water from the sump to a constant head tank,

Fig. 7. Cofferdam enclosing area dewatered for first section of control dam.

from which the water flows down to the inlet areas of the model through three pipes, each of which is equipped with controlling and measuring devices. The three pipes supply respectively the three channels entering the Chippawa-Grass Island Pool around Navy and Buckhorn Islands. The various power plant intakes were located precisely on the model, and the flow into them is controlled by specially built valves and measured before being discharged into the sump.

Due to the great width of the river in this area (about one mile) and the relatively shallow depth, a distorted scale was considered necessary if a flow pattern similar to the prototype was to be reproduced and depths measured with sufficient accuracy. The Froude number governs in a model of this type and the transference factors between model and prototype in accordance therewith are:

Horizontal lengths	1:250
Vertical lengths	1:50
Velocity	1:7.07
Discharge	1:88400
Time	1:35.36

The general model topography was produced by erecting plywood templates across the model on two-foot centres. The top of each template being accurately cut to match the survey information. Despite the size of the model and the large number of templates, a tolerance of one thirty-second of an inch was adhered to rigidly in their positioning. Between the templates, sand was placed to within a few inches of the top and, thereafter, concrete was added until its surface was flush with the top of the templates.

In the Cascades area, the templates were spaced more closely due to the more irregular topography, and in the area where the remedial works were to be built, rectangular sheet metal cells 6 x 12 inches filled with concrete, formed to the natural topography, were used. Any of these cells could then be removed and replaced by others incorporating various remedial excavation schemes.

For measurements of elevation and flow, special point gauges, calibrated orifice meters and Van Leer and V-notch weirs were suitably disposed to secure all necessary data. During the course of the tests, it was found desirable to measure the flow over the Horseshoe Falls in 100-foot sections along the crest (model scale). This was accomplished by a specially constructed scoop which diverted the flow through one of the Van Leer weirs for measurement.

Some statistics of the building and models are as follows:

Building	170 feet by 70 feet
Model	96 feet by 37 feet
Sand	550 tons
Plywood	9,000 board-feet
Maximum model flow	— about three and one-half cubic feet per second

The Vicksburg model reproduces about 26 miles of the Niagara River extending from about 11,500 feet above the Peace Bridge to the Rainbow Bridge, 5,000 feet below the Falls. It was constructed to linear scale ratios, model-to-prototype, of 1:360 horizontally and 1:60 vertically. Its scale is thus smaller than for the Islington model, but its coverage is considerably greater. Scale ratios in accordance with Froudian relationships are:

Velocity	1:7.74
Discharge	1:167,328
Time	1:46.48

The model is of the fixed-bed type, with all channel and overbank areas moulded in concrete. Concrete forms a thin shell about two inches thick and, in certain areas, removable concrete blocks were used so that existing channel conditions could be readily changed to represent any of the proposed improvement plans. The present and proposed power intakes along the river were precisely located, and the flow into each was controlled by a standard gate valve and measured by a Van Leer weir. Water elevations at selected points along the river were measured by eighteen manometer type gauges.

Further details of its construction need not be given as, for the most part, they would be a repetition of those for the Islington model. Its dimensions are impressive; the length is over 250 feet and width 150 feet. It is housed in a frame structure, of a type more or less standard for large models at the Experiment Station.

Verification of the Models

Before reliance can be placed on predictions of future conditions by models of this type, it is essential that the model shall faithfully reproduce known conditions of the past over as large a range as possible. In the case of the Niagara models, verification divides naturally into two separate operations. Firstly, the relatively low velocity river section upstream from the Cascades, and, secondly, verification of the high velocity Cascades and Falls section.

As this latter part proceeded and comparisons of the models were made, it became evident that more reliable water level and bed level information was essential if the necessary similarity between model and prototype was to be achieved. Additional survey information already referred to was secured and a final verification of this area effected, which was considered to be satisfactory.

Verification of the river section involved principally the correct reproduction of known river gauge elevations for various total river flows and power diversions. In this connection, the distorted scale of the models necessitated the use of special devices to reproduce the re-

quired order of roughness. This was secured by covering the bed of the models with expanded metal screening laid on top of the bed.

A rather striking visual indication of the accuracy of the reproduction in the models of conditions in the prototype is provided in aerial photographs of each which show the streamlines. The photographs of the river were taken when ice was flowing. In the models the ice is simulated by blocks of paraffine which has about the same specific gravity. The streamlines traced in river and model by ice and paraffine respectively verify, in that respect at least, the accuracy of the reproduction of natural conditions in the models.

Tests and Results

A program of tests without remedial works was laid out and covered in each of the models. A wide range of total river flows and of various power diversions was covered in these and extended over many weeks. From the Islington tests, it was concluded that without remedial works:—

(a) Under maximum future diversions, the Chippawa-Grass Island Pool elevations would drop by as much as 4 feet below its present normal level, exposing considerable areas of the river beds presently covered.

(b) Because of the lowering of the pool level, under maximum diversions, the flow over the American Falls would drop to 3,500 c.f.s. with a total Falls flow of 50,000 c.f.s., and to slightly below 5,000 c.f.s. with the total Falls flow of 100,000 c.f.s.

(c) With a total Falls flow of 50,000 c.f.s., both flanks of the Horseshoe Falls would be dry. With a total Falls flow of 100,000 c.f.s., the Goat Island flank would still be dry, while the Canadian flank would be only inadequately supplied.

As the Vicksburg model extended to Lake Erie, it was possible to investigate the time required to change the Falls flow from 50,000 to 100,000 c.f.s. and vice versa. The tests indicated that this time was so great that only a small part of the extra diversion authorized at night during the tourist season could be utilized.

It will be realized that the above is only a brief description of the tests and investigations made on each of the models. The tests include gauge heights at all gauges, flow distribution around Goat Island, photographs to show streamlines from the foot of Grand Island to the head of the Cascades, photographs of the Falls and Cascades from established vantage points, water surface elevations at 100-foot intervals along the crest of the Falls, and discharge through each 100-foot panel along the crest of the Falls.

Studies of Remedial Works

It was obvious from the preliminary tests that consideration had to be given to construction of some type of remedial works at the head of the Cascades, which would compensate for the added diversions, and enable the existing relation between Pool levels and River flow to be maintained. It was also indicated that consideration had to be given to some type of remedial works that would properly redistribute the flow over the Horseshoe Falls, and maintain a satisfactory spectacle, particularly at the flanks.

For the maintenance of satisfactory Pool levels with the added diversions, it was decided that a structure with openings as wide as possible would be desirable, such a structure to be located downstream from the existing submerged weir, which would be left in place. In order to minimize interference with the free passage of ice, the sills of the proposed structure should not be placed at an elevation above the bed of the river except in the portion opposite the existing submerged weir, where the sill elevations should not exceed the present weir crest.

In all tests at Vicksburg, sluice openings 100 feet wide, separated by piers 10 feet wide, were used. At Islington, the same sluice openings were used, but the piers were 14 feet wide. The tests on the remedial works were carried out for various total river flows up to the extremely high flow of 320,000 c.f.s., and with widely varying power diversions. Preliminary tests were made of the control structure extending completely from the Canadian shore to the United States shore.

As the work proceeded, tests were made to determine the number of gates necessary to maintain the desired Pool levels. These tests indicated that a control structure ex-

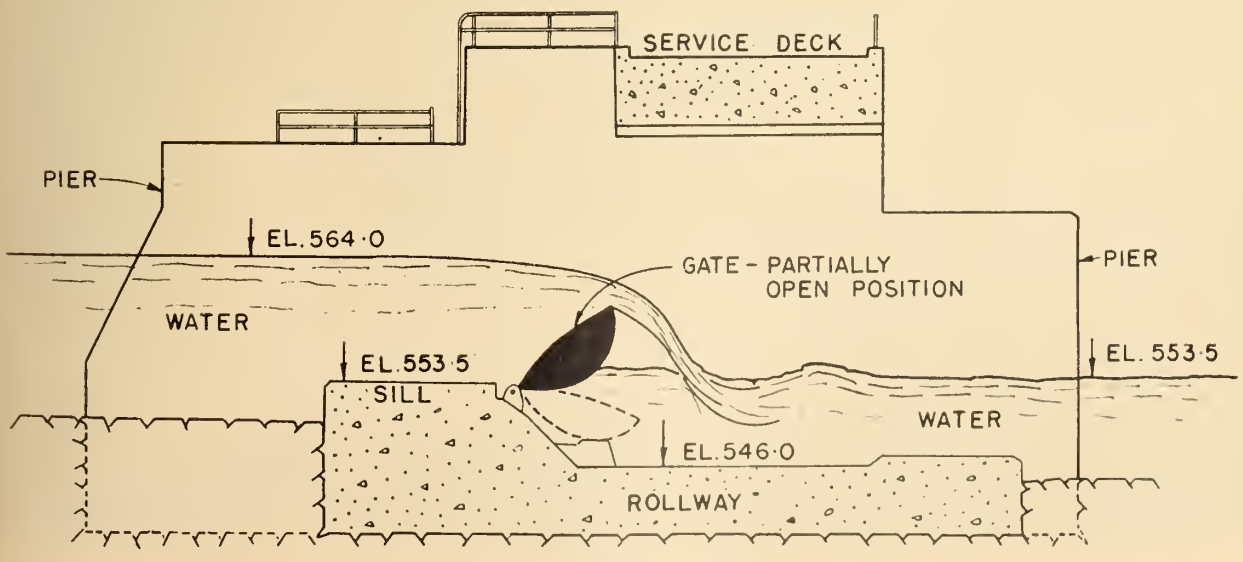

Fig. 8. Section through sluice of control dam.

tending some 1,550 feet from the Canadian shore secured the desired results. At the Islington model, various tests were made also to determine the effect of the works on the American Falls flow. The tests indicated that from the standpoint of scenic appearance of the American Falls, future conditions would be essentially the same as at present.

Various schemes of remedial works were considered to secure the desired results at the flanks of the Horseshoe Falls. The appearance of the American Falls provided an indication of the flow per foot that would be necessary to secure a satisfactory spectacle.

After a discussion of the matter at a meeting of the Engineering Board, it was decided that a satisfactory remedial scheme would provide complete coverage of both flanks, with an unbroken sheet of water at a total Falls flow of 50,000 c.f.s. It should also provide six to eight cubic feet per second per foot on the Goat Island flank, and 10 to 12 cubic feet per second per foot on the Canadian flank with a total Falls flow of 100,000 c.f.s.

The general policy followed in developing remedial schemes was to start with light excavations, which were increased until the target flows over the flanks were reached. Certain small areas at the extremities of the flanks were to be filled, and it was assumed that thirteen 100-foot sluices would be in operation at the control dam. Tests were also made of the cofferdams for various schemes and at various river flows. Consideration was also given to the use of submerged weirs for redistribution of the flow, these being tested with and without excavations.

On the basis of this extensive series of tests, the International Niagara Engineering Board recommended the construction of the remedial works shown in Fig. 5, and the construction of a control dam at the head of the Cascades. The Board also recommended that the task of construction be divided between the two countries on the basis that each country would construct, generally, those portions of the work that lay within their national boundaries.

The works to be built consist of three separate parts. The first of these is the Chippawa-Grass Island Pool control structure. This structure will extend from the Canadian shore some 1,550 feet into the river, on a line parallel with the present submerged weir and from 200 to 250 feet downstream therefrom.

With the exception of an approach fill adjacent to the Canadian shore, the structure will consist entirely of piers and movable control gates. As shown on the plan, there will be 13 sluices, each 100 feet wide, the minimum width desirable in passing ice. There will be a service deck spanning from pier to pier for access, operation and maintenance. For aesthetic considerations the operating machinery is to be enclosed in the piers.

The second item consists of excavation in the Cascades upstream from the Canadian flank and will involve approximately 64,000 cubic yards of rock. There will also be crest fill of about 100 feet on the Canadian flank adjacent to the Canadian shore, extending upstream about 100 feet where it will merge with the present shoreline.

The third item is at the Goat Island flank of the Horseshoe Falls. There, a fill will be carried for about

Fig. 9. Improvements at Goat Island flank of Horseshoe Falls under construction.

300 feet along the crest and upstream for about 300 feet where it will merge with the existing shoreline. Adjacent to this, excavation involving the removal of 24,000 cubic yards of rock will be made to divert an adequate volume of flow over the Goat Island flank under all future conditions.

Cofferdam for Control Structure

The control structure is being built in stages. The first section comprises the shore abutment and two sluices, and the cofferdam enclosing the area extends roughly 400 feet from the shore. As work proceeded on these first two sluices, the cofferdam was extended to enclose the area to be occupied by the third and fourth sluices.

On completion of the sluices in the first section, the cofferdam will be removed and the sluices there will be in full operation. The same procedure will be followed for section 3, (three sluices) and in turn for the remaining sections (two sluices each) until all thirteen sluices are completed. Thus at no time will the river channel be obstructed for more than a few hundred feet.

Velocities in the section of the river where the works are being built are high, and the flow is very turbulent. Construction of a cofferdam in the area, therefore, was a problem to which much thought was given in the planning. The method developed has proved to be eminently satisfactory and warrants a description in some detail.

Immediately adjacent to the shore, extending out into shallow water, a section of the cofferdam was built using rock filled timber cribs of conventional design. Beyond this, structural steel cribs top loaded with concrete blocks were used. The cribs and the method of placing are illustrated in a diagrammatic sketch (Fig. 6.)

Each crib is 10 feet by 30 feet, and was lowered into place adjacent to the next one previously placed by means of a crawler crane. A series of interlocking rollers keep the crib in alignment with the previous one, and the crib was lowered until close to the bed of the river, its 30 feet dimension being upstream and downstream.

After it was placed, heavy H-Sections were inserted in guides in the crib and lowered until they were in contact with the river bed. They were then driven to secure good contact. The portion of the H-Section projecting above the top of the crib was then cut off at the proper level and the crib loaded with 36 precast concrete blocks each 10 feet x $2\frac{1}{2}$ feet x 3 feet, weighing six tons.

Crib placing continued in this manner until both the upstream and downstream sections of the cofferdam were completed, and the section joining their extreme ends was built in a similar manner. Steel sheet piling was then driven on the river faces of all sections of the cofferdam, penetrating the rock. An earth fill along the base of the cofferdam then provided a watertight seal.

The loading of the crib is carried, not by the crib but by the H-Sections, and the cofferdam is designed to be stable against the maximum water pressure. To make it secure against the excess pressure that might result from ice accumulation upstream, heavy struts were installed after the area was dewatered. The cofferdam has proved exceptionally tight and the whole area enclosed was pumped dry in the

Fig. 10. Improvements at Goat Island flank of Horseshoe Falls after completion and removal of cofferdam.

course of one day. Since that time, leakage has been handled by a small pumping unit.

The Control Structure

The control structure will have 13 sluices, each with a clear width of 100 feet, separated by piers 14 feet wide. It will extend 1,482 feet from the face of the abutment on the Canadian shore, and is so designed that additional sluices may be added, if necessary, at the outer end. It is surmounted by a service deck 25 feet in width, carried on flat arches of pleasing proportions spanning from pier to pier.

The operating machinery for the gates is entirely below the level of the service deck and is located in the piers. The piers noses are pointed with a backward sloping cut water from elevation 555 to 569. The overall length of the piers is 91 feet.

Various types of gates were considered and carefully studied. The choice finally rested on a submersible gate of the "fish belly type" secured to the sill by eighteen hinges, which take the thrust, and having trunnions at the ends with centres at elevation 552.5 or one foot below the sill level.

To open the sluice, the gate is lowered into a depression downstream from the sill and when fully open its surface is approximately at the same level as the sill. Thus in the full open position there is nothing to retard the flow of water (or ice) through the sluice.

The trunnions fixed to the ends of the gate are also the driving disks, and are provided with seals where they pass through the walls of the piers. Within the piers they are equipped with a heavy lever connected to the operating mechanism. Hydraulic operating cylinders are mounted above maximum water level, and the piston rods from these engage the end of the lever.

Normally, the two hydraulic cylinders, one at each end of a gate, will be used to raise or lower the gate but the design is such that a single cylinder can exert sufficient operating force to open or close the gate should the other, for any reason, become inoperative. The gates will be controlled from a single control room located on shore. A diagrammatic sketch (Fig. 8) shows a longitidunal section through a sluice.

Works at the Goat Island Flank

The purpose of the work at the flanks of the Horseshoe Falls is to assure such a scenic spectacle as will result from a flow per foot in the tourist season approximately equal to that over the American Falls, and complete and adequate coverage of the crest at other times.

The work at the Goat Island flank to secure these results comprised the filling and landscaping of an area adjacent to the shore. It also involves the excavation of about 24,000 cubic yards of rock in the river bed, to divert a sufficient flow to that part of the crest to secure the desired results. The excavation extends for approximately 1,000 feet upstream from the crest and involved a maximum cut of about 6 feet.

The area to be excavated was dewatered by building a cofferdam outward from the shore of Goat Island, the cofferdam consisting of a loose rock-fill faced with steel sheet piling. No particular difficulty was experienced in placing the fill until it reached the area of swift water toward its outer extremity. From that point on, the contractor used a protective steel cell moored by cable to a point on Little Brother Island some distance upstream and moved outward by crane as the work progressed.

The work is now completed, except for the minor part of grading and landscaping the fill, and the cofferdam has been removed. Only minor modifications from the recommended plan have been made; a number of heavy boulders having been left in place to give a more natural appearance, and to break up what would otherwise be a smooth stream flowing over the area.

It is now possible to observe the result of this part of the work, and it is quite evident that what was desired has been amply realized. The excavation and fill to be made at the Canadian flank of the Horseshoe is of a similar nature to that at the Goat Island flank. Work on this will commence shortly.

The work at the Goat Island flank of the Horseshoe Falls was carried out under the supervision of the District Engineer of the Corps of Engineers, U.S. Army at Buffalo. The work on the control dam is being done by the Construction Division of the Hydro-Electric Power Commission of Ontario.

Acknowledgements

The writer would like to make reference to the happy relations that have existed throughout the work with various organizations in Canada and the United States, throughout the investigations and planning of the Works. Particular reference is made to the cordial cooperation of the officers and staff of the Buffalo District of the Corps of Engineers, and of the effective work by the staff of The Waterways Experiment Station at Vicksburg. √

Another Step

The *Journal* regularly notes the new standards it receives from the American, British and Canadian standardizing associations. Once in a while, however, a standard appears of such importance that it deserves editorial notice; such were the ABC screw thread standards.

Now the Canadian Standards Association has issued CSA Standard B78.1-1954, Mechanical Engineering Drawings Standards ($1.75). These are the result of five years' work of one of its committees of which George Noble was vice-chairman, with the cooperation and assistance of the American and British associations. This is the first step—and a long one—toward international standards aimed at reducing the cost of drawings, eliminating errors and delays, producing an Esperanto of drawing symbols and setting tolerances in fits, finishes and the like, to mention only a few of their many objectives.

The classic story used to emphasize the necessity of something approaching international uniformity in engineering drawing practice is that of Packard's experiences during the war with drawings for Rolls-Royce engines. Hundreds of these drawings had to be redrawn so they could be understood by Packard workers, delaying the production of vital equipment by many months and adding many thousands of dollars to its cost.

Mr. Noble aptly remarks, "It is only by actual experience that . . . discrepancies (in these standards) will show up . . . and prompt submission . . . of comments, criticisms and suggestions will be of invaluable assistance in . . . the further development of the standards, if the ultimate goal of . . . international standard(s) is to be achieved."

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The Impact of the New Plastics on Engineering

by

Irving R. Tait, M.E.I.C.

Consulting Engineer,
Canadian Industries (1954) Ltd.,
Montreal, Que.

This paper contains about all the average engineer needs to know about plastics. Outlining the history of the plastics industry, the author classifies the main groups of plastics and describes some fifteen types, giving their properties and the uses each is best suited for.

The amazing growth of the industry, to a point where its tonnage output exceeds that of aluminum, is recorded, while in conclusion a peek at future developments in store for the industry is added.

Plastics have made it possible for engineers to do many things otherwise impossible or uneconomical. To give one example, from many that might be quoted—the safety glass in automobiles is entirely dependent on a thin layer of plastic material squeezed between two sheets of glass. Plastics are fairly new to engineering, but are rapidly growing in interest and importance. Referring to the words "New Plastics" in the title, here we shall consider new uses of the various plastics, even though some of the materials may have been available in one form or another for many years.

Plastics are man-made materials, in contrast to nature's materials like wood and metal. A generally accepted definition is: "Any one of a large and varied group of materials consisting wholly, or in part, of combinations of carbon with oxygen, hydrogen, nitrogen and other elements which, while solid in the finished state, at some stage in its manufacture is made liquid or softened thus capable of being formed into various shapes, usually through the application of heat and pressure, either singly or together."

Each member of the plastics family has its special advantages, and the raw materials from which plastics are made are capable of being variously combined to give a wide range of properties in the end products. However, unlike nature's products, they are produced under controlled conditions. The widespread and growing use of plastics in almost every phase of modern living and engineering is largely due to their unique combinations of advantages. Some of these advantages are: light weight, range of color, good physical properties, and adaptability to mass production methods which often results in lower costs.

Classification and Properties

A convenient classification of plastics can be made on the basis of their behavior under the influence of heat, causing all of them to fall into one of two groups—the thermoplastic, or the thermosetting. Thermoplastic materials are made up of very long molecular chains, held together by relatively weak physical forces; whereas the large molecules of thermosetting resins contain groups which react to join the molecules together permanently under the influence of heat. In the case of thermoplastics, heat reduces the effect of these weak attractive forces and softening or melting results. The material recovers its solid state on cooling, but retains its ability to re-melt.

With thermosetting resins, temporary softening under heat is followed by the formation of a network of strong chemical linkages, which binds the molecules together and makes the structure permanently solid and resistant to heat. The performance of thermoplastics may be compared with the melting of wax. Also we might liken thermosetting behaviour to what happens with a hardboiled egg. Although some plastics are converted into finished products without further additives, many can be modified by the use of fillers, stabilizers, plasticizers, extenders and pigments to give them the properties desired for processing and specific uses.

It is possible to alter the properties of many plastics by the use of various fillers. Basic characteristics may be modified or special characteristics introduced. For example, fabric fillers used in thermosetting plastics lead to greatly increased strength. Of course fillers may also serve to reduce costs by replacing more expensive materials. A good example of this type of filler is wood flour, which has been used in quantities as high as 80 per cent in some products. In some plastics, stabilizers are used to offset degradation caused by heat. Many of these are quite expensive.

Plasticizers, either liquid or solid, are usually chemical compounds or resins having very low vapor pressures, and are added to some products up to some 10 to 40 per cent by weight in order to improve moulding properties, increase plasticity and flexibility and augment resistance to moisture, chemicals, weathering and other conditions. It is important to use the proper plasticizer for a particular plastic or for a specific application. Ex-

tenders are low priced materials which may be added to many compositions to decrease the quantity of plasticizer needed. Pigments for plastics products are generally selected on the basis of compatibility, light fastness and thermal stability.

History and Development

The history of plastics dates back to ninety years ago when an American inventor, John Wesley Hyatt, investigated materials to replace scarce and expensive ivory in billiard balls. After some experimenting, he developed a material that gave the ball all the properties required. This was cellulose nitrate, or "Celluloid", and in 1869 the first U.S. patent was issued describing one of the many compounds known today as plastics.

The discovery and preparation of cellulose nitrate itself can be traced back to the early work of Braconnot in France in 1833, and that of Schoenbein in Germany in 1845. Parkes, an Englishman, prepared various articles from a solution of cellulose nitrate and camphor during the period 1855–1865, but John Wesley Hyatt was the first to attempt to work with cellulose nitrate as a plastic mass rather than in solution.

It is amazing that cellulose nitrate a material so hazardous to handle, so readily decomposed by heat, and so unstable to sunlight in the unpigmented form, stood alone in the plastics business for many years. However, its many unique properties made it the best available material for many purposes. Coloured pink, it was quickly adopted by dentists for denture plates. It will be remembered as the material from which wipe-clean collars and shirt fronts were made, as well as the window curtains on early automobiles.

Not until 1910 did the next plastic, this time of the thermosetting variety, come on the scene. This was phenol-formaldehyde, commonly known as "Bakelite". Not until the mid-twenties did interest develop in plastics as a *family* of materials. To indicate this industry's growth, the output in the U.S. and Canada in 1922 was only about 6 million pounds. This grew to 213 million pounds in 1939 and, with the impetus provided by World War II, reached 818 million by 1945. 1954 saw more than 2.8 billion pounds produced—over 470 times as much as in 1922. The overall value of finished products makes plastics one of the few multi-billion dollar industries on this continent.

Considered for many years as substitutes, plastics have now reached the level of respectability held by metals, woods and ceramics. Plastics are now looked upon as full-fledged engineering materials, though it is doubtful that they will ever replace the older materials completely. Steel and wood have properties lacking in plastics. On the other hand, plastics have properties of their own that cannot be matched by other construction materials. Plastics tonnage has already passed that of aluminum, the most popular of the non-ferrous metals, and is rapidly approaching that of glass. The rise of plastics production has already caused revolutions in many industries and in the thinking of engineers.

Types of Plastic

The Acrylic Resins

These include "Perspex", "Lucite" and "Plexiglas", are glass-like thermoplastic materials with light weight, formability, strength, weatherability, shatter resistance, optical clarity, wide colour range and machinability. Although their surface hardness is comparable to that of aluminum, surface scratches show up more clearly on their glossy surfaces. They are used for watch crystals, aircraft canopies, lighting fixture diffusers, decorative panels, outdoor signs, costume jewellery etc. An interesting characteristic of acrylics is their ability to "pipe" or bend light. This finds application in illuminated spatulas and other medical instruments and edge-lighted signs.

Alkyd Plastic

This is a thermosetting material which is fast curing, has good dimensional stability, electrical insulation and heat resistance. It has, however, low impact resistance, unless special fillers are used. Its widest application has been in enamels and paints providing a high gloss, durable coating for stoves, refrigerators, etc. Latterly alkyd has become available as a moulding material with interesting properties which suit it for such units as automobile distributor caps, circuit breakers, television tuning devices and tube supports.

Amino Plastics

These include Melamine and Urea types, which are thermosetting materials. They have unlimited color range, good electrical properties and resistance to organic solvents. Melamines are familiar in colorful tableware and are also used widely for caps and buttons, hearing aid cases, etc. They are also used for surfacing laminates for table tops, for baking enamel, and in textile and paper treatment. The Urea types are moulded into such things as scale housings, lamp reflectors, radio cabinets and electrical devices. In the resin form they are also used in baking enamels, in paper and textile treatment, and in plywood adhesives.

Casein

Casein is a product of the protein of skim milk. When reacted with formaldehyde it forms a thermosetting material, a strong, rigid plastic which resists the effect of both impact and flexing. It is not adversely affected by contact with gasoline or dry cleaning solvents. However, immersion in liquids for long periods at room temperature or short periods at boiling temperature will cause it to absorb water, swell, soften and break easily. Casein-formaldehyde becomes more brittle as the temperature drops, and is not recommended for continuous outdoor exposure. Some of its uses are buttons, buckles, beads, knitting needles, adhesives, etc.

Cellulosics

Cellulosics are found in four different types, all thermoplastics.

1. *Cellulose acetate* is resistant to gasoline, oil, and most household chemicals but is affected by alcohol, acetone and alkalis. It it used for such things as combs, vacuum cleaner parts, lamp shades and toys.

2. *Cellulose acetate-butyrate* is the only cellulosic plastic recommended for outdoor use, as it stands rough usage and sub-zero temperatures. It is resistant to most household chemicals but is also adversely affected by acetone, strong alkalis and alcohol. It is noted for its high impact strength, and finds uses in telephone housings, portable radio cases, automobile hardware, tool handles, pipe and tubing.

3. *Ethyl cellulose* maintains its toughness and resiliency at sub-zero temperatures and is dimensionally stable over a wide range of temperature and humidity conditions, is unaffected by alkalis and weak acids, but should not be subjected to cleaning fluids oils or solvents. This material is used for edge mouldings, wire coating and certain electrical parts.

Cellulose nitrate is an extremely tough material which resists most weak acids and alkalis. It discolors badly in sunlight and is the only highly inflammable plas

tic. While its uses have been decreasing in the face of competition with other materials, it is still used for covering wood heels, toilet seats, hampers, etc. Solutions of cellulose nitrate are widely used in coatings.

Flurohydrocarbons

These include tetrafluoroethylene and chlorotrifluoroethylene polymers, and are thermoplastics having high impact strength over a wide range of temperatures. They also have extremely high chemical resistance and excellent electrical properties. Fluorohydrocarbon polymers are used for making valve seats, pump diaphragms, laboratory tubing and low loss insulation. Up to now, large volume use has been restricted by very high price.

Nylon

Nylon is a generic term applied to a family of polyamides produced by the reaction of polybasic organic acids with polyfunctional amines. It is not a trade name. The nylons are thermoplastics noted mainly for high tensile, impact and flexural strength and abrasion resistance. They are not affected by many ordinary chemicals, greases and solvents, but are attacked by most mineral acids and are soluble in phenols and formic acid. Nylons are not recommended for continuous outdoor exposure unless specially stabilized. While most familiar as filaments for wearing apparel, brushes and fishing lines, the nylons are used in gears, bearings, cams, gaskets, wire insulation, etc.

Phenolics

Phenolics are hard, rigid, and strong thermosetting materials. They are heat and cold resistant, have low thermal conductivity, and are resistant to alcohol, oils, greases and common solvents. The wide use of phenolics is due principally to their low cost and broad range of properties obtainable with different fillers. One shortcoming has been the characteristic color of these resins, which has limited use to dark-colored products. They are used for such things as T.V. and radio cabinets, handles for electrical appliances, washing machine agitators, radio tube bases, switch parts and gears.

Polyesters

Polyesters are thermosetting materials which are combined with glass fibers or other reinforcing fillers to yield strong, durable products such as military sleds, automobile bodies, luggage, pipe, interior partitions, skylights, etc.

Polythene (or polyethylene) is a semi-rigid thermoplastic with very high flex strength even at temperatures below −70°F. In thin sections it is quite limp and flexible. Although not truly transparent, its slightly milky transparency lends itself to pigmentation. Extremely high weather resistance is obtainable through the use of properly compounded carbon black.

Polythene has extremely good dielectric properties, which has led to widespread use in high frequency cables. Thin films have extremely low moisture vapor transmission, indicating its use as a vapor barrier in packaging and building construction. Its wide range of chemical resistance suits it for drum liners and tank linings, fume ducts and various other plant uses. Its flexibility, flex strength, lack of toxicity and resistance to chemical action have resulted in its application in the familiar squeeze bottle. Polythene is also used as a coating on paper, such as used for multi-wall bags. In pigmented form it is made into pipe which remains tough at low temperatures, is light in weight, does not corrode, and is easy and economical to install. Other uses are unbreakable toys, refrigerator ware and tumblers.

Polystyrene

This is a rigid thermoplastic naturally transparent, which lends itself to a wide range of color possibilities. The basic polymer has been modified, particularly with synthetic rubber, to increase its impact strength. It is known from experience with many of the attractive polystyrene toys, to be somewhat brittle, in unmodified form. Polystyrene has good electrical characteristics and good dimensional stability under high humidity, but is attacked by gasoline, dry cleaning solutions and other organic solvents. It is used in refrigerator food containers, battery cases, instrument panels, wall tile and radio cabinets.

Silicones

Silicones, although not always considered as plastics, do exhibit properties and behaviour often associated with thermoplastics. They are available as resins, coatings, greases, fluids and as silicone rubber. They exhibit high heat stability and have very good dielectric properties over a wide frequency range. They are water-repellent, have good weathering characteristics and are highly resistant to mineral acids and corrosive salt solutions. They are difficult to mould, requiring a long curing cycle, and are relatively expensive. Their major outlets are in industry where they are used for coil forms, switch parts, induction heating apparatus, as insulation for generator and motor coils, and in power cables.

Vinyls

Vinyls constitute a wide range of thermoplastic resins, many of which have their individual properties adjusted by the use of various plasticizers, extenders and fillers. Some of the vinyl compounds have extremely high chemical resistance and low moisture absorption, while others are water-soluble. The applications are manifold. Polyvinyl acetate is an important ingredient in many adhesives and coatings, while polyvinyl butyral is used as the interlayer in safety glass.

Polyvinyl chloride and chloride-acetate appear variously as wire insulation, shoe soles, shower curtains, rainwear, tubing, gramophone records, coated fabrics for upholstery, floor tile, gaskets, etc. Color possibilities with some of the vinyls are virtually unlimited and they can be decorated in a variety of ways. For instance, sheeting may be embossed and printed to produce very attractive effects.

Epoxy Resins or Ethoxylene Resins

These resins which are of the thermosetting type, have been developed quite recently. So far their greatest use has been in the paint industry. They have also been used successfully to make adhesives which will bond together wood, glass, steel, aluminum and other materials. These resins are still fairly expensive, which tends to restrict their use at present.

Conversion to Finished Products

Most plastics may be converted into finished products by one or more of the following methods.

Moulding includes compression, transfer, injection, blow, pulp and solvent moulding. Under the influence of temperature and pressure, plastics may be made to flow into many complex shapes by the use of suitable moulds.

Casting includes coating by spread-coating, spraying, roller coating, dipping and brushing. For such application, plastics usually are used as highly plasticized pastes, organosols, solutions and dispersions. Some are available in unpolymerized liquid form which sets up, usually aided by a catalyst.

Laminating includes high-pressure laminating of sheets, rods, tubes, and special shapes. The laminating resin acts as a bonding

agent for a usually high filler content, or as a simple adhesive for continuous fabric or paper filler.

Low Pressure Moulding is usually applied with reinforced resins, such as polyester/fibreglass. Matched moulds may be utilized, although shapes are often built upon a simple male or female mould and allowed to cure in the desired shape. Pressure is often applied by means of rubber blankets or vacuum bags.

Extrusion usually involves melting of a plastic inside a cylinder which also contains a rotating screw. The screw forces the molten resin through a suitably shaped orifice to produce pipe, rod, belting and a multiplicity of special shapes.

Calendering involves the squeezing of molten resin between two or more rotating rolls. These rolls may be smooth or may have various designs in the surface to produce an embossed effect on the processed sheet.

Fabricating process starts with plastic sheets, rods, tubes, etc., which may be converted to the desired shapes by machining or forming. The latter is carried out at temperatures where a thermoplastic may be readily forced into the desired shape.

The Industry at Present

At the present time about 40 per cent of all plastics production goes into the manufacture of consumer products, whereas 60 per cent is required to supply industrial and military demands. Last year (1953) the total increase in plastics production over that of 1952 amounted to about 13 per cent. This increase was obtained largely from the high level of sales in many consumer and industrial products which contain plastic parts such as television sets, automobiles, radios, etc., and the increasing use of plastics in textiles, paints and adhesives. Thus the plastics industry is, to a considerable extent, dependent upon the general economy.

As in all large, diverse fields, the plastics industry employs men and women at all levels of education and practical skills. As the industry has developed greater diversification in materials and methods of processing and increased specialization in their application, there has been, and will continue to be, increasing opportunities for the chemist, and chemical, mechanical, electrical and design engineers.

Plastics materials manufacturers use chemists, mechanical, electrical and chemical engineers with Bachelor's, Master's, and Doctor's degrees for positions in research, engineering, production and sales. Each year more schools and universities are adding instruction in plastics to their curricula. As interest grows, new courses are added, old courses realigned to better prepare students for the needs and demands of the plastics industry.

What of the Future

The range of properties of plastics is greater than that of metals and much greater than that of either concrete or wood. Even so, it has been said that they behave more like wood than any other building material. They have many properties desirable in building construction, but they also have other characteristics, not inherent in ordinary building materials, that are a disadvantage. Their modulus of elasticity is relatively low and they creep under stress. Their thermal expansion is larger than older structural materials, particularly metals, and their temperature range of use is limited.

The use of plastics in the building field will therefore be stimulated by certain properties and limited by others. It is easy to make plastic products but difficult to make good ones. However, plastics will make revolutionary changes in the appearance of future buildings if predictions of the plastics industry come true. They foresee buildings covered with unbroken plastic skins in attractive colour combinations. Future buildings could have very unusual shapes to take advantage of some of the structural properties found in plastics.

At the recent Building Research Institute Conference in Washington, one speaker visualized the possibility of floating plastic farms, complete with buildings, on the equatorial oceans where climatic conditions encourage plant and animal growth. Imagine the opportunities such ideas may open for the engineer in the form of extra flexibility in design and construction.

During the past five years there has been much speculation on the possible application of intense radiations to problems in the polymer fields, and an increasing volume of research on the possibilities in the synthesis of new polymers and the improvement of the physical properties of presently existing polymers.

Gamma radiation offers some unique advantages as an initiating agent, in that initiation can be effected at low temperatures where heat-sensitive monomers can be polymerized, polymerzations can be carried out in the solid state and polymers can be made with no contamination from catalyst fragments. Recent work has shown that the physical properties of certain polymers can be markedly altered by exposure to radiation fields, and that a vulcanization type process takes place. Future developments in this field promise to be interesting and important.

New Developments Expected

New resins which will maintain their mechanical strength under continuous exposure to certain heated liquids should further open up the tank and transportation field. Synthetic resins which will withstand temperatures of 1,000°C. are considered a possibility. Both at chemical engineering and mechanical engineering levels, research in pipe should produce important results. New reinforcements, chiefly synthetic fibers, may provide specialized materials for applications not now practical. Research accomplished on sports car bodies is due to be translated into trucks, farm equipment and probably station wagon components.

Standardization in all the above mentioned fields under the sponsorship of The Society of the Plastics Industry, Inc., is expected to provide sound engineering design data which will increase the acceptance of those materials. The lack of precise data has to date tended to limit the use of plastics by engineers. A considerable increase in the use of reinforced plastics for metal tooling is a certainty.

Much criticism has been aimed at the plastics industry because of the "backyard" nature of many of its conversion operations. However, the material suppliers and the industry societies have exerted a stabilizing influence. This, coupled with a sincere effort on the part of many converters, has led to a sharp upgrading of the industry's status. Some converting operations are of considerable magnitude and are often associated with important industrial concerns. In other words, "bigger money" has been introduced and prestige is much higher than in the days of garage and basement operations in the "forties". When sometime in the distant future, the history of plastics is written, the next several years will probably be recorded as the most fruitful in regards to materials developments, technological progress and widening of applications.

(Continued on page 456)

A paper presented before the Maritime Professional Meeting of the Engineering Institute of Canada and the Associations of Professional Engineers of New Brunswick, Nova Scotia and Newfoundland.

Some Industrial Applications of Fluidrive

by

Antony Vickers

Executive Director,
Fluidrive Engineering Co. Ltd.,
Isleworth, England

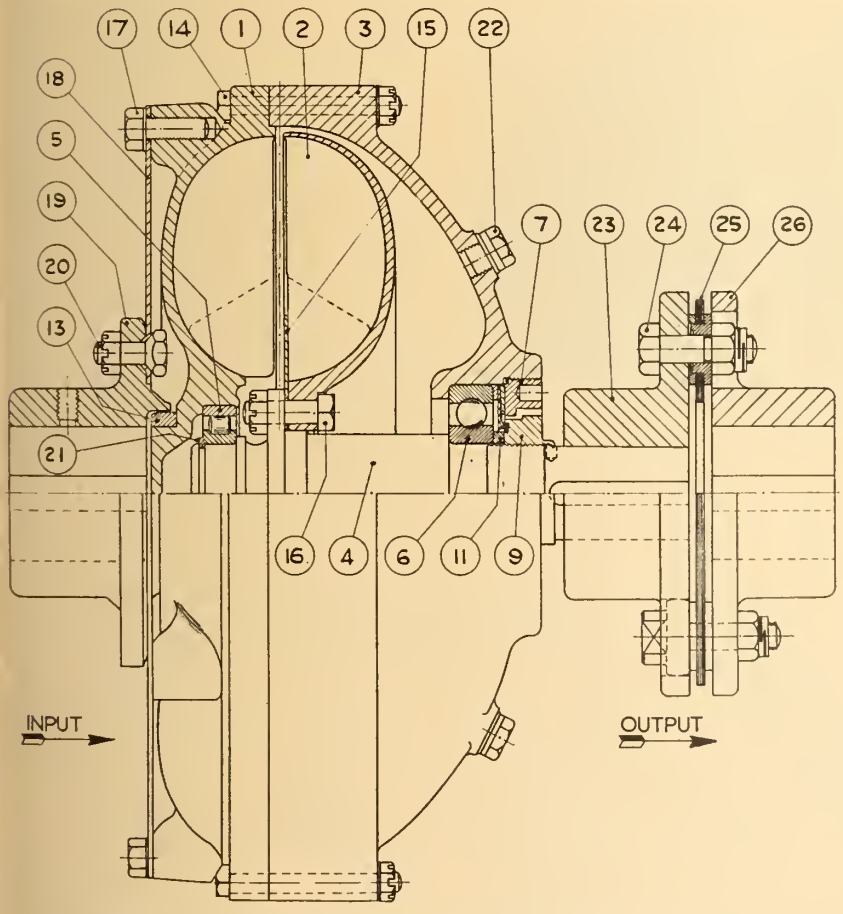


Fig. 1 Sectional arrangement of traction type fluid coupling.

1. Impeller.
2. Runner.
3. Casing.
4. Shaft.
5. Roller bearing.
6. Ball bearing.
7. Casing nut.
8. Gland diaphragm.
9. Gland nut.
10. Casing distance piece.
11. Shaft distance piece.
12. Cupped washer.
13. Spherical spigot ring.
14. Casing bolts.
15. Baffle.
16. Runner bolts.
17. Driving bolts.
18. Resilient driving spider.
19. Driving boss.
20. Driving boss bolts.
21. Circlip.
22. Filling plug.
23. Runner half coupling.
24. Multidise coupling bolts.
25. Multidise plate assembly.
26. Output half coupling.

The principle of transmitting power hydro-kinetically was invented by Dr. Fottinger in Germany in 1905, when he developed the 'Fottinger Transformator', or fluid torque converter as it is now known, the purpose of which was to transmit the power of marine turbines to propellers.

The Transformator was a three-element transmitter, and reduced the input speed from the turbine to the comparatively low requirements of the propeller. From 1907 to 1912 a number of sets were constructed in sizes up to 35,000 hp. for the German navy but, due to its limited efficiency, the Transformator was subsequently eclipsed by the highly efficient mechanical reduction gear, introduced by Sir Charles Parsons in 1909.

The Vulcan coupling had also been invented by Dr. Fottinger in 1905, but it was considered to have no application in ships until after World War I. It was then developed in conjunction with helical reduction gearing in a most efficient form for diesel driven vessels. Similarly, the Vulcan coupling was widely applied in connection with exhaust turbines and steam reciprocating engines, under the name "Baner-Wach" system.

Strangely enough, despite the considerable engineering development in Germany, no industrial application was envisaged for the Vulcan coupling. In 1926 however, Mr. Harold Sinclair foresaw the possibilities of improving the power transmission of motor vehicles by means of a fluid coupling of a considerably simplified form. Thus, Mr. Sinclair made arrangements with the Vulcan Company of Hamburg to develop the Vulcan-Sinclair

fluid coupling for industrial and automotive drives, and shortly afterwards introduced the name 'Fluidrive.'

The first major success was in May 1930, when the Daimler Company announced the adoption of this fluid coupling in conjunction with a planetary gearbox in a production model, under the now well known name Fluid Flywheel Transmission. Shortly afterwards, this transmission was standardized in Daimler and Lanchester cars, and in Daimler and A.E.C. buses. In fact, after more than twenty years, it still remains the regular transmission of all London's buses.

"Fluidrive", of fluid flywheel transmission, first invented in 1905, made its first appearance in the late "twenties" as the Vulcan Sinclair fluid coupling. In this paper the author gives a history of its early development, up to the time of its adoption by the automobile industry in the "thirties". Detailed descriptions of the traction type and of the "scoop control" fluid couplings are given, with illustrations. A number of applications of fluidrive in various industries, most of them Canadian, are given.

It is also of interest that in 1938 Chrysler Corporation introduced the first automobile in the United States with a fluid coupling constructed under Vulean-Sinclair patents, and with the name 'Fluid Drive'. Since then, more than 3½ million Fluid Drives have been incorporated in Chrysler, de Soto and Dodge cars and trucks.

So much, then, for this brief reference to the historical and automotive background of the Vulcan-Sinclair fluid coupling which, in 1928, was being developed in two principal types — the automotive or traction coupling, and the variable filling or scoop tube type.

Traction Type Fluid Coupling

Figure 1 shows a traction type fluid coupling, mounted as a unit, the driving boss (19) being carried on the electric motor shaft with the spherical spigot of the impeller (1) duly registered therein. The torque is transmitted to the driving bolts (17) by means of the resilient diaphragm disc (18), and the casing (3) is, in turn, bolted to the impeller.

The runner (2) is secured to the shaft (4) which runs on two bearings — roller bearing (5) and ball bearing (6), the latter taking care of the hydraulic thrust. The gland assembly comprises a mild steel nut (9) with an inserted lead bronze ring on which runs a lapped steel

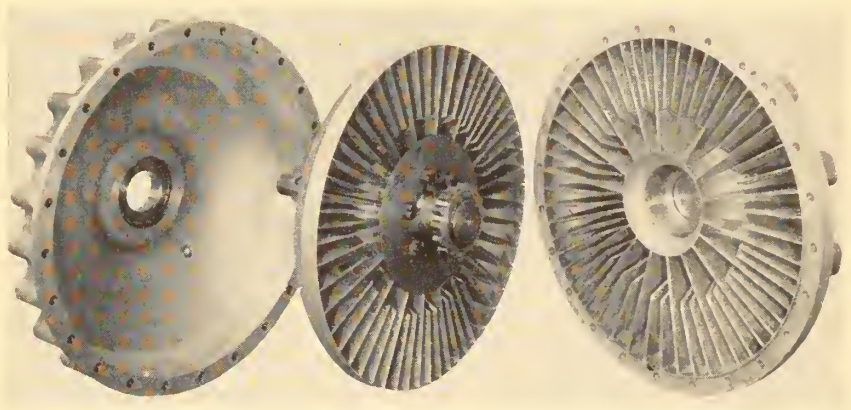


Fig. 2. Main components of traction type fluid coupling.

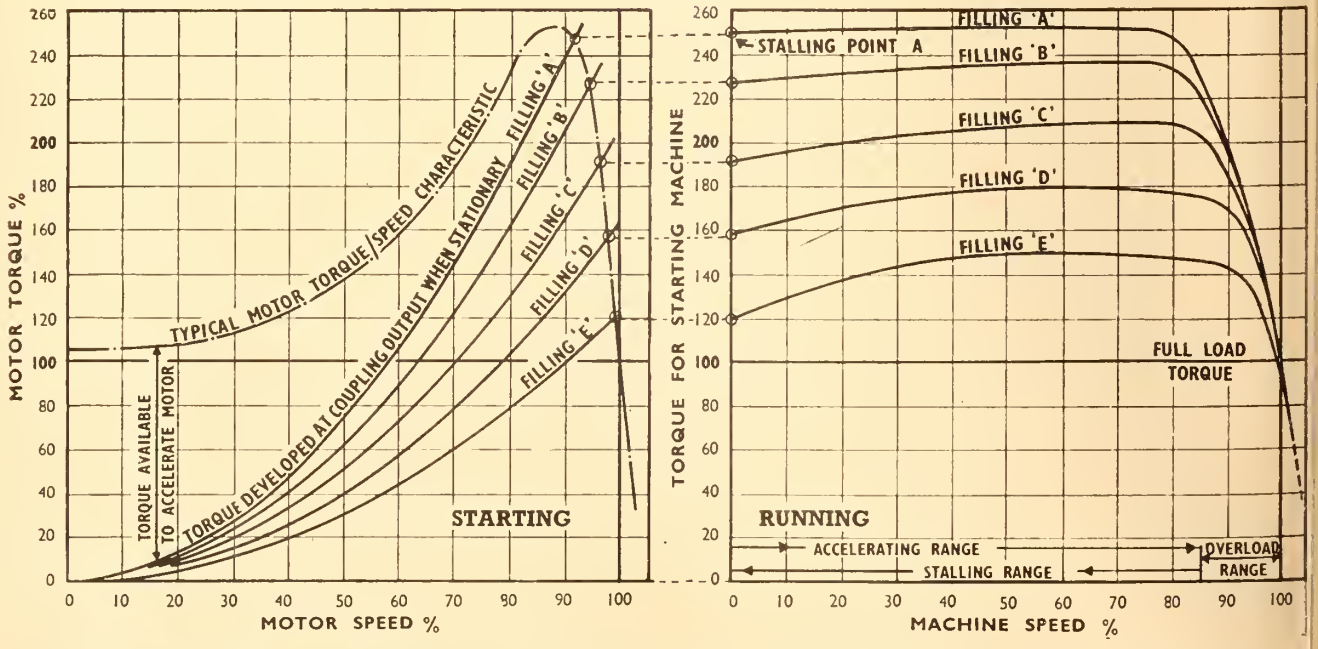


Fig. 3. Curves showing characteristics of combination of squirrel-cage motor and traction type fluid coupling.

diaphragm secured by the casing nut (7). Torque from the output shaft is transmitted as shown through a multi-disc flexible unit (25). Thus, with its flexible input and output mounting, it will be seen that the fluid coupling permits a small degree of angular flexibility and, in effect, acts as a short carden drive.

Two important features of the traction coupling are the baffle (15) and the comparatively large reservoir chamber between the casing and the back of the runner. The impeller, runner and casing, as shown in Fig. 2, are made from aluminium castings with the vanes set radially, so that the fluid coupling transmits power equally well in either direction.

As is generally known, the power transmitting medium is a light mineral oil, which is filled to the required level through the plug (22). Thus, when rotated the impeller acts as a centrifugal pump and the runner as a turbine, the torque building up as the square of the input speed.

At the point where this torque exceeds that of the resistance torque, the runner will commence to revolve and, at normal full load and speed, will rotate at about 98 to 96 per cent speed of the impeller. This corresponds to a slip of 2 to 4 per cent, the ratio of output torque to input torque being 1:1 under all conditions of slip. Clearly, the efficiency of power transmission for this type of fluid coupling is 100 — the percentage slip.

Figure 3 shows the characteristics of the traction coupling when driven by a standard squirrel-cage motor with across-the-line starter. In the left half a typical torque/speed curve is given, and beneath it five curves for different fillings of oil show how the torque builds up as the square of the speed, so long as the output shaft remains stationary.

With the maximum oil filling the fluid coupling permits the motor to run up to practically full speed, thereby developing peak torque for starting as compared with, perhaps, 110 per cent of full load torque with a direct coupled motor. Furthermore, the initial high amperage rapidly falls off because the motor accelerates under light load so quickly.

The right half of the curves shows the speed of the output shaft under different conditions of load and oil quantity and — so very important in many drives — that even if the output shaft is stalled the motor will continue running until switched off. With the minimum oil quantity the torque transmitted will not exceed, say, 150 per cent of full load, although at normal speed and load the slip will be no greater than with the maximum filling.

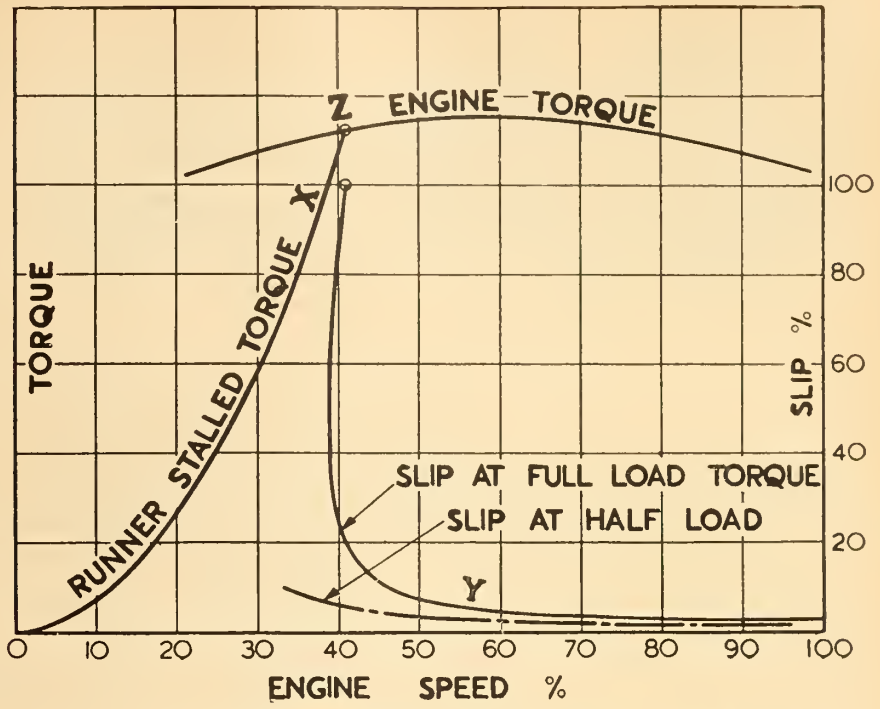


Fig. 4. Curves showing characteristics of combination of diesel engine and traction type fluid coupling.

This wide range of adjustment is due to the combination of several features, including the internal baffle and the reservoir chamber already referred to. Under heavy overload or stalling conditions, the oil vortex ring will strike the baffle and a portion of the oil will escape into the reservoir, thus limiting the torque transmitting capacity of the coupling. As the overload decreases to normal and the speed of the coupling increases, oil returns from the reservoir into the working circuit, and the vortex no longer strikes the baffle.

The characteristics of the traction type fluid coupling, when driven by an electric motor, can be summarized thus:—

1. A standard squirrel-cage motor can develop peak torque for accelerating the load and, therefore, can be rated for the running instead of the starting condition.

2. Acceleration is extremely smooth and the rate can be adjusted over a wide range, simply by varying the filling of oil.

3. The torque transmitted can be limited to a predetermined safe value, even if the output shaft is suddenly stalled. In the case of a direct coupled motor, the kinetic energy of the motor rotor, when stalled, is superimposed in the form of additional torque on the electrical pull-out torque. With the fluid coupling the motor continues running until switched off by thermal overload trip.

4. In the case of reversing drives, the motor can be 'plugged' because of the torque limiting characteristic of the coupling.

5. In the case of wound-rotor or variable speed motors the fluid coupling considerably increases the flexibility of the drive.

As regards internal combustion-engined drives, the combined characteristics with a traction type coupling are as shown in Fig. 4. Here again the torque transmitted by the coupling builds up as the square of the engine speed until the output shaft begins to rotate at point Z. The slip then rapidly decreases until over the normal working range it is of the order of a few per cent. At half load the slip is approximately half that of full load.

Hence, when driven by an internal combustion engine, the characteristics of the traction coupling are briefly as under:—

1. The smoothest possible take-up of the drive is obtained simply by accelerating the engine.

1. Resilient driving plate.
2. Impeller.
3. Runner.
4. Inner casing assembly.
5. Reservoir casing.
6. Scoop housing.
7. Splash baffle.
8. Scoop tube.
9. Operating spindle.
10. Scoop tube pin.
11. Scoop housing brkt.
12. Back casing assembly.
13. Operating lever.
14. Shaft.
15. Dowel retaining plate.
16. Roller bearing.
17. Dowels.
18. Ball bearing.
19. Spacing collars.
20. Retaining washer.
21. Centre spigot.
22. Retaining ring.
23. Control lever.
24. Runner baffle.
25. Driving bolts.
26. Collector ring.
27. Shaft ring.
28. Bearing cover.
29. Fitted bolt.
30. Inner casing bolts.
31. Tundish.
32. Ball bearing.
33. Runner bolts.
34. Casing set bolts.
35. Impeller set bolts.
36. Socket head screws.
37. Bearing liner.
38. End cover.
39. Set bolts.
40. Bearing nut.

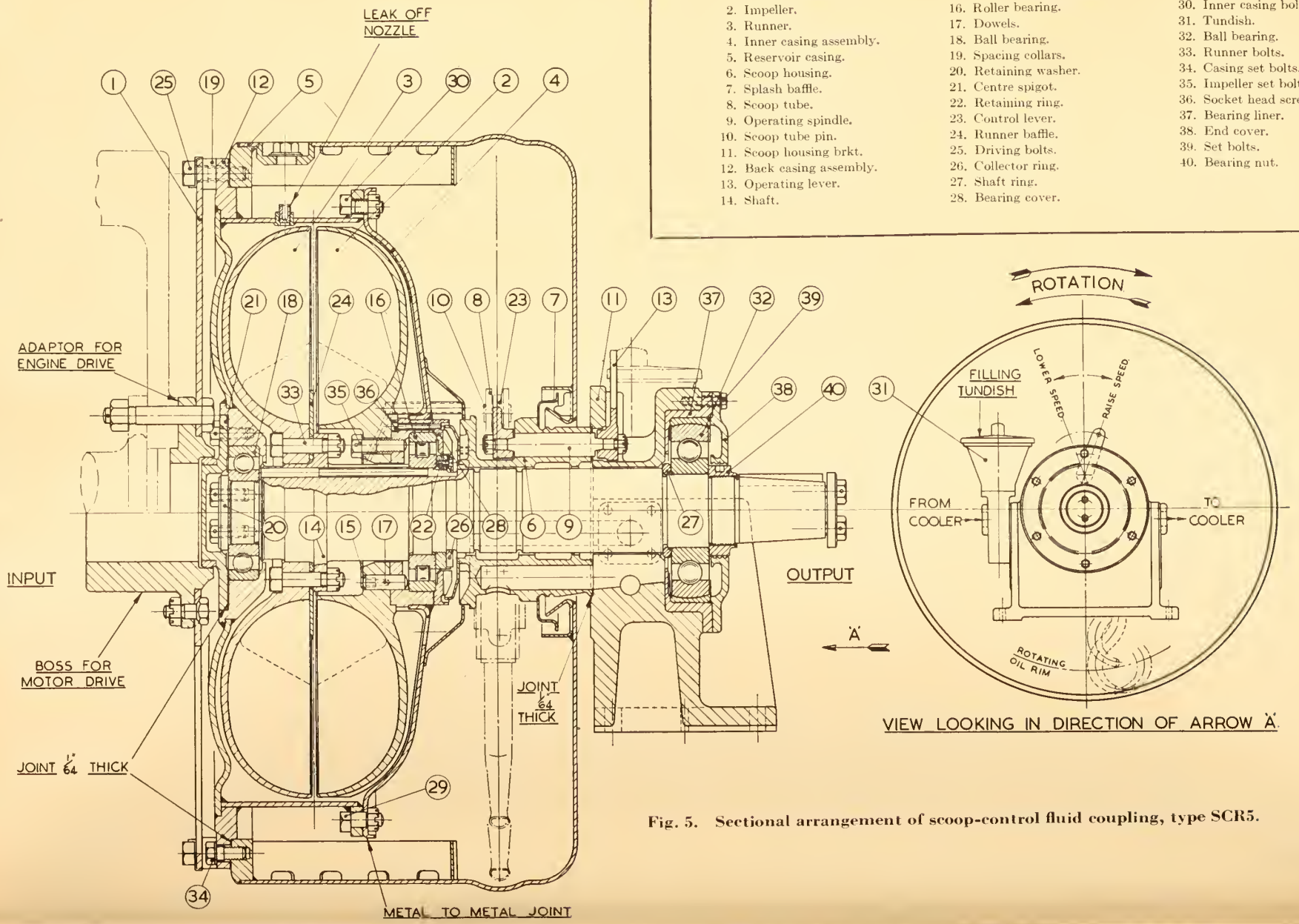


Fig. 5. Sectional arrangement of scoop-control fluid coupling, type SCR5.

2. The engine ean develop maximum torque when aceelerating the load from a standstill.

3. It is not possible for the engine to be stalled by overload.

4. Neither torsional oseillations nor shock loads ean be transmitted by the fluid coupling.

5. Two or more engines ean be compounded to a eommon shaft.

Fig. 6. Main components of type SCR 5 fluid coupling.

Scoop-control Fluid Couplings

The scoop-control fluid eoupling, Fig. 5, whieh is used in many types of drive in powers ranging up to several thousand horsepower in a single unit, differs from the traetion type of fluid coupling, in that the working eircuit ean be filled and emptied when running. This is achieved by arranging for the oil in the working circuit to be emitted by centrifugal pressure through the leak-off nozzles into the rotating reservoir (5).

The oil is picked up by the non-rotating scoop tube (18) and returned through the ports in the scoop housing (6), the collector ring, the ports in the centre of the inner easing (4) and from there is pumped into the working eireuit by means of the radial vanes on the baek of the impeller (2).

The position of the scoop tube which slides in vertieal guides in the housing is controlled by the operating lever (13) and the spindle (9). When the seoop is in the fully withdrawn position and the coupling is being driven, the oil will form a rotating annulus in the reservoir easing and the working circuit will empty. In consequence, no power will be transmitted and the drive will be disengaged.

With the scoop in the fully 'in' position, the working circuit will be praetically full and the drive engaged. Intermediate positions of the scoop give a reduetion in speed of the output shaft, with a maximum range, subjeet to the nature of the drive, down to 20 per eent of full speed. The scoop tube lever ean be operated in several ways, including direct manual eontrol, remote electric with fractional horsepower servo-motor and switch or automatic control, the torque required at the operating spindle being very modest.

In the type SCR5 shown, the shaft is carried in three bearings, the outboard bearing being of the self-aligning type and the driven machine being conneeted to the shaft by means of a fully flexible coupling. An important feature of the design is that the diameter and length of the eoupling are sueh that, when stationary, all of the oil is eontained below the level of the opening of the reservoir easing. In consequence, no gland seal is required, but a simple labyrinth is provided and hence there are no wearing parts.

Filling of the eoupling with the correet amount of oil is done with the coupling running, but with the scoop in the 'withdrawn' position. Unscrewing the tundish (31) top opens a valve through which the light mineral oil is poured until an oil witness is observed. This signifies that the rotating annulus of oil has reached the scoop tip.

Lastly, it should be mentioned that it is a simple matter to connect an oil cooler to the scoop housing bracket (11), the oil pressure from the scoop tube being ample to

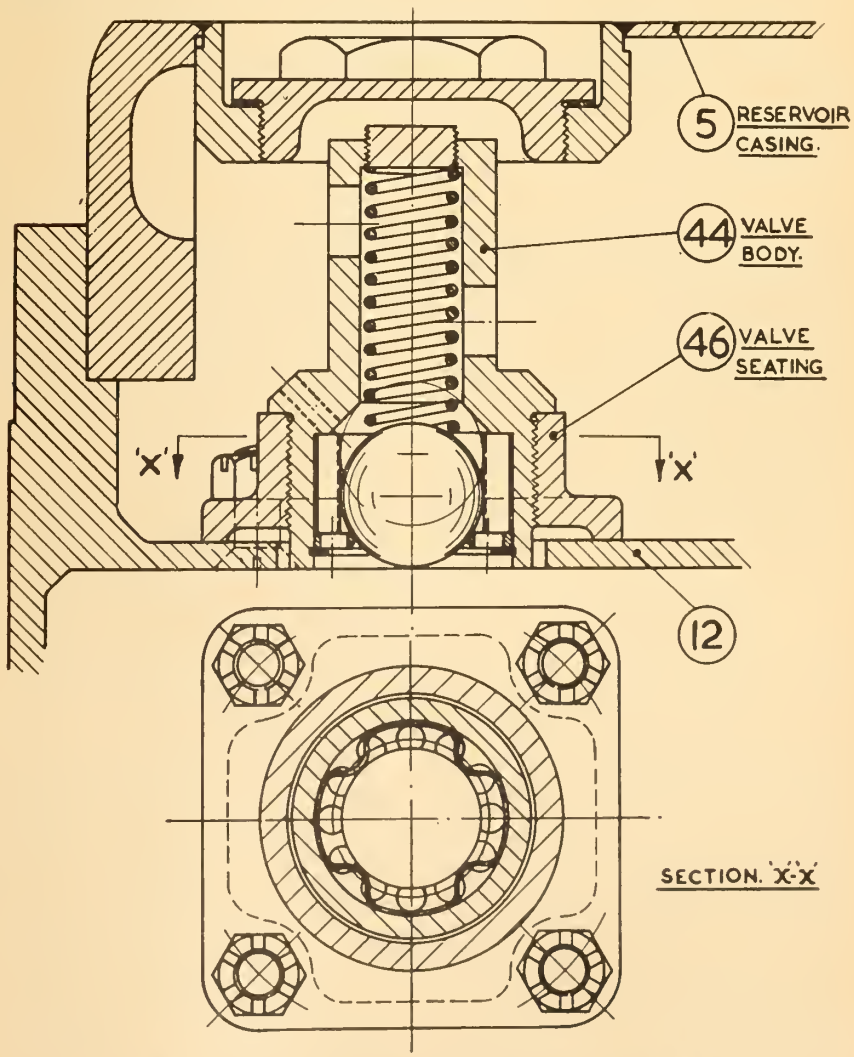


Fig. 7. Assembly of centrifugal quick emptying valve.

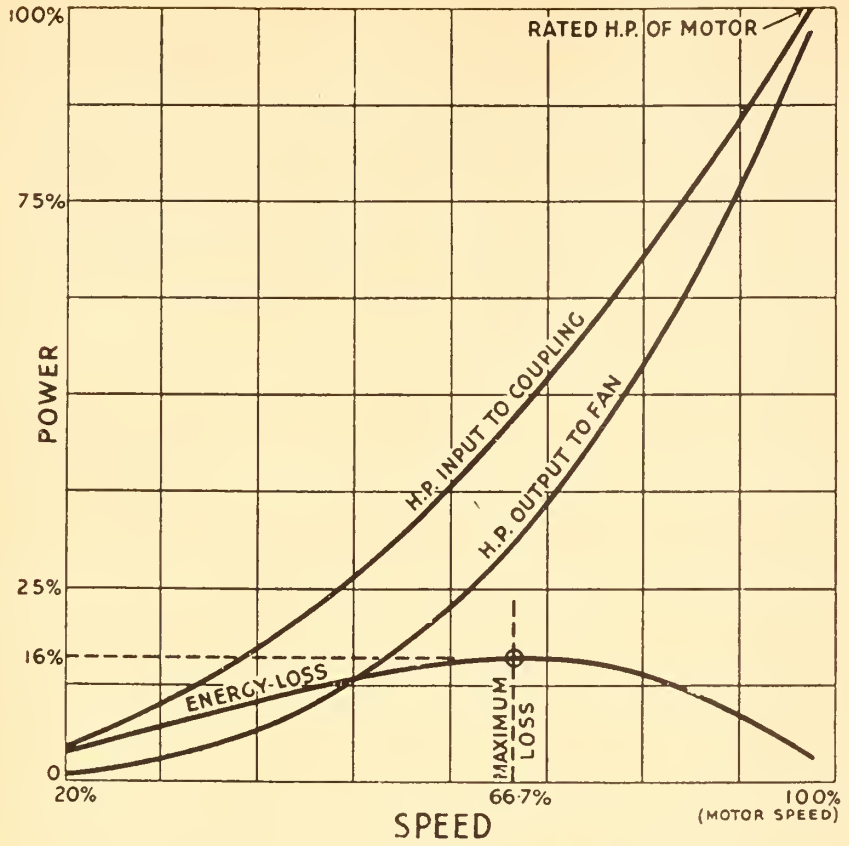


Fig. 8. Input and output power curves of scoop-control coupling when driving a fan or centrifugal pump.

ensure the necessary circulation. Further reference to this is made in connection with the characteristics of the coupling.

The main components of the SCR5 coupling are shown in Fig. 6, the rotating parts, with the exception of the aluminium impeller and runner, being of fabricated mild steel. Incidentally, for simplicity of construction of this particular type, the impeller is mounted 'away from' the motor.

Speed Regulation

It will be appreciated that for many drives, such as fans and centrifugal pumps, the rate at which it is desirable for the working circuit to empty is comparatively slow, and this will be taken care of by the three leak-off nozzles. On the other hand, for some drives more rapid emptying is necessary and, therefore, centrifugal quick-emptying valves are fitted Fig. 7.

Thus, at normal speeds of rotation, the centrifugal force of the ball overcomes the compression of the spring and the valve is closed, the oil being emitted through the leak-off nozzle in the valve body. When the input speed drops to a predetermined figure, the spring forces the ball from its seating and allows the oil to escape through the large ports in the valve body.

A screw adjustment is provided so as to determine the rotational speed at which the valve will close. For example, in the case of heavy starting drives the centrifugal valves can be so adjusted that the working circuit will remain virtually empty until the motor has accelerated up to, say, 90 per cent of full speed. With the drive thus disconnected a compensator starter can be used, because the motor will accelerate up to full speed under off-load conditions on the low voltage tapping, the scoop tube remaining in the fully engaged position.

The ability to provide infinitely variable speed regulation is one of the reasons why this type of fluid coupling is so widely used, always bearing in mind that the ratio of output torque to input torque is 1:1 over the whole range. In the case of fans, pumps and propellers in which the power absorbed varies as the cube of the output speed, the characteristics of the coupling are as shown in Fig. 8.

The maximum loss of power transmitted occurs at 66.7 per cent of full speed and amounts to 16 per cent of the rated power of the motor. At 50 per cent of full speed the loss of power will be 12.5 per cent of the motor rating, although the efficiency will be only about 50 per cent; the actual formula for efficiency percentage being

$$(100 - 2) \times \frac{\text{Output Speed}}{\text{Input Speed}}$$

As regards drives where the torque is constant over the speed range, the power loss through the coupling at reduced speeds is obviously greater than with drives as in Fig. 8, and instead of a speed range of 5:1 it is customary not to exceed 2 or 3:1 except for comparatively small powers. In the case of high power machines such as flywheel generator sets of 2,500 hp., the advantages of even a 15 per cent speed range are thoroughly well worthwhile.

A further example of the scoop-control type of fluid coupling is shown in Fig. 9, this being the SCM10 coupling as used for marine propulsion and other higher powered diesel drives. For rapid filling the scoop tube is of larger proportions and, to cater for reversing engines, a double-ended scoop is fitted. Rapid emptying is obtained by means of quick emptying valves, of which there may be six or more. For marine propulsion the minimum overall diameter is particularly desirable, and a reduction of about 10 per cent as compared with the SCR5 type is achieved by the introduction of the small spill-over tank.

This tank holds about 10 per cent of the total oil quantity when the coupling is stationary, thereby reducing the amount to be contained in the reservoir casing. When starting up the oil is returned to the reservoir by means of an ejector operated by the scoop pressure, and the spill-over tank remains empty until the engine is again shut down. No auxiliary pump is necessary and the coupling is entirely self-contained.

Figure 10 shows the main components of the coupling, both impeller and runner being of fabricated mild steel. Apart from the complete disconnection of the engine from the propeller shaft and the non-transmission of torsional oscillations, the scoop-control coupling enables the propeller to be driven down to a minimum of 10 per cent of full speed, the engine speed range being of the order of 2:1. This has the double advantage of enabling the ship to be manoeuvred at very

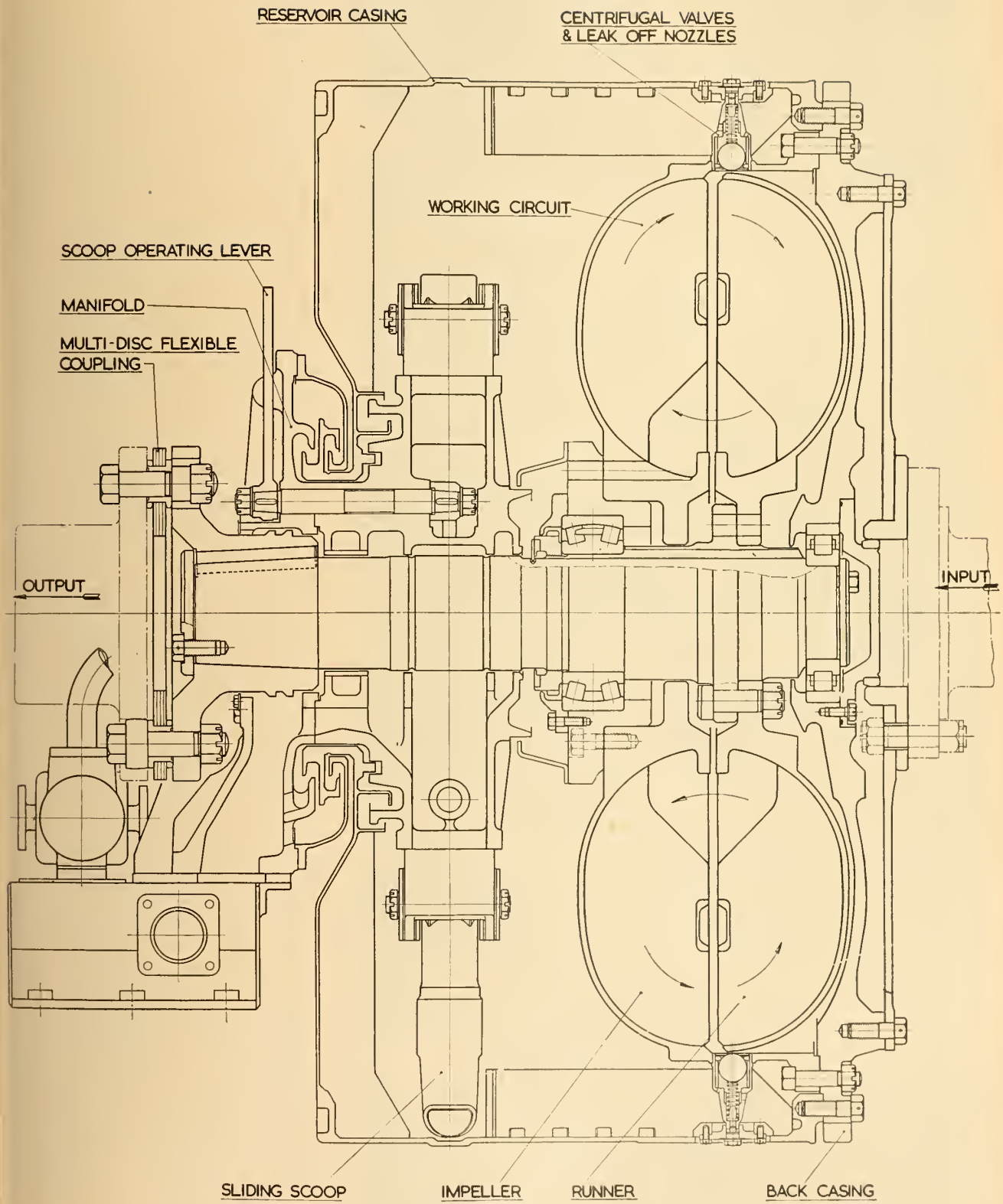


Fig. 9. Sectional arrangements of scoop-control coupling SCM10 for marine propulsion.

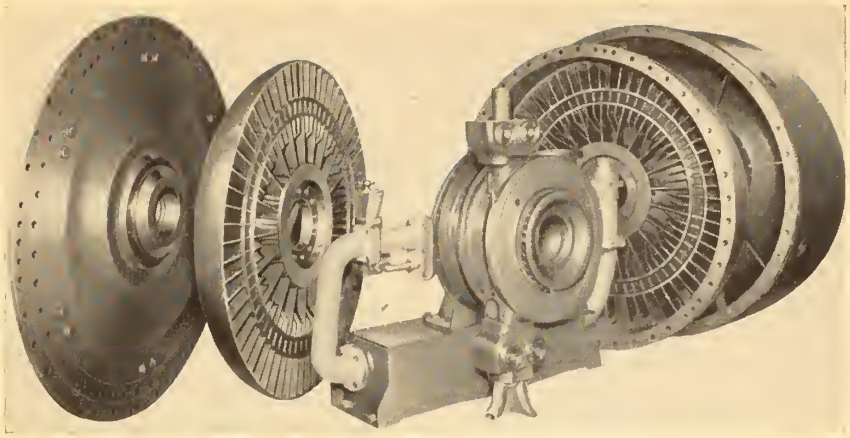


Fig. 10. Main components of SCM10 fluid coupling.

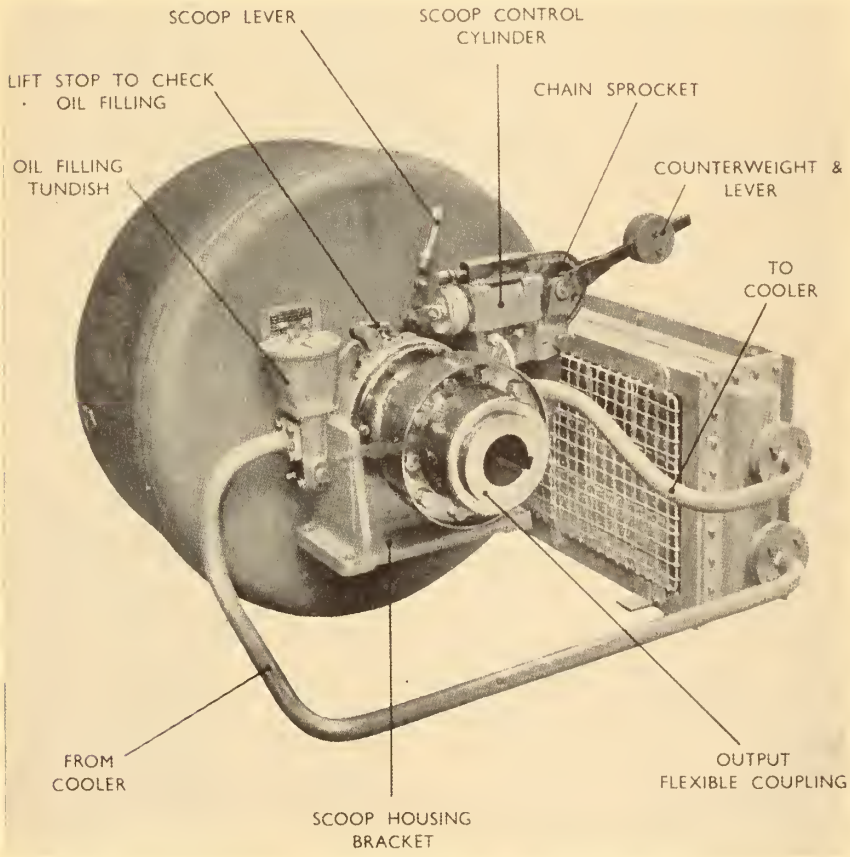


Fig. 11. Outside view of SCR5 fluid coupling with automatic torque limiting control.

low speed whilst permitting the engines to run at a comparatively fast idling speed.

Furthermore, for reversing, where two bi-directional engines are geared to a single propeller shaft, one engine can be set to idle in the reverse direction with the coupling empty. Hence manoeuvring is effected simply by accelerating one engine and filling its coupling, whilst the other is reduced to idling speed and the coupling emptied. This is very favourable to the engine, as cold air is only introduced once instead of for each reversal.

In the case of two uni-directional engines driving through a reverse reduction gear, one engine can be engaged to the astern clutch with the fluid coupling empty, thus manoeuvring becomes a matter of accelerating one or the other engine and filling or emptying the respective coupling. In so doing, clutch wear is reduced to an absolute minimum. Obviously, both engines can be used for driving the ship astern if required.

It is not possible to refer here to more than a comparatively few aspects of Fluidrive but, nevertheless, brief mention should be made of the automatic torque limiting control (Fig. 11). The purpose of this automatic control is to limit the torque transmitted during acceleration to a pre-determined value — say 140 per cent of full load torque. This is desirable in certain kinds of machines, including heavy ore conveyors, when the limiting factor may be the tensile strength of the belt.

Oil pressure is taken from the scoop to a small external cylinder, the piston of which applies a thrust to withdraw the scoop tube lever against an adjustable stop, thus reducing the torque transmitting capacity of the coupling. As the machine accelerates the oil pressure decreases, and the scoop lever is brought into the engaged position by means of the weighted lever. The position of the weight is adjustable, thus a simple and certain means of limiting the torque during acceleration is provided by this automatic control.

Representative Applications

At the present time Fluidrive has been established in some 500 different types of industrial drive, in powers ranging from a fractional horsepower to 10,000 hp. and more. In many cases the reasons why Fluidrive is used vary and, to illustrate this paper a few representative applications are included:

Worsted Spinning Frame

An example of smooth acceleration is shown in Fig. 12, which illustrates a P.S.C. worsted spinning frame driven by a standard squirrel-cage motor rated at 30 hp. at 1,450 r.p.m., and size 12.75 fluid coupling unit of the traction type. With the development of the centrifugal principle of spinning wet yarn, the rate of spinning has been increased from 2½ to 4 times previous practice. Thus container speeds up to 15,500 r.p.m. are now regular practice, involving accelerating periods of 50 seconds, the rate of acceleration being readily adjustable by varying the quantity of oil in the coupling.

Belt Conveyors

Ability to rate the motor for the running instead of the starting load, with corresponding economies in electric cable, starters, etc. has resulted in the combination of

squirrel-cage motor and traction type fluid coupling being widely standardized. Smoothness of acceleration is also responsible for the virtual elimination of tail-end surge and makes it practicable to reduce initial belt tension.

In the case of conveyors of medium length, or longer, where gravity tensioning devices are customary, it is most noticeable that the vertical movement of the tensioning weight, when the conveyor is started up, is greatly reduced if Fluidrive is used. Figure 13 shows a typical coal handling conveyor in a steam power station, driven by a 37½-hp. 720-r.p.m. S.C. motor and size 20 fluid coupling unit.

In the case of heavy ore conveyors, where excessive belt tension is a limiting factor, the scoop-control type of coupling with automatic torque limiting control, as described in Fig. 11 is used. All the main 3000/4000 tons per hour conveyors at the Sept Isles Terminal of the Iron Ore Company of Canada Ltd. are so equipped, an example of a dual drive aggregating 675 hp. being shown in Fig. 14.

Crane Bridge and Cross Travel Motions

The heavy inertia and frequent starting, stopping and reversing involved in the bridge travel drive of overhead cranes causes arduous conditions for electric motors. The characteristics of the traction type fluid coupling are particularly suited to such drives, and considerably enhance the smoothness of operation with corresponding reduction in maintenance, particularly where 'plugging' is practised.

Fig. 15 shows a 20-ton crane constructed by Provincial Engineering Ltd., the drive units for both bridge and cross travel motions comprising reversing squirrel-cage motors and fluid couplings.

Swing Hammer Crushers

An example of rating the motor for the running load instead of the starting load is a 42 in. x 48 in. crusher operating at a gasworks, which reduces bituminous coal from 2 to ½ at the rate of 200 tons an hour, and is driven by a squirrel-cage motor rated at 80 hp. at 975 r.p.m. through a size 20 fluid coupling unit. Without a fluid coupling the catalogue calls for a motor of 160 hp. but with fluid coupling the 80 hp. motor is able to develop 160 hp. when starting in the event of the crusher box being full. Clearly, a motor will run more efficiently if it operates at its rated load instead of at part load.

Gyratory Crushers

In the case of gyratory or cone crushers handling hard rock, the experience with Fluidrive has proved very satisfactory. The transmission requirements are somewhat different from those for swing hammer crushers, and considerable value is attached to the torque limiting feature of the traction type fluid coupling as shown in the right hand half of the curves (Fig. 3).

Figure 16 shows two 4-foot cone crushers at a South African gold mine, each of which is driven by a squirrel-cage motor rated at 125 hp. at 485 r.p.m. through a size 32 fluid coupling unit, and has a capacity of 80 tons an hour when reducing rock from 2 in. down to

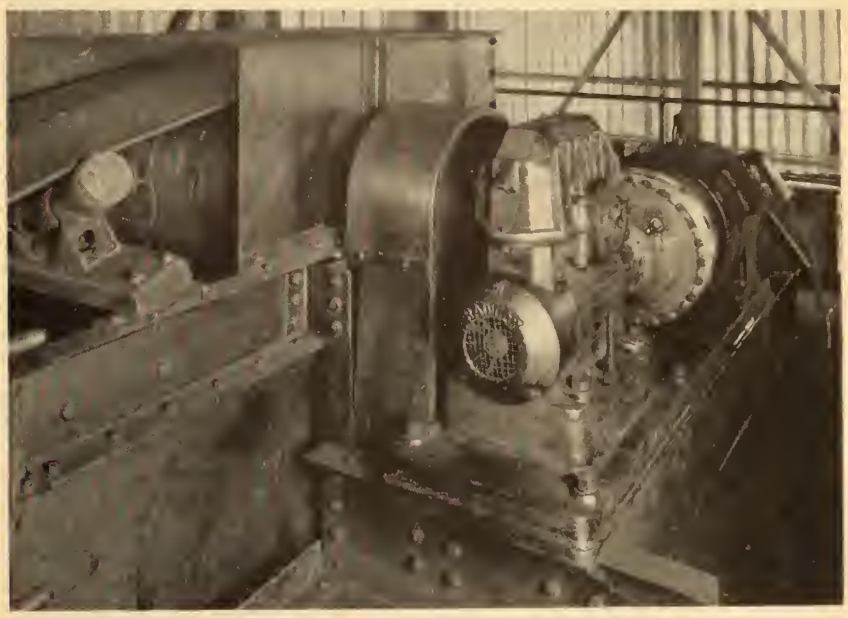


Fig. 12. P.S.C. worsted spinning frame.

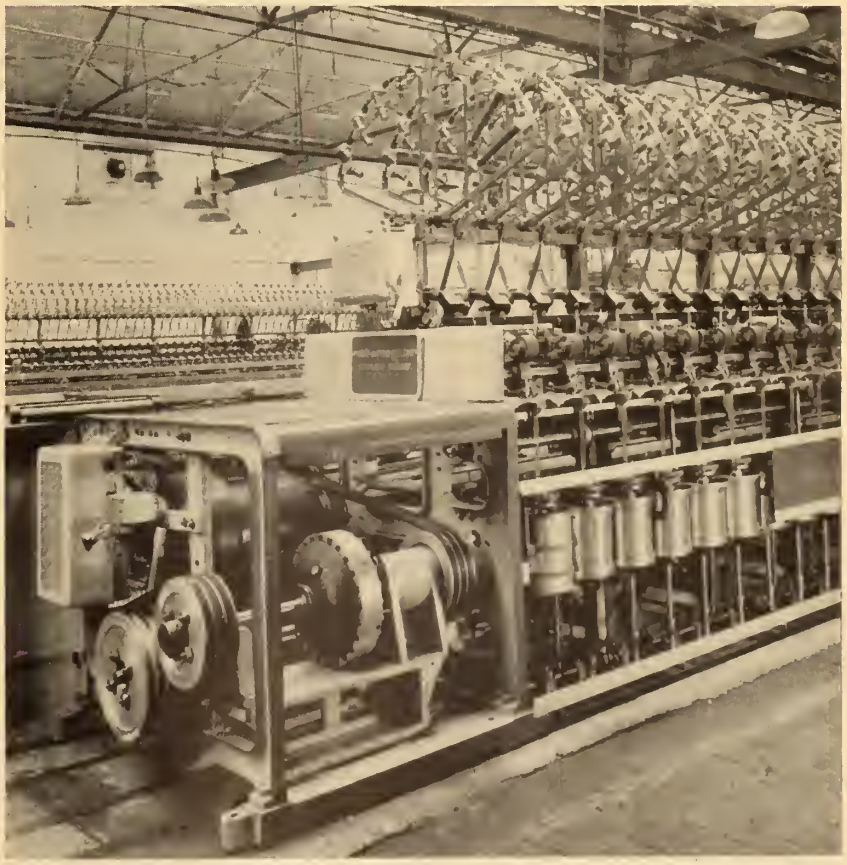


Fig. 13. 37½ h.p. belt conveyor.

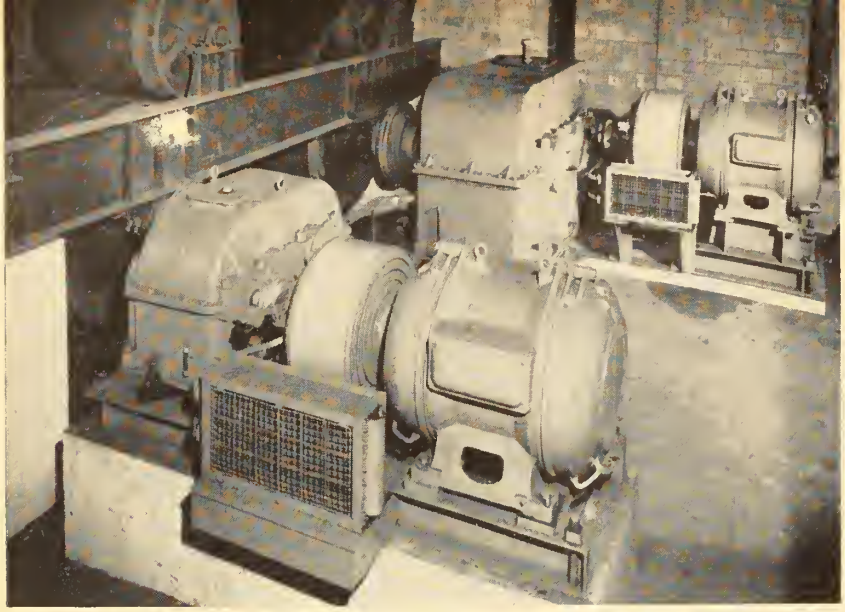
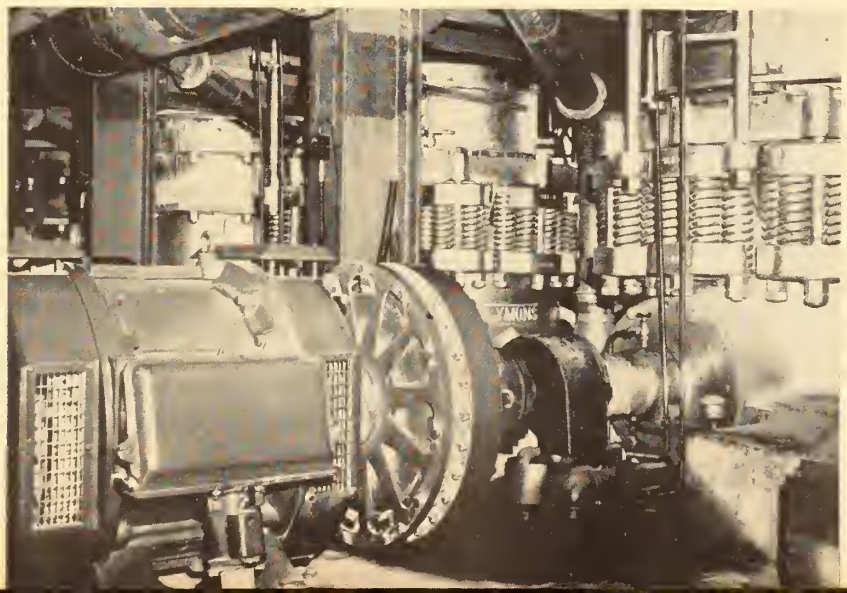


Fig. 14. 675 h.p. Heavy ore conveyor with scoop-control coupling drive units at Seven Islands.

Fig. 15. Overhead crane with bridge and cross travel motions, driven by traction type couplings.

Fig. 16. Gyratory crusher.



5/8 in. Normally these crushers are operating at about 80/90 hp., whereas the couplings are filled so as to allow the crusher to stall when the load rises to about 250 hp.

Curiously enough, there has been considerable conservatism in the past as regards the use of Fluidrive for gyratory crushers. However, it is significant that within two months of the first gyratory crusher being converted to Fluidrive in Canada, a repeat order was placed by the same user.

Infinitely Variable Speed Fans

The first infinitely variable speed fluid coupling for the driving of a boilerhouse fan in Canada was installed at the Minto Power Station of the New Brunswick Electric Power Commission in 1934. Today there are more than 5,000 scoop type couplings driving fans in power stations in many countries. A typical example of a fan drive is shown in Fig. 17, this being one of the Sirocco type SE fans serving the lead furnace baghouse plant at the Trail Smelter of Consolidated Mining and Smelting Co., Ltd. The squirrel-cage motor is rated at 250 hp. at 1,180 r.p.m., and drives through a size 26 scoop-control fluid coupling equipped with Bailey Meter automatic control.

Centrifugal Pumps

An interesting example of the saving in power effected by means of an infinitely variable speed fluid coupling is the pumping set used by the City of Edmonton. The 20 in. x 16 in. type S1 Canadian Allis Chalmers pump is driven by a 1,200 hp. 900 r.p.m. synchronous motor through a size 41 SCR9 fluid coupling. The discharge of the pump is varied according to demand, against a maximum head of 305 feet, from 10,600 Imperial gallons per minute down to 2,000.

The saving in power at 0.8 cents per kwh. due to the ability to run the pump at reduced speed, as illustrated in Fig. 8, is estimated by the City engineers at 3,976 a year and, as a capital investment, the price of the fluid coupling is repaid in less than two years.

The speed regulation of centrifugal stock pumps in pulp and paper mills is another application of the scoop-control coupling. For example, five size 16.25 SCR couplings at the Chandler mill of The Gaspesia Sulphite Co. Ltd. driven by S.C. motors of 100 hp. at 75 hp., have a speed range of 3:1. They are used for transporting stock from stage to stage in the sulphite bleaching plant. In comparison with

constant speed pumps and throttling valves the power saving reported by the plant engineers in question is approximately 200 hp. (Fig. 18).

Ball Mills

Two characteristics of the scoop-control coupling with centrifugal valves are well suited to heavy drives such as ball and rod mills. Firstly, a standard squirrel-cage motor with compensator starter can be used because the motor will run up to full speed under off-load conditions and, when switched over to full line voltage, the motor can develop twice full load torque for starting the mill. Secondly, the mill can so easily be 'inched' round for changing the liners, the operation being simply that of running the motor at full speed and engaging the scoop as required, to obtain the necessary degree of rotation.

An example of this is the four Hardinge Tricone ball mills installed at the Barvue Mine, having a capacity of 1,500 tons of zinc ore daily and grinding from ½-inch feed to 60 per cent minus 200-mesh. The 600 hp. 1,160 r.p.m. S.C. motor, which can develop 1,200 hp. in starting, drives through a size 29 SCR5 coupling and infinitely variable speed regulation over a 10 per cent range is available in order to obtain optimum grinding conditions.

Hydraulic Ram Pumps

The reasons why Fluidrive is used vary from one application to another, some being better known than others. An example of the latter group is the battery of three ram pumps serving 1,250 lb. per square inch hydraulic pneumatic accumulators (Figure 19), the pumps being driven by continuously running motors of 100 hp. at 1,465 r.p.m. and size 18 scoop-control couplings.

When the full pressure is reached, the scoop tubes are automatically withdrawn, thus causing the pumps to stop. When the demand on the system reduces the water level in the accumulator, the automatic control reintroduces the scoop tubes one by one, as required.

Experience with Fluidrive in such an application, where as many as 20 starts and stops an hour are made, establishes that there is a power saving of 20 per cent as compared with similar pumps fitted with an automatic by-pass system; that the elimination of the by-pass system results in a reduction of maintenance, and that the capital cost of the Fluidrive system is slightly more favourable. √

Fig. 17. Infinitely variable speed fan.

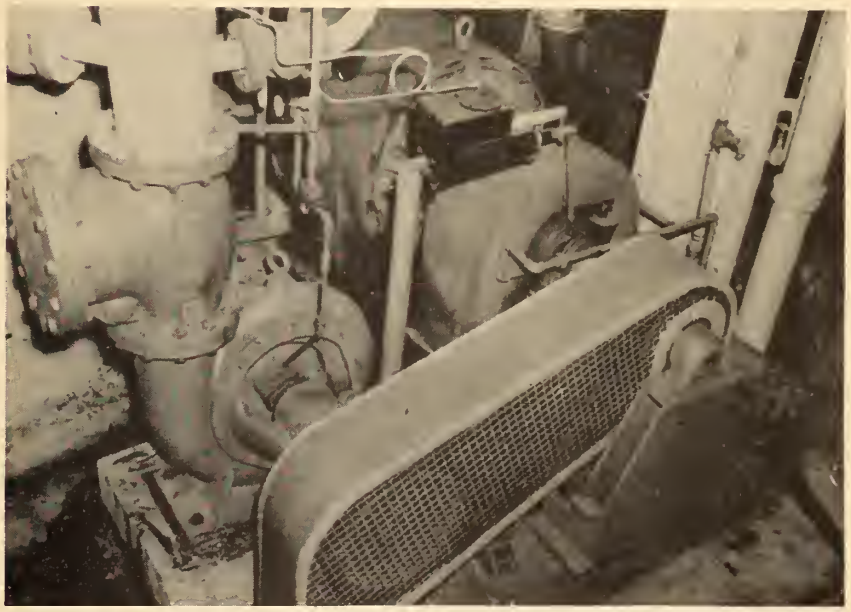
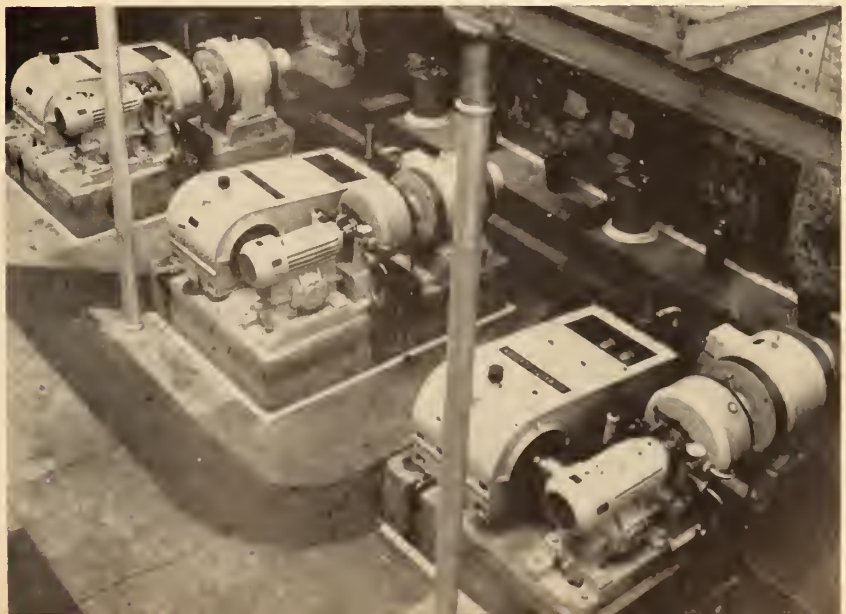


Fig. 18. Infinitely variable speed stock pump.

Fig. 19. Hydraulic ram pumps.



Nature, Distribution and Dispersion of Contaminants in the Urban Environment

Contributed as Report No. 166 from Defence Research Chemical Laboratories, Ottawa, Canada.

by

Dr. Morris Katz, M.E.I.C.

Chairman, Canadian Section, Technical Advisory Board on Air Pollution, International Joint Commission, Ottawa

The rapid growth of our cities has intensified the problem of the contamination of the air by the waste products from combustion of fuels, manufacturing and processing industries, vehicular traffic and other activities of the population. The average human adult, in a day, will consume about two and three-quarter pounds of food, drink four and a half pounds of water and breathe about thirty pounds of air. He may be concerned with the purity of his food and water supplies, but is less fastidious about the air which enters his lungs.

However, the time is fast approaching when some consideration must be given to the quality of the air in our environment. The capacity of the atmosphere to dilute and disperse effectively the vast quantities of contaminants discharged daily over a city or industrial community is not unlimited. This is shown by the increasing incidence of smog and nuisance effects in many cities, and the appearance of pollution problems in urban communities which were relatively free from such influences in the past.

Recent smog disasters, accompanied by illnesses and deaths, at Donora, Pa. in 1948 and London, England in 1952, indicate that when the atmosphere becomes overburdened with solid, liquid and gaseous waste products the result may be not merely a nuisance but can constitute a serious menace to our health.

In order to control effectively and economically the extent of pollution in our urban areas, and to minimize the possibility of unpleasant effects, it is necessary to know as much as possible about the physical and chemical properties of these wastes. We must learn how they are distributed through the atmosphere by the prevailing air currents, and the influence of topographical and meteorological factors on their accumulation and dispersion.

Recent advances in science and engineering technology have made it possible to control most stack emissions at the source to the extent that they do not constitute a nuisance to the surrounding community. The extent of such control is limited only by economic considerations, and by how much we are willing to pay for reasonably clean air.

Nature of Contaminants

In our urban and industrial communities the atmosphere serves a natural function as a means of disposal of waste effluents. There is no reason to question this practice until the amount of waste products released becomes too much or the stack discharges constitute a visible nuisance. The combustion of coal results in the release to the air of carbon dioxide, water vapour, carbon monoxide, sulphur dioxide, oxides of nitrogen; organic compounds such as hydrocarbons, oxygenated derivatives and acids; as well as tarry material of indefinite composition, soot and fly ash.

Liquid and gaseous fuels may be burned more efficiently so that there is much less soot but they still release a variety of organic vapours and gases, including methene, acetylene, phenols, alcohols, aldehydes and ketones in addition to sulphur dioxide, ammonia and oxides of nitrogen.

The contribution to this problem from the general activities of the public must not be underrated. Thus, in a city where half a million

Few of us realize the rapidly growing impact of air pollution on the health of our city populations and on our economy. Dr. Katz, one of Canada's foremost authorities on the subject, here summarizes the studies made by the International Joint Commission over the past four years in the Windsor-Detroit area. Pollution, he points out, cannot be remedied by legal action alone, but technical understanding as to what remedies are economically feasible is needed also.

automobiles, trucks and busses are operated, there may be consumed a daily total of 1 million gallons of gasoline and oil, releasing nearly 1 billion cubic feet of exhaust gases.

In order to determine the extent of atmospheric pollution in an urban area it is convenient to measure the rate of dustfall, the concentration of suspended particulates or acrosols and the concentration of sulphur dioxide. These quantities serve to assess the pollution on a preliminary basis. Provided continuous testing or sampling methods are employed, one can gain an insight into the variations in the levels of contamination introduced by changes in weather conditions and other factors, at different periods of the day and seasons of the year.

Such measurements have been in progress for a number of years in the Greater Windsor-Detroit area in connection with an international air pollution investigation, in accordance with the terms of a joint reference submitted to the International Joint Commission by the Governments of Canada and the United States in January 1949. The area under investigation lies on both sides of the Detroit River for a distance of about 30 miles and extends to about 15 miles inland from the river.

The overall estimated population is about three million, of which about 160,000 is on the Canadian side. This region is the third largest industrial area in North America. The total annual consumption of solid fuel for industrial and domestic purposes is estimated at about 15 million tons on the U.S. side and about 650,000 tons on the Canadian side. Approximately 430,000 tons of sulphur dioxide are discharged to the atmosphere annually from the combustion of solid fuels alone. This total is increased appreciably by the sulphur dioxide liberated from liquid and gaseous fuels.

Additional sources of industrial wastes include operations associated with the automotive industry, power plants, rubber, chemical, metallurgical, oil refining and numerous other plants. During the navigation season there is also the problem of smoke and fly ash from the Great Lakes vessel fleets which make about 30,000 passages of the Detroit River in transporting 120 million tons or more of cargo, consisting of iron ore, coal, grain and limestone.

(a) *Dustfall*

The larger particles of dust, fly ash and soot settle out of the atmosphere fairly rapidly. Such particles range in size from over 100 microns down to about 5 microns. Most of the mass of material collected in dustfall receptacles is over 44 microns in size (325 sieve mesh, Tyler). Dustfall records, which are usually expressed as total solids in tons per square mile per month, afford an indication of the extent of contamination from such relatively large particles over a city.

The data in Table I indicate the dustfall rates for various areas of Greater Windsor and the nature of some fractions of this deposited material. The mean values are derived from a total of twenty stations distributed throughout the various areas. The industrial-resi-

Table I. Mean Values for Dustfall in Greater Windsor Area in Tons per Square Mile per Month

Area	Dustfall	Components of Deposited Material					
	Total Solids	Water Insoluble	Water Soluble	Tar	Other Combustible Matter	Ash	pH (water soluble fraction
— Test Period: August — December 1951 —							
Industrial	92.2	69.2	21.1	1.48	21.0	45.9	5.42
Industrial — residential	53.9	45.0	11.0	0.62	13.0	28.7	6.31
Residential— semi-rural	35.9	26.9	8.8	0.61	11.0	16.1	6.81
— Test Period: May — September, 1952, Non-heating season —							
Industrial and residential	36.1	31.4	4.3	1.23	10.3	21.3	6.9
Residential — semi-rural	18.8	16.7	2.1	0.81	3.6	11.3	7.3
— Test Period: October 1952 — February 1953, Heating season —							
Industrial and residential	92.1	69.1	22.9	1.70	13.5	52.0	6.1
Residential — semi-rural	53.0	40.8	12.3	2.59	8.2	30.0	6.8

Table II. Mean Dustfall in Tons per Square Mile per Month for Various Cities

No.	City	Year	Monthly Mean	Reference
1	Detroit	1946	51.7	Detroit Department of Buildings and Safety Engineering.
		1950	59.8	
		1951	62.1	
		1952	64.1	
		1953	72.1	
2	New York	1953	67.5	New York State Chamber of Commerce
3	Chicago	1947	61.2	Nos. 3-6, McCabe, L. et al., Ind. Eng. Chem. *41*, 2486 (1949).
4	Cincinnati	1946	34.0	
5	Los Angeles	1948	33.3	
6	Rochester	1942	26.4	
7	Pittsburgh	1951	45.7 (insoluble matter only)	City of Pittsburgh, Dept. of Public Health Report 1951.
8	Toronto		31.7-54.2	Allent, E.A., Eng. J. (Canada) *30*, 154 (1947).

Table III. Concentrations of Suspended Particulate Matter (Micrograms per Cubic Metre) in the Atmosphere of Greater Windsor, Ontario

Area	Test Period	Number Sampling Stations	Range of Concentration	Mean for all Stations
High pollution	Oct. 24 – Dec. 5, 1951	8	36–467	210
Moderate pollution	" " "	16	1–556	150
Low pollution	" " "	2	3–214	80
High pollution	Aug. 7 – Sept. 17, 1952	5	27–718	247
Moderate pollution	" " "	3	22–568	170
Low pollution	" " "	2	3–257	107

Table IV. Rise in Mean Daily Concentrations of Suspended Particulate Matter (Micrograms per Cubic Metre) During Two Smog Periods in Windsor Area

Date 1952	Daily Mean for 10 Sampling Sations
August 22	95
August 23	151
August 24	205
August 25	282
August 26	288
August 27	275
August 28	245
August 29	56
September 7	90
September 8	281
September 9	392
September 10	500
September 11	410
September 12	303
September 13	164
September 14	71

dential stations were located in the most heavily populated and industrialized zone, which lies close to the Detroit River. The residential-semi-rural stations were located at distances of about 4 to 15 miles from the Detroit River.

The rate of dust deposition rises considerably during the heating season with the increase in use of fuel for domestic and industrial space heating purposes. Coal for domestic purposes is burned much less efficiently and the waste products are emitted from much shorter stacks, on the average, than the combustion products of industrial solid fuel. Furthermore, many of the industrial stacks are equipped with fly ash receivers and dust collectors. In the outlying residential-semi-rural area of Greater Windsor, the dustfall rate is about one-half of that in the heavily populated and industrial section. The average dustfall in the latter area during the heating season is about 92 tons per sq. mile per month.

The rates of deposition at some of the most heavily polluted stations have ranged as high as 100 to 150 tons per sq. mile per month during the heating season. In one or two months of the year the rate has risen as high as about 200 tons per sq. mile. The water-soluble fraction in these shows a relatively high sulphate content and greater acidity. The content of tar and combustible organic matter shown in Table I is related to the amount of soot, carbon and incompletely burned waste products deposited with the dust and fly ash.

Table II indicates the monthly mean rate of dustfall in certain other cities of North America. The Detroit records show a rise from about 52 tons in 1946 to 72 tons in 1953. The rates are comparable to those of New York and Chicago. The lowest values in the table are shown by Los Angeles, Cincinnati and Rochester. Los Angeles is troubled with a persistent smog problem which has been under intensive investigation during the past five years[10]. However, nearly all the fuel used in this area consists of gas and oil, although large quantities of refuse and trash are also burned in domestic incinerators.

There is some conflict of opinion as to the reliability of comparisons of dustfall in different cities. This is due largely to the fact that various types of dustfall containers are in use and methods of exposure are not uniform. In the Windsor area the dustfall containers used are of the same type as those employed in the Detroit area, a design which was developed by City of Detroit engineers after wind tunnel tests of various models.

However, the data shown in Table II provide a fair comparison because the results are in line with the mean values to be expected for cities of comparable size and coal consumption. Wherever solid fuel has been replaced by liquid or gaseous fuel for domestic space heating, there has been a considerable drop in the city dustfall rate. Effective smoke abatement has also resulted in a decrease in dustfall.

It is difficult to ascertain accurately the fraction of the dustfall rate in cities which is due to natural sources, such as wind-blown sand, soil particles, pollen and vegetation. However, the dustfall in rural areas remote from urban communities ranges from less than five to about 15 tons per sq. mile per month. This is confirmed by the results for the stations at 8 to 15 miles distant from the Detroit River in the Greater Windsor area.

Suspended Particulate Matter

Although aerosols include, by definition, all solid and liquid par-

Table V. Mean Sulphur Dioxide Concentrations in Parts per Billion of Air for Each Month of the Year, September 1950-January 1953.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					— near centre of Windsor, Ontario —							
1950									74	71	63	91
1951	73	88	76	107	122	47	70	88	93	119	104	149
1952	121	143	82	90	89	70	116	120	109	134	102	200
1953	127											
Mean	107	116	79	99	106	59	93	104	92	108	90	147
					— McGregor, Ontario, 15 miles South of Detroit River —							
Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1950									10.0	12.0	11.0	27.0
1951	1.5	3.0	3.2	0.8	3.3	3.9	1.2	3.9	3.5	3.5	5.0	10.0
1952	10.0	1.9	4.3	5.7	4.5	6.3	5.0	5.0	15.0	7.0	6.0	13.0
1953	8.0											
Mean	6.5	2.5	3.7	3.3	3.9	5.1	3.1	4.5	9.5	7.5	7.3	16.7

ticles in the diameter range from about 100 microns down to 0.01, the suspended impurities in the atmosphere which influence visibility, stain or soil walls, textiles and other exposed surfaces, and penetrate into the lungs are in the size range of less than about 5 microns. The amount of light scattering or reduction in visibility depends more on particle size and refractive index of the material, than on the number of particles per unit volume.

The size range which is most effective for obscuration of visibility is the diameter from 0.3 to 0.6 micron for liquid aerosols. Visibility may also be reduced by small particles which absorb light. Below 5 micron size, the particles begin to penetrate into the lungs after passing through the respiratory tract, but when their size becomes less than 1 micron, the retention of such particles in the lung decreases. Only a small fraction of the very small particles is retained in the lung (7).

Suspended impurities are collected for measurement by filtration through paper or other membranes, by electrostatic or thermal precipitation, or by use of impinger or impaction devices. The concentration is influenced markedly not only by the mass rate of emission and nature of industrial and other activities in a given area, but also by various meteorological factors.

In the Windsor-Detroit area daily fluctuations in the levels of suspended particulate matter have been investigated intensively by use of the High Volume Sampler of a type similar to that developed by the U.S. Atomic Energy Commission (9). As in the case of settled dust, the values tend to increase in proceeding from the outlying areas towards the centre of the populated and industrial section.

Table III indicates the range in concentration and the mean values for various pollution areas in Greater Windsor during surveys carried out on a continuous basis for 6-week periods in 1951 and 1952. The two stations in the low pollution area were located about 8 and 15 miles from the heart of Windsor, at Tecumseh and McGregor, Ont. respectively.

In Table IV there is indicated the rise in the concentration of atmospheric suspended matter during two smog periods in the Greater Windsor area. During these events the levels rose markedly over four-day periods at all the sampling stations, even those at points 8 and 15 miles distant, and then subsided as meteorological conditions became more favourable for dispersion. These smogs were accompanied by a marked reduction in visibility and complaints of eye irritation.

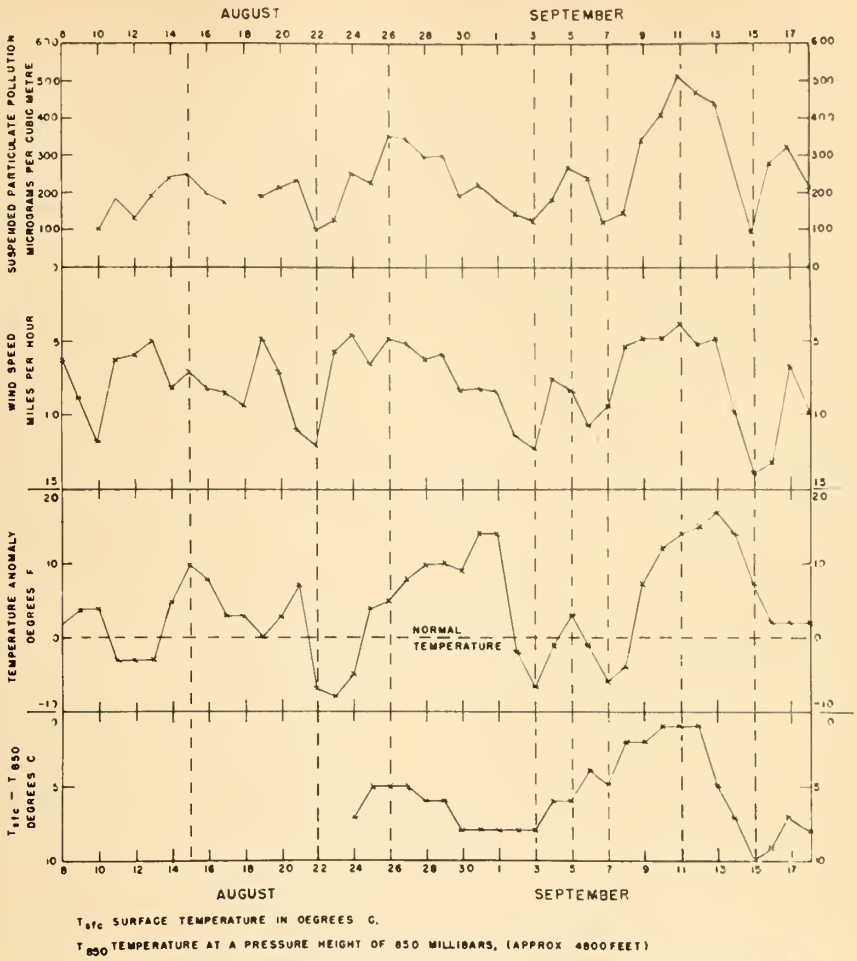


Fig. 1. Variation of suspended particulate pollution in the Windsor-Detroit area during the period August 8 to September 17, 1952, with wind-speed, temperature anomaly, and temperature gradient.

Similar surveys of suspended particulate matter carried out by the U.S. Public Health Service in Detroit (4) reveal higher atmospheric loadings than those found for Windsor. A six weeks' survey in Detroit with 31 sampling stations during May 7 to June 17, 1951, indicated a range of median values of 121 to 357 micrograms per cubic metre from the least polluted to the most heavily polluted areas, with maximum values ranging from 351 to 1,009.

Comparisons with other cities are difficult because of a lack of data gathered by comparable technique. Cholak (3) has presented results for Cincinnati (1946-51) which show a mean value of 370 micrograms per cubic metre for the city as a whole, 420 for the industrial and commercial areas, and 180 for the rural areas near the city. The median size range of suspended particles in the Windsor-Detroit atmosphere is about 0.9 micron for samples collected by the thermal precipitator or standard impinger and evaluated by standard microscope counting techniques, which do not include particles smaller than 0.2 micron.

The inorganic fraction of the suspended dust has been studied intensively in the Windsor-Detroit area by methods of spectrographic analysis. About 20 metallic elements have been found in varying amounts. The most abundant are calcium, silicon, aluminum and iron. Next in order of abundance are magnesium, lead, copper, zinc and manganese. Elements which were found in small quantities only were titanium, tin, molybdenum, barium, nickel, vanadium, chromium, cadmium and beryllium (8).

A considerable number of crystalline compounds have been identified in the Windsor suspended particulates by X-ray diffraction studies. These include calcium carbonate, alpha-quartz, gypsum, ammonium chloride, magnetite, hematite, cadmium carbonate, nickel fluoride, graphite and carbon. The

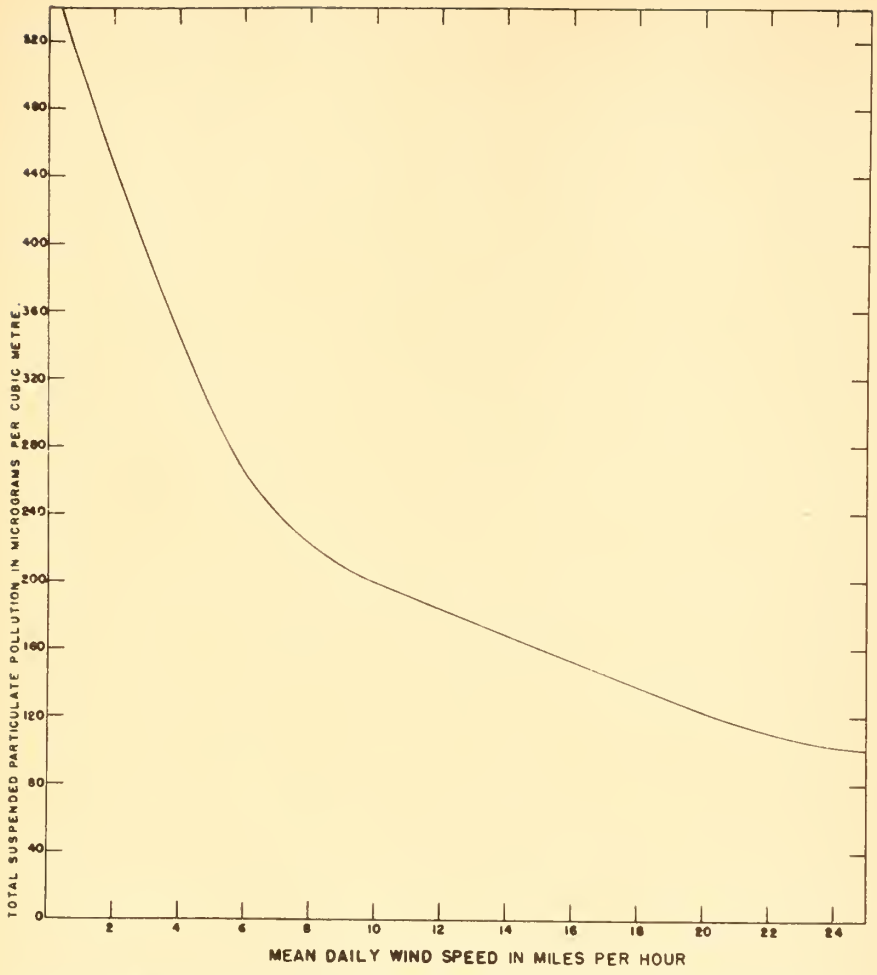


Fig. 2. Regression of suspended particulate pollution in Windsor area on mean wind-speed from observations on 74 days during period August 11 to December 31, 1953.

shape and size factors of suspended impurities have been studied by the electron microscope. Sub-micron particles show a tendency to agglomerate. This is particularly evident in carbon, which was the most widely distributed constituent. Carbon particles formed distinctive filaments consisting of individual units in the size range of 0.05 to 0.2 micron (14).

Suspended particulate matter consists of about 60 to 75 percent carbon and a complex mixture of organic matter. The nature of this fraction in the Windsor atmosphere is under investigation at the present time. In contrast to this, the settled dust consists largely of ash and material of inorganic origin.

Sulphur Dioxide and Other Impurities

Atmospheric sulphur dioxide levels have been investigated continuously for several years by recording analyzers at four to five stations in the Greater Windsor area. In view of the large amount of solid fuel used in the Windsor-Detroit area, the sulphur dioxide content of the atmosphere is of considerable importance in assessing the extent of the pollution load in various sections of this region.

The average monthly concentrations at a sampling station near the centre of the industrial part of Windsor and at McGregor, Ont., a semi-rural district 15 miles south of the Detroit River, are shown in Table V. There is a considerable difference in the mean values for these two areas, the sulphur dioxide pollution in Windsor being about 18 to 25 times greater than that registered at McGregor. The overall mean values in parts per billion for the Windsor and McGregor stations were as follows:—

	1951	1952
Windsor—		
industrial area	94.7	114.7
McGregor	3.6	6.1

The maximum 30-minute average concentration in Windsor during the test period 1951-1952 reached a value of 1.45 parts per million. The maximum over the same period at McGregor was 0.876 parts per million.

Mean sulphur dioxide concentrations reported in the literature for other city areas within recent years are, as follows, in parts per billion (3):—

Cincinnati (1947-51)	
Industrial and commercial areas	64
Residential area	44
Rural	37
Baltimore (1950)	
Industrial area	74
Rural	23
St. Louis (1937)	
Warm months	127
Cold months	250
Cold months (1950)	41
Cleveland (1949-50)	
Industrial area	42
Donora (1949)	150
Yonkers, N.Y. (1936-37)	32
Los Angeles (1949-50)	
Days of good visibility	50
Days of reduced visibility	200

The increased use of natural gas, liquid and solid fuel of low sulphur content for space heating has been reflected in a progressive decrease in the average sulphur dioxide concentration of the atmosphere in a number of cities, such as St. Louis, Cincinnati, Pittsburgh and Salt Lake City.

Other impurities which have been found in the Windsor atmosphere, as in other city areas, include aldehydes, oxides of nitrogen, ammonia and chlorides.

Influence of Meteorological Factors on Dispersion

Although the total amount of contaminants discharged to the atmosphere over a city or industrial area may remain constant from day to day, the concentration of impurities per unit volume of air will vary widely because of changing meteorological conditions imposed by the weather. This is especially true where topographical features such as mountain valleys and large bodies of water are absent.

At Trail, B.C., Donora, Pa. and Los Angeles, the topographical features tend to complicate the influence of meteorological factors on the dispersion of contaminants. No such complications are evident in the Detroit River area, however. The terrain is relatively flat and the river valley is shallow. The influence of Lake St. Clair and Lake Erie is only minor in character. The dispersion of contaminants in this area is governed by weather correlations consistent with diffusion theory.

Baynton (1) has analyzed the findings of a six weeks' joint study of suspended particulate matter in the Windsor-Detroit area, carried

out by our Windsor staff and the U.S. Public Health Service in the late summer of 1952. Twenty sampling stations were operated continuously and the daily mean values of particulate pollution were related to the observed weather.

Correlation of Meteorological Factors

The results of this correlation are presented graphically in Fig. 1. The daily values for three weather elements have been plotted underneath the day to day fluctuations in the levels of particulate pollution. These elements are the daily mean wind speed in miles per hour, the daily temperature anomaly defined as the difference between the daily mean temperature and the normal temperature, and lastly, the daily value of the difference between surface temperature and the temperature at a pressure of 850 millibars. The pressure region of 850 millibars corresponds roughly to an altitude of 4,800 feet above mean sea level.

The dispersal of atmospheric contaminants by air currents is usually accomplished by dilution laterally on wind movements and by diffusion vertically through convection currents. This process is assisted or inhibited by the "lapse rate". The lapse rate is defined as the rate of decrease of air temperature with height. Large lapse rates induce convection currents, whereas small lapse rates inhibit such currents. It is evident therefore that large lapse rates should coincide with reduced pollution levels whereas small lapse rates favour the accumulation of pollutants.

The temperature anomaly is considered as an index of the lapse rate. In the Great Lakes region it is generally true that lapse rates are large during unusually cold weather, and small during unusually warm weather. A large lapse rate would be indicated by a relatively large negative temperature anomaly, whereas a small lapse rate would be indicated by a large positive temperature anomaly.

The curves in Fig. 1 indicate clearly the phase relationships of the above three weather elements. Light winds, small lapse rates and above normal temperatures coincide with high pollution loadings of the atmosphere or lead to high pollution levels. Strong winds, large lapse rates and below normal temperatures reduce pollution rapidly.

The strong influence of the wind speed in this region on the total suspended particulate pollution is illustrated by the curve in Fig. 2. This curve represents the regression of the daily mean value for suspended particulates on the daily mean wind speed in Windsor. These pollution concentrations represent the average results of two sampling stations located in a heavy and moderate pollution area respectively, in measurements on 74 days during the period August 11 to December 31, 1953. There is a much greater effect on the absolute concentration of suspended matter by changes in the diffusion process at low wind speeds than at high wind speeds.

Other factors which have been found to affect the levels of pollution are changes in wind direction, frontal passages and precipitation. Marked reduction in the level of pollution is associated with cold frontal passages over the area. A cold front may be defined as the leading edge of an advancing mass of cold air that is displacing and passing under warmer air. Precipitation also tends to reduce the level of pollution, although it is difficult to isolate specifically the influence of rainfall because of the frequent coincidence of cold frontal passages and higher wind speeds with rain.

Daily Cycle of Pollution

During the period Feb. 26—June 26, 1952, measurements were made of the hourly variation in the concentration levels of fine suspended matter near the centre of Windsor, by means of a modified Owens pollution recorder. (9, 13). This instrument yields a series of spots or stains around the periphery of a filter paper disk. The intensity of these spots is a measure of the concentration of suspended solids or smoke in the atmosphere and the results are evaluated by an optical method. The data have been plotted for each hour of the 24-hour day and reveal a marked diurnal trend, as shown in Fig. 3.

The level of suspended matter increases during the night and early morning hours until a peak is reached at 7.00 a.m. Thereafter the concentration decreases rapidly until the minimum value is attained about 3.00 p.m. This cycle is probably closely related to the diurnal variation in wind turbulence and temperature lapse rate. It is known that, in clear weather, turbulence reaches a maximum about the

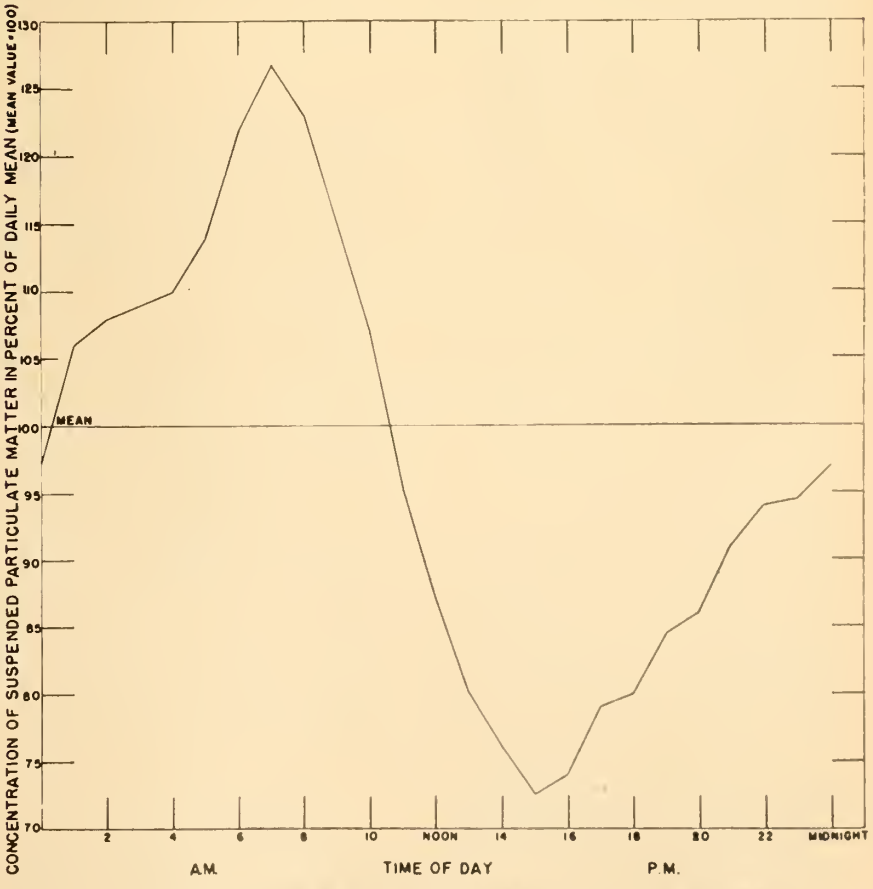


Fig. 3. Daily cycle of suspended particulate pollution in Windsor. Test period February 26 to June 26, 1952.

middle of the afternoon and then decays after sundown and during the night.

The daily and seasonal cycles of sulphur dioxide pollution in Windsor are indicated in Figs. 4 and 5 over the test period September 1950 to January 1953. In the fall and winter months there are well-defined maxima in the pollution levels during the morning period from 8.00 to 9.00 and 9.00 to 10.00 o'clock, respectively. During the spring and summer seasons the relation is more complex with peaks in the daytime and a lowering of the concentration levels during the night hours up to about 5.00 a.m.

There is evidence that turbulence, which consists of the two co-variables of wind velocity and temperature gradient, has somewhat similar but by no means identical effects on the concentrations of sulphur dioxide and suspended particulates. Air pollution studies by the Department of Scientific and Industrial Research in England (5) indicate that some of the causes which do not operate similarly on smoke and sulphur dioxide are due to the following:

(a) differences in rate of emission, because sulphur dioxide is always present in the flue gases from solid fuels whereas smoke is produced by ineffieient combustion.

(b) proportionately more sulphur dioxide than smoke is emitted from industrial chimneys; there are differences in place of emission and in the height of emission.

(c) smoke and sulphur dioxide are removed from the atmosphere at different rates; small particles of suspended smoke are removed by collision or impaction with surfaces and obstructions whereas sulphur dioxide is removed by absorption by water and vegetation as well as by chemical reaction with other impurities.

Fig. 4. Daily eyele of sulphur dioxide pollution in Windsor during winter and summer seasons.

Influence of Adverse Factors — The Los Angeles Problem

The Los Angeles pollution problem represents an excellent example of the limitations imposed on natural air cleaning processes by adverse meteorological and topographieal factors. The Los Angeles area consists of a basin hemmed in on three sides by mountains that limit the lateral movement of the land and sea breezes. The air circulation is further limited by the presence of an inversion layer known as the Pacific Inversion, which consists of a warm air mass above cooler air, extending aloft from the California coast far out into the Pacific ocean. On many days of the year, this inversion layer drops to about 3,000 feet or lower, below the level of the mountains, effectively sealing the basin and preventing the vertical diffusion of the polluted air.

The result is a recurrent haze and smog accompanied by eye, nose and throat irritation, reduced visibility, and economic losses in crop damage and rapid deterioration of rubber (6, 11). The major pollutants in the Los Angeles area are believed to be due to organic products from the daily eombustion of about 45,000 tons of gasoline, fuel gas and oil, and about 4,000 tons of household rubbish. Exeluding carbon monoxide and dioxide, at least 1,800 tons of impurities are emitted daily from industrial and public sources, including the exhaust fumes from about two million motor vehieles (11).

Reaetions Between Atmospherie Contaminants

It is known that gaseous contaminants sueh as ammonia and sulphur dioxide may react after release to the atmosphere, or oxidation of sulphur dioxide, nitric oxide and other oxidizable compounds may take place in the air, especially in the presence of sunlight and catalytie impurities. Recent investigations into the Los Angeles smog problem have shown that during smogs there is a considerable increase in the concentration of ozone or "oxidant" material, coincident with the severe cracking of rubber, eye irritation and crop damage. The ozone or "oxidant" material is not found at night but begins to form simultaneously throughout the Los Angeles basin in the smoggy atmosphere shortly after dawn. The oxidant concentration reaches a peak whieh eoincides generally with the period of highest intensity of the smog or least visibility in daylight hours. (6, 11).

These faets have led to several interesting theories on the photochemical formation of ozone from impurities in the atmosphere by the aetion of sunlight. These include the photolysis and photochemical aetivation of nitrogen dioxide, sulphur dioxide, aldehydes, ketones,

Fig. 5. Daily cycle of sulphur dioxide pollution in Windsor during spring and fall seasons.

and organic free radicles. Ozone can be formed as a by-product in most of these reactions. The ozone thus formed may react readily with olefins and other constituents of smog forming organic peroxides, aldehydes and acids. (2, 6).

It is interesting to note that most of the impurities involved in these reactions are present in other city atmospheres besides the Los Angeles air. The principal difference is that, in other city areas, natural air cleaning processes are more effective in dispersion of the contaminants, so that their persistence in the atmosphere is not as prolonged as in the Los Angeles area.

Conclusions

It is apparent that the impurities in a city atmosphere are extremely complex and varied. They represent the waste products of all human activities in the area, including both industrial and public operations. The problem created by exhaust gases from vehicular traffic is in some large cities, such as Los Angeles, overshadowing that of the effluents from industry. The possibility of interaction of some of the contaminants to form products which are more harmful than the original wastes is an additional complicating factor in attempts at control.

Control measures in a given area will depend not only on the mass rate of emission of particular contaminants, but also on the capacity of the atmosphere to disperse and diffuse such impurities effectively under the prevailing meteorological conditions. Measures suitable for an area which is adversely affected by topography and persistent inversion conditions need not be applicable where the geographical location and weather factors are more favourable.

Experience in the Los Angeles area and elsewhere has indicated that a pollution problem cannot be remedied by legal machinery alone. Unless there is adequate technical understanding, a knowledge of cause and effect and the remedies are feasible economically, the problem will remain. In Los Angeles County the troublesome smog is still present in spite of drastic limitations on industrial emission of dust, fumes, smoke and sulphur dioxide.

In London, England the inefficient combustion of bituminous coal for domestic space heating presents an unsolved smoke nuisance. It is probable that future remedies will include city and community planning in relation to location of industrial and residential areas, decentralization of industry and more extended use of land for public parks, gardens and wooded areas to prevent overcrowding of sources of emission.

As air pollution becomes of increasing importance in cities and industrial communities, forecasting of major smog periods will be an essential service. This could prevent the occurrence of a disastrous or unpleasant episode by providing time for the institution of relief measures. Recent studies on the correlation of pollution with weather factors in the Windsor-Detroit area indicate the feasibility of predicting pollution levels.

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Predicting the Runoff from Snowmelt

by

R. H. Clark, M.E.I.C.

Chief, Water Development Projects Section,
Engineering and Water Resources Branch,
Department of Northern Affairs and Natural Resources, Canada,
Ottawa

The problem of predicting short-period runoff from snowmelt is complex. The general situation discussed herein consists of a seasonal snow accumulation melting under a critical temperature sequence, with the occurrence of rainfall at the time of maximum snowmelt runoff. Many articles have appeared in technical literature describing the application of heat-exchange formulae to the problem of estimating snowmelt runoff. These can be used to advantage for some specialized purposes involving small homogeneous areas, but the hydrologic characteristics of a natural basin exceeding a few square miles in area are so varied as to make such an approach virtually impossible. For short-period forecasting, the resulting stage of a river from a given snowmelt is desired, whereas in extended-period forecasting, such as for water supply, irrigation or power purposes, the volume of runoff is required.

The considerations in short-period forecasting in their order of importance are speed, accuracy and timeliness. Time is usually not available for the detailed consideration of large basins, even though a greater degree of accuracy might thus be obtained. After extensive study, a graphical correlation of runoff with selected parameters was proposed as the most satisfactory approach to the forecasting of runoff from the snowmelt of the Red River. The derivation of this approach is described in detail and it

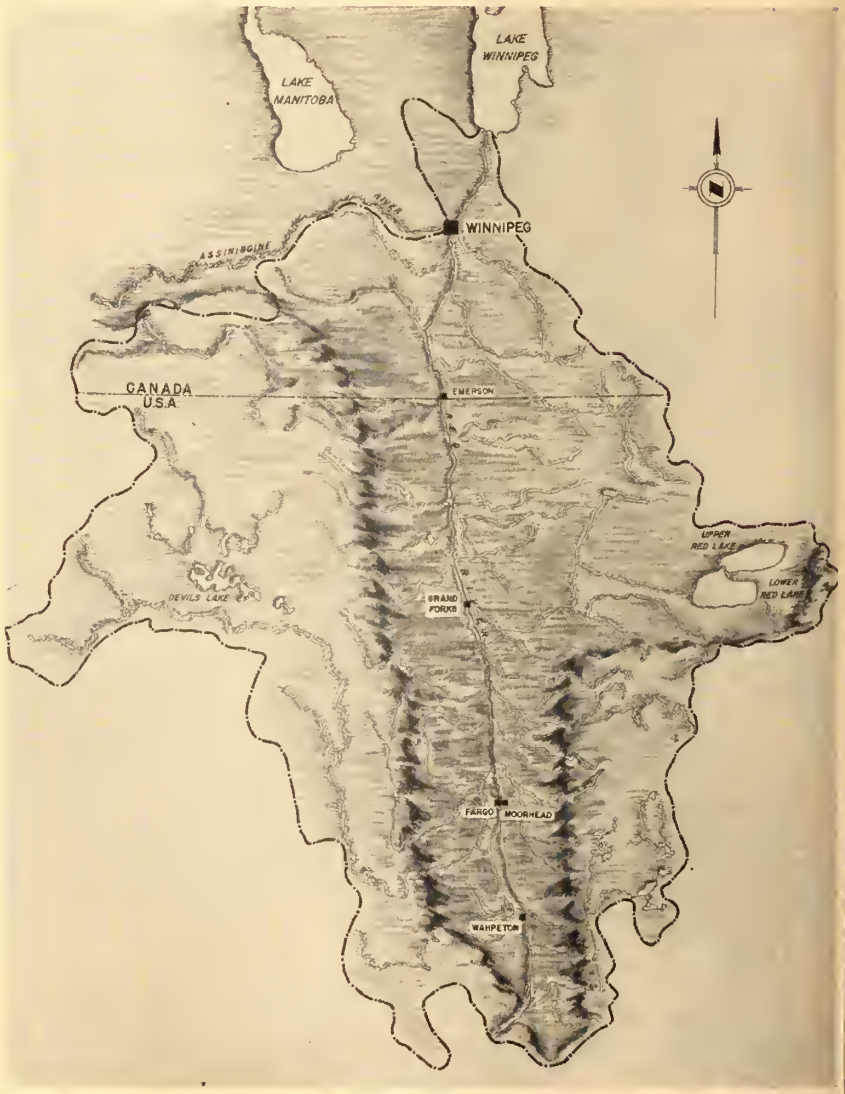

Fig. 1. Relief map Red River basin.

will be evident that it offers a quick and fairly accurate estimate of the volume of runoff. The solution presented may be extended to include short-period forecasting.

The Red River Basin

Since the discussion presented herein is particularly applied to the Red River basin, a brief description of this basin will be helpful to the reader. It is felt that this analysis of the snowmelt-runoff problem may be applied, with minor modifications, to other prairie streams.

Within the drainage area of the Red River of 48,000 square miles above the confluence of the Assiniboine River, there are two major types of topography—the bed of the former glacial Lake Agassiz, which is a broad flat plain extending east and west of the river, and the rougher and higher upland region above the level of former Lake Agassiz. The plain varies in width from 15 miles at the upper end to about 100 miles at Winnipeg, and the general elevation varies from about 980 feet at the upper end to 720 feet at Lake Winnipeg. There is generally a gentle and uniform rise from the river to the toe of the upland slopes. In Canada it amounts to only two or three feet per mile, and on the west it terminates with an abrupt rise known as the Pembina escarpment. On the east side in Canada, the plain is nearly level and includes extensive swamp lands. The uplands vary in elevation from 1,200 to 2,150 feet. Figure 1 shows the general topography of the basin. The river has a fairly uniform slope northward averaging about one-half foot per mile.

Selection of Parameters

In developing a technique for forecasting, the most important consideration is the selection of the proper parameters. Runoff or stream flow is the factor which is required in the preparation of river forecasts. Some techniques attempt to apply to snowmelt forecasting the methods that have been developed for dealing with rain which require the selection of an element corresponding to rainfall—namely, an integration of local snowmelt which, at best, is an unobservable and indefinable element. In dealing with runoff as the dependent variable, however, the data are permitted to express the very structure of the relationship itself. For the purpose of forecasting, runoff is assumed to fall into two classes; (a) base or ground water flow, and (b) direct runoff. Many methods have been suggested for the separation of these two components in the hydrograph and these are described in detail in texts on hydrology (1). The selection of method, however, is not as important as the consistent use of a single method throughout the study.

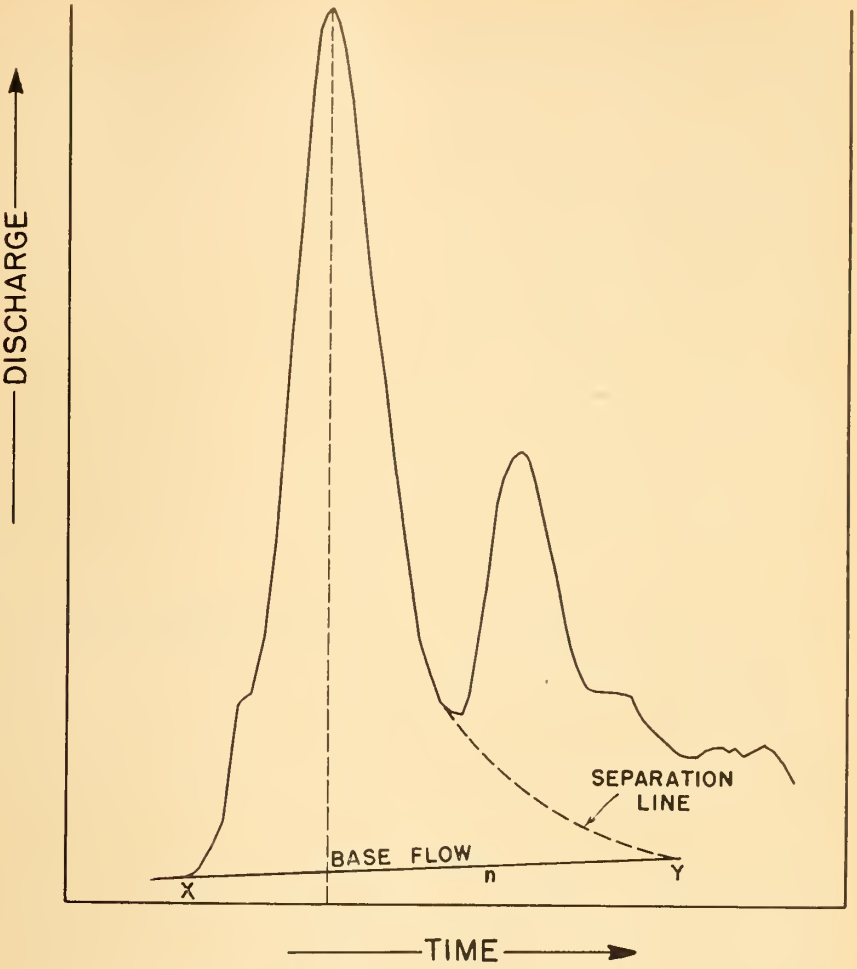

Fig. 2. Method of hydrograph separation.

The method adopted in the flood control investigation of the Red River is shown in Figure 2. The straight line XY intersects the hydrograph at a point "n" days after the crest or after the end of the surface runoff. The value of "n" is assumed constant for any basin, but is varied according to drainage area. Although other factors, such as basin slope and density and arrangement of tributaries, should be considered, the value of "n" is not particularly critical providing its derivation is used consistently in the analysis. The area bounded by the hydrograph and XY converted to inches depth over the basin is considered to be the flood runoff from the particular storm or snowmelt in question.

The watershed should be given close scrutiny with respect to its effectiveness in contributing to flood runoff. In the study of the physical characteristics of the Red River basin and the runoff pattern, it became evident that there were certain areas within the basin that did not contribute to runoff or, in other words, were "dead areas"; while, in other sections of the basin,

Estimating the volume of runoff that may be expected from a seasonal accumulation of snow is a fundamental problem in spring flood forecasting. Such estimates are necessary before the various techniques can be used to predict the stream hydrograph. The author describes a technique, developed during the course of the investigation of flood control measures for the Red River, for evaluating the effect of antecedent conditions, temperatures, and rainfall during the snowmelt period on the runoff from the accumulated snowfall. The technique yields a high degree of accuracy in estimated runoff and, although prepared by empirical procedures, it is believed that rational parameters have been adopted.

areas containing lakes and swamps exercised a highly regulatory action on the flow and were only partially effective in contributing to the peak of the runoff hydrograph. Adjustments to the total drainage area were made for these non-effective and partially-effective areas so that of the gross drainage area of 40,166 square miles of the Red River at Emerson, Manitoba, only 23,830 square miles were considered effective in the runoff hydrograph.

The rate and quantity of runoff from melting snow are determined primarily by the water equivalent of the snow cover, the rate of release by melting and the ground conditions affecting infiltration losses. The volume of water from melting snow available for flood runoff depends upon the depth, density, and area of snow accumulation. The rate of melt depends upon various meteorological factors such as temperature, cloudiness, wind movement, humidity and the basin physiographic factors, such as slope, aspect, elevation and vegetation. Of the meteorologic factors, temperature has usually been recorded for a long period, and this record gives widespread coverage over the basin. Other factors, such as snow density, depth of accumulation before break-up humidity, etc., have been recorded only in recent years, and sufficient data are not usually available for correlating their effects on runoff. The physiographic factors are generally constant for a basin and will be reflected in any relationship derived from the hydrologic records of that basin. Consideration of the numerous immeasurable factors relating the characteristics of snowmelt to runoff leads to the conclusion that there can be no strictly theoretical forecasting technique. Theoretical studies serve to indicate general physical laws and the relative magnitude of various influences. However, empirical methods are necessary in applying these laws and in evaluating the total effect of all the factors on each basin.

In selecting the parameters influencing runoff, all available data should be graphically examined to ascertain their conformance to certain assumptions. In the development of a forecasting procedure for the Red River, all spring snowmelt periods, both historical and modern, were analysed. From this examination, it was determined that for the large spring floods in the Red River the causative factors could be described as: a wet autumn saturating the ground; very severe and continued frosts before the heavy snowfall, sealing up the marshes, lakes and saturated ground against infiltration and evaporation; a heavy accumulation of snow; a late and sudden spring; and rainfall over the entire drainage basin during the break-up. Therefore, it was apparent that the factors necessary for a study of snowmelt floods in the Red River Basin should be: ground-moisture conditions, temperature in the late fall and spring, snowfall, and rainfall during the break-up period. These factors, or indices representing these factors, were analysed in the study of runoff from snowmelt in the Red River Basin.

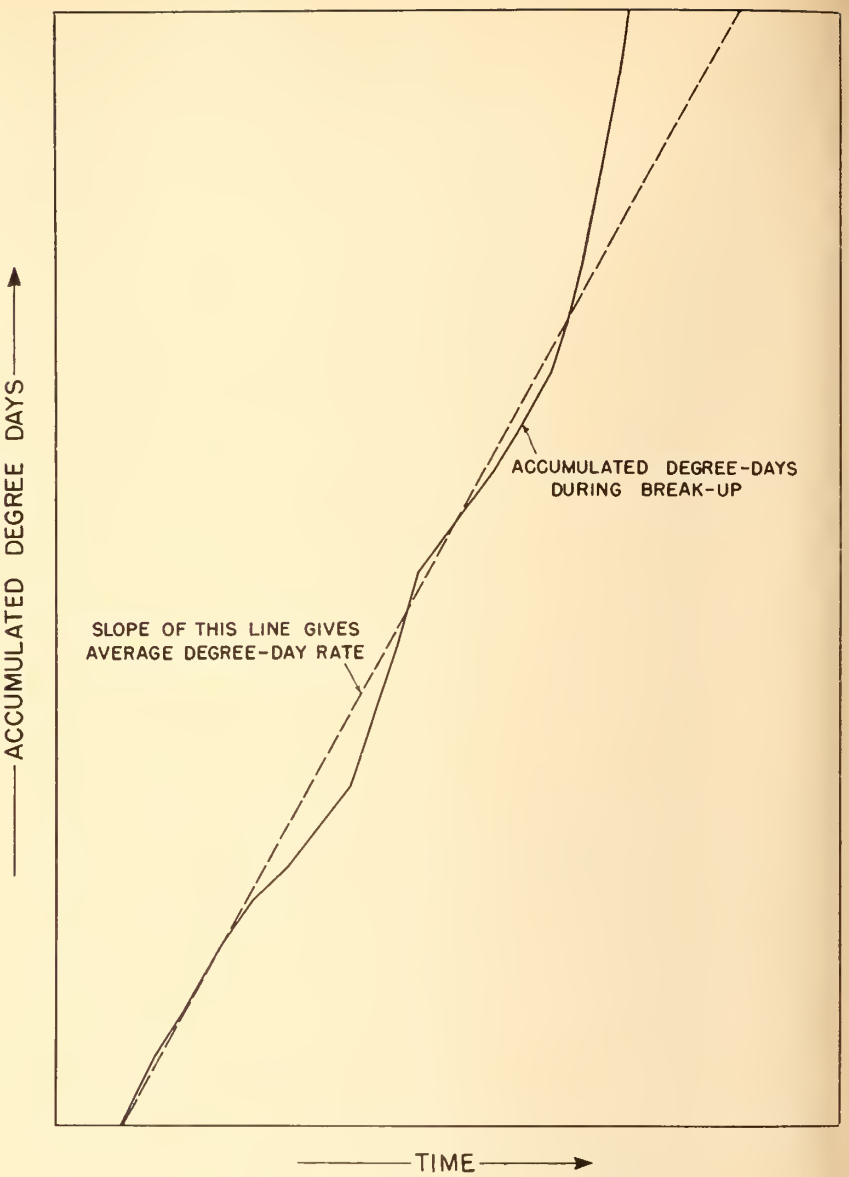

Fig. 3. Method of degree — day determination.

Ground Conditions

The infiltration capacity of the soil beneath a snow blanket has an important influence on the quantity of runoff from snowmelt. Since the depth and nature of the earth-mantle varies widely on each watershed, it is extremely difficult to determine quantitatively the amount of water necessary to prime the soil on that watershed. Also the rate of melting and the condition of the surface of the earth-mantle will determine to a large extent the amount of water that penetrates the soil to prime the earth-mantle. The optimum ground conditions for a high percentage of runoff from snowmelt result when the capillary field moisture is high at the time of the freeze, and a severe freeze occurs prior to the occurrence of much snow. Inasmuch as snow is a poor conductor of heat, very little additional freezing of moisture in the soil may be expected after a moderate depth of snow has been accumulated.

There is generally a dearth of data on the fluctuations in the water table, or on the amount of moisture present in the soil at the beginning of the melting period. This consideration, however, does not eliminate the possibility of using some other recorded factor that will reflect or give a measure of the field moisture deficiency. Two alternatives were studied for the Red River. First, the precipitation preceding freeze-up was assigned weights which varied with the time of the rain in relation to the time of freeze-up. It was found that the precipitation falling as rain before the snow started to accumulate furnished a poor index, because its effectiveness depended primarily upon the time and intensity of the storm. Assigning more weight to the precipitation just before freeze-up, and reducing the weights assigned to rainfalls more removed from the freeze-up date, gave no improvement in the correlation between fall precipitation and snowmelt runoff. In the second approach consideration was given to the fall streamflow (2) as a measure of the ground condition, since during this season the effect of regulation on the flow of the Red River is negligible. The October streamflow, the November streamflow, and finally the mean flow for the period October to January, inclusive, were correlated with the snowmelt runoff. The last comparison gave results which were highly significant as a measure of the effect of the ground conditions on spring runoff. It may be argued that the fall and winter stream-flow would reflect the effects of precipitation and the intensity of this precipitation, i.e., heavy fall precipitation would be reflected in higher streamflows, and the maintenance of these flows through the early part of the winter would reflect a fairly saturated soil; in addition, any melting taking place during the early part of the winter would be reflected in higher streamflow, if the ground moisture deficiency were satisfied.

Water Equivalent of Snow Cover

The volume of runoff from a snow cover is limited to the amount of water contained in the form of snow and ice, plus the water stored in the snow structure. The water equivalent of a snow cover may substantially exceed that of the precipitation occurring in the form of snow by reason of the retention of rainfall in the voids of the snow structure and the condensation of moisture on the snow surface. More often, however, the water equivalent of the snow cover is less than the recorded precipitation. Under average conditions, the density of freshly fallen snow is 10 per cent, i.e., 10 inches of snow are equivalent to 1 inch of water. As the snow remains on the ground, the density increases by reason of packing, drifting and by alternative thawing and freezing. The density of the snow cover may then be as high as 60 per cent, although densities most commonly range from 20 to 30 per cent.

Properly conducted snow surveys are more indicative of the potential runoff from snowmelt than is a summation of the total snowfall during the winter period. Lacking an adequate period of snow survey records, however, and in order to correlate the stored water of the snow cover with runoff, the accumulated snowfall from freeze-up to break-up expressed as water equivalent, must be used. This figure may be upset by evaporation from the snow cover, which may vary from 0.4 to 1.4 inches of snow or more per month, although very little information on this factor is available. During the break-up period the influence of evaporation will vary with temperature changes, increasing as the period of runoff increases, providing the dew point temperature of the air is less than the temperature of the melting snow surface. In a correlation of accumulated snowfall to runoff, the degree of correlation will be affected by evaporation.

Rate of Release by Melting

The energy for melting the snow or for evaporation is supplied by the sun. The immediate factors in their probable order of effectiveness are:

(a) Under ordinary conditions there is an appreciable exchange of heat by means of radiation between a snow cover and space; the snow absorbs solar radiation and at the same time radiates heat back into space. Because of direct insolation, the surface of snow in sunlight may melt near midday, although the air temperature is 18°F. This effect is greatly limited by the reflectivity of the snow surface. The reflection loss from newly fallen snow may be as high as 30 per cent greater than the reflection loss from a wet snow surface.

(b) Heat from the air to the snow mantle is transferred in

Table I. Summary of Data Selected for Snowmelt-Runoff Analysis of the Red River at Emerson, Manitoba

Year	Flood Runoff Inches	Melting index, Degree-days per day	Accumulated snowfall, Inches	Spring rains, Inches	Soil priming index, Per cent	Estimated Runoff, inches	
						From equation	From graphical correlation
1950	2.489	16	4.50	0.54	139.5	2.319	1.87
1949	0.737	9	3.53	0.04	77.4	.636	.37
1948	1.983	8	4.36	2.11	192.5	1.956	2.05
1947	1.281	7.5	2.13	2.31	177.0	1.156	1.07
1946	0.931	9	2.39	1.47	172.0	.949	.94
1945	1.302	9	1.37	1.65	354.0	1.237	1.32
1943	1.325	11	3.31	1.91	140.7	1.353	1.12
1942	0.861	5	1.19	1.94	191.0	1.038	.81
1941	0.680	18	3.06	2.66	39.5	.652	.58
1930	0.481	15	2.99	0.21	46.2	.545	.26
1929	0.462	7	2.09	0.17	180.0	.490	.60
1928	0.376	14	2.57	0.17	125.5	.517	.51
1927	0.690	6.5	2.50	2.07	87.4	.608	.52
1925	0.225	14	1.98	0.05	51.4	.033	.18
1923	0.692	16	3.15	1.34	61.8	.809	.65
1922	0.677	7	3.94	1.17	87.0	.626	.70
1920	0.800	8.5	4.94	0.01	105.0	.898	.85
1917	0.703	6	2.86	0.08	277.0	.619	1.10
1916	2.105	10	4.67	1.61	192.5	2.248	2.04
1915	0.180	12	2.06	0.16	146.3	.291	.41

two ways (i) by direct heat exchange due to the temperature difference between the air and the snow, and (ii) by the release of heat due to the condensation of moisture on the snow surface. Moisture condensed on the snow surface will melt 7.5 times its own weight of snow.

(c) The direct effect of rainfall is of small importance in melting snow. The temperature of the falling rain usually deviates very little from the temperature of the snow. Even if the temperature of the rain is 40°F., it would melt only one-eighteenth of its weight, and at 60°F., one-fifth of its weight of snow.

(d) The effect of the residual warmth of the earth from the previous season may be considered as almost negligible in the light of the relatively small winter runoff of the streams. However, for shallow depths of snow, probably less than 18 inches, the penetration of the snow mantle by the sun to the soil permits melting of the snow from beneath.

Since snowmelt-runoff is directly related to above-freezing temperatures, the index commonly used is degree-days above 32°F. An inspection of the spring flood hydrographs of the Red River revealed a possible correlation between the rate of the temperature rise and the rate of rise of the hydrograph. That is, the rate at which snow melts might be considered analogous to the intensity of rain. With a quick melt, the top soil would be quickly saturated and thus permit greater runoff; a slow rate of melt would probably yield a smaller volume of flood runoff than would a rapid melt, because infiltration and evaporation losses would be larger in the former instance since they would be occurring over a longer period. In general, however, the difference in the losses occurring from a slow or a rapid melt would not be large, and it is concluded that temperatures would have only a minor influence on the volume of runoff. The rate of melting will have more effect on the magnitude of the peak of the hydrograph than on its volume.

The influence of temperatures on spring runoff was expressed in terms of the rate of degree-day rise or degree-days per day. To calculate the degree-day rise, the following procedure was adopted. The mass curve of degree-days above 32°F. was drawn, beginning with the first pronounced rise of mean temperatures above 32°F., and the average slope of this curve was determined for the period during which the snow was melted. There may be some years in which the mass curve of degree-days will rise and fall preceding the snowmelt period, making it difficult to select the beginning of the melting period, so it must be left to judgment. An example of a degree-day determination is presented in Figure 3 for the break-up period of 1946 in the Red River basin.

Spring Rains

Rains during the snowmelt period are not usually distinguishable in the resultant flood hydrograph. However, these rains, falling either on snow or on saturated frozen ground, will affect the total volume of runoff. There are cases where the rain follows the snowmelt period and the spring hydrographs may be characterized by a second peak. Rainfall occurring after the snowmelt had run off was not considered in this analysis, and the effect of such rain was eliminated by the usual methods of hydrograph separation (1).

Summary of Variables

For the snowmelt analysis of the Red River basin, the data were compiled from twenty years of record selected from the period 1915 to 1950. In general, low water years were not considered for the following reasons: (a) the study was concerned primarily with the causes of high floods, and (b) only four of the many factors related to snowmelt-runoff were considered. For years of low spring runoff, the factors not considered, such as vapor pressures, evaporation, depth of frost penetration and winds, may cause large discrepancies in forecast runoff. These factors do not affect the larger volumes of snowmelt-runoff proportionately. The high water years prior to 1915 were omitted because of the difficulty of securing sufficient precipitation and runoff data.

Runoff

For the selected years, the spring flood discharge hydrographs of the Red River at Emerson, Manitoba, were drawn and the base flow separated. For the cases in which rainfall caused a second peak, or an extension of the recession limb of the hydrograph, this effect was separated. The volume of runoff represented by the resulting hydrograph was converted into inches on the effective drainage area and tabulated.

Spring Rains

Precipitation falling during the snowmelt-runoff period was classified as spring rains and was averaged over the whole basin and tabulated.

Accumulated Snowfall

The accumulated snowfall was arithmetically averaged for the basin, from the date of freeze-up to that of break-up, using snowfall recorded at numerous precipitation stations. The period of accumulation was determined from the records of various temperature stations in the basin.

Melting Index

The influence of temperatures on the snowmelt was obtained by using the rate of degree-day rise, which is referred to as the "melting index". A mass curve of degree-days at the index station, (Moorhead, Minnesota), was plotted for the break-up period for each selected year. The average slope of the mass degree-day curve gave the rate of snowmelt.

$$\text{Degree-days per day} = \frac{\text{max. temp.} + \text{min. tem.}}{2} - 32°$$

Soil Priming Index

The average flow at Emerson for the period October to January, inclusive, preceding each selected year, was used to determine the soil priming index. This flow was expressed as a ratio to the long term mean flow during these months of 770 second-feet.

The data for the five variables used in the analysis are summarized in Table I.

Coaxial Graphical Correlation Analysis

In the preceding discussion, an hypothesis has been set up, the various factors enumerated in it have been considered and the measurements of the various factors to be studied have been tabulated. The next step is to test the adequacy of the theoretical hypothesis and to determine the exact relations as expected from the hypothesis. Mathematical correlation (3) can be used, but the existence of joint functions complicates the problem to such an extent that the selection of an appropriate equation is extremely difficult. The coaxial graphical correlation (4), on the other hand, is flexible and yields correspondingly better results for runoff relations, because of the joint relations involved.

In the coaxial method, a three-variable relation is first developed by plotting in Figure 4A accumulated snowfall against runoff, labelling the plotted points with inches of rain and fitting a smooth family of curves representing the various

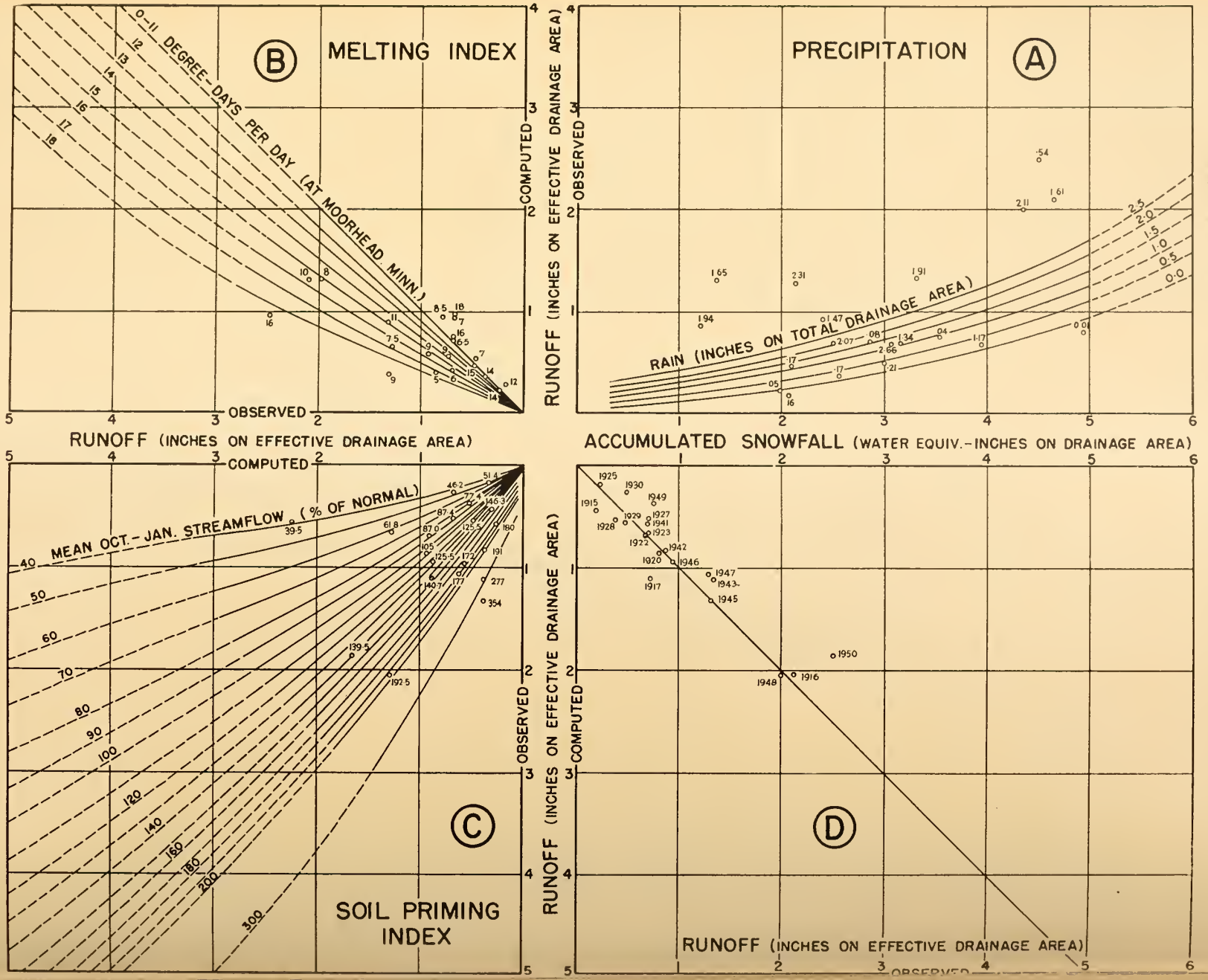

Fig. 4. Derivation of snowmelt — runoff relation for the Red River at Emerson, Man.

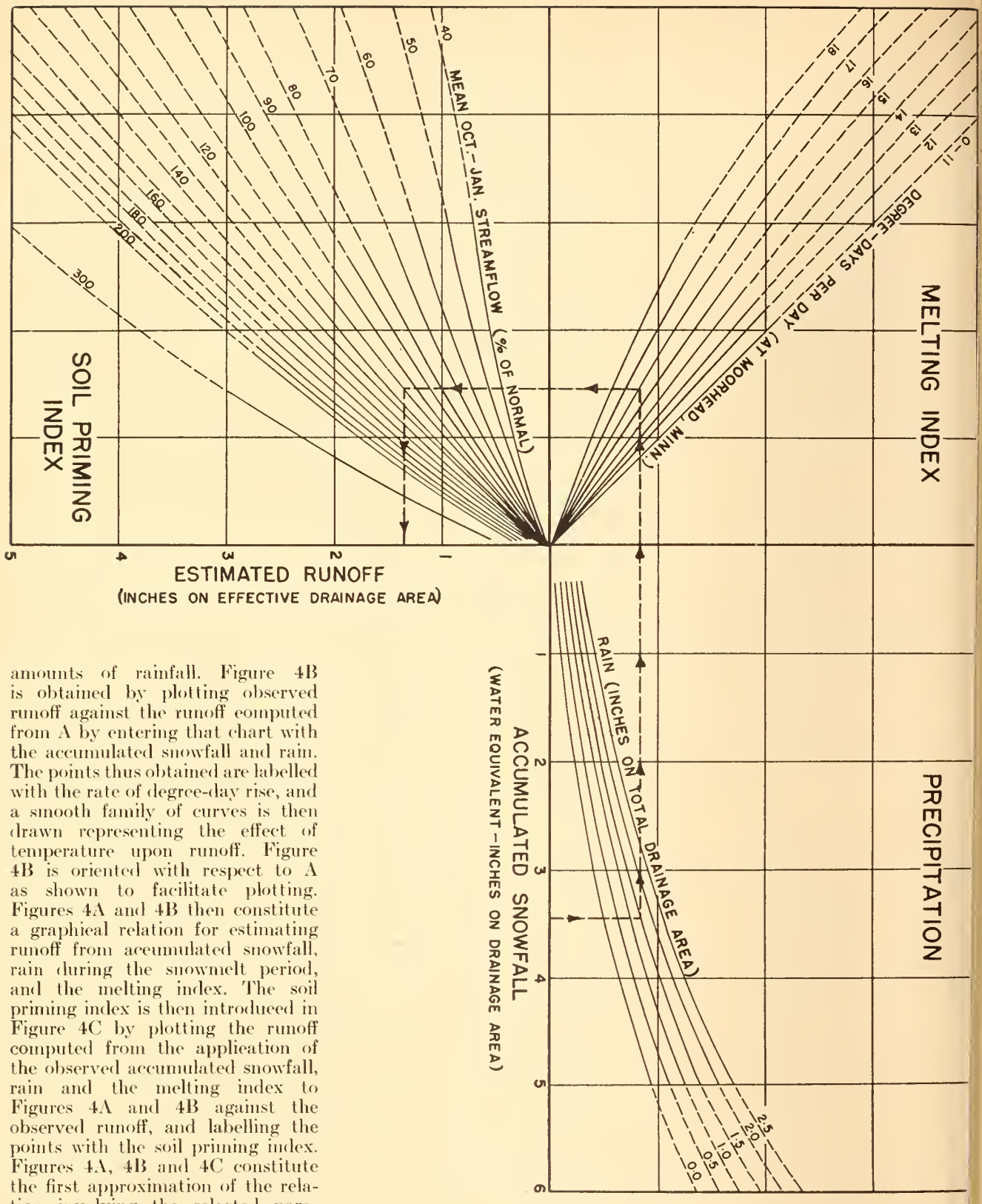

Fig. 5. Snowmelt — runoff relation for the Red River at Emerson, Man.

amounts of rainfall. Figure 4B is obtained by plotting observed runoff against the runoff computed from A by entering that chart with the accumulated snowfall and rain. The points thus obtained are labelled with the rate of degree-day rise, and a smooth family of curves is then drawn representing the effect of temperature upon runoff. Figure 4B is oriented with respect to A as shown to facilitate plotting. Figures 4A and 4B then constitute a graphical relation for estimating runoff from accumulated snowfall, rain during the snowmelt period, and the melting index. The soil priming index is then introduced in Figure 4C by plotting the runoff computed from the application of the observed accumulated snowfall, rain and the melting index to Figures 4A and 4B against the observed runoff, and labelling the points with the soil priming index. Figures 4A, 4B and 4C constitute the first approximation of the relation involving the selected parameters. Figure 4D obtained by plotting the computed runoff against the observed runoff, indicates the overall correlation of the relation.

Since variables were introduced subsequent to the development of the first two charts, tests should be made to determine if revisions to these charts would improve the relation, i.e., the process is one of

successive approximations. Thus, to check the curves of Figure 4A, the assumption is made that the other charts are correct. Figures 4B and 4C are entered in reverse order, and the computed runoff thus obtained is plotted against the accumulated snowfall and the rainfall curves are revised to fit the point adjusted in this manner, if the relation is to yield a computed value equal to the observed. The second approximation curves for the melting index and soil priming index and all subsequent approximation are made in a similar manner.

In proceeding with this analysis, it was found that a poor correlation existed for those data with a melting index less than 11 degree-days/day. However, a consideration of only three independent variables, i.e., omitting the melting index, provided a poorer correlation. After further trial solutions, it was found that the best correlation for the whole range of data was obtained by assuming that the melting index from 0 to 11 effected the same net change in runoff. The final relationships are shown in Figure 5.

The fact that a fairly good correlation is obtained by graphical means does not prove the correctness of the variables used in the analysis. In other words, is there a chance correlation between any one of the independent variables and runoff, or is there a true relationship ? To answer this question, a mathematical statistical analysis was made. From an examination of the final graphical correlation, it appeared that a straight line joint function with an equation of the form

$X_1 = a + b_1X_2 + b_2X_3 + b_3X_2X_3 + \ldots .$

would best fit the data. The equation obtained by the application of the observed data is as follows:

$$X_1 = 2.713 - 0.253X_2 - 0.734X_3 - 0.379X_4 - 0.00687X_5 - 0.0821X_2X_3 + 0.0108X_2X_1 + 0.000277X_2X_5 + 0.027X_3X_4 + 0.0019X_3X_5 + 0.00312X_4X_5$$

where X_1 = runoff, inches

X_2 = melting index, degree-days/day

X_3 = accumulated snowfall, inches

X_4 = spring precipitation, inches

X_5 = soil priming index

The standard error of estimate, or the deviation that might be expected between the actual value of runoff and the value estimated from this equation, is 0.159 inches. The coefficient of multiple correlation, which is a measure of the degree of correlation between the variation of all the independent variables and the dependent one, is very high, 0.976, but high coefficients are common for joint functions. Perfect correlation would be expressed by a coefficient of 1.000.

The partial correlation coefficients were also calculated to determine the degree of association between the dependent variable and each of the independent variables. It was found that the correlation between runoff and each of the variables, snowfall, rain and soil priming index, was highly significant, i.e., there is a true relation in the overall population so that if a new sample of records were considered the odds would be 99:100 that a true correlation would exist. On the other hand, the correlation between runoff and melting index could be due to chance. The coefficient of multiple correlation, however, was reduced when the melting index was omitted from the analysis. The graphical method affected a compromise solution whereby all melting indices below 11 were assumed to have no effect on runoff.

A comparison of the results of the graphical and mathematical solutions is shown in Table I. It is evident that the mathematical solution provides the more accurate results within the range of the recorded data, but when extreme values of the independent variables are applied the equation gives erroneous results, such as more runoff than precipitation. The curves for the graphical solution, on the other hand, can be extrapolated by a rational consideration of the factors involved and their ultimate effects on the volume of runoff. As with any extrapolation, however, the results will be of limited accuracy. The mathematical equation is cumbersome, and, although it gives accurate values of runoff within the range of recorded data, the values of the variables at the time of forecasting are known only within certain ranges. Taking into account the accuracy of the basic data at the time of the forecast, the graphical solution will provide a quick and fairly accurate estimate of the runoff.

Applications of the Derived Relations

The relations shown in Figure 5 may be useful for storage studies in relation to power and water supply where the volume of runoff from the seasonal accumulation of snow is important.

For river forecasting, it is necessary to carry the forecast a step further and to predict the river stages. This may be done by the application of the unit hydrograph principle to the predicted runoff. To do this, however, an estimate of the effective snowmelt period must be made. If the amount of snowmelt per degree-day is known for the basin, this factor multiplied by the average degree-day rate and divided into the predicated volume of runoff will provide an estimate of the effective snowmelt period.

The amount of snowmelt-runoff in inches per degree-day, termed the "degree-day factor," was found to vary from 0.02 to 0.06 inches per degree-day for a number of spring flood periods in the Red River basin. The wide range in values may be explained by the following: (a) temperature alone is not a perfect index of the snow melting potentialities of an air mass; (b) at the beginning of the selected melt period some of the melt water may be stored in the snow to be released at a later time; (c) unequal snow distribution; (d) the large area of the basin. This wide range in values makes it somewhat hazardous to select a degree-day factor for estimating purposes. A high rate of melt, however, will result in a high peak discharge for a given volume of runoff, and, for the preliminary forecast, it is desirable to determine the approximate upper limit of the peak discharge and thus the peak stage.

Summary

The coaxial graphical correlation method of predicting runoff from snowmelt with accompanying rainfall gives fairly good results for the Red River and has the advantage over other methods of prediction in being quick and easy to apply. The use of snow survey results would be more desirable than the use of accumulated snowfall in the analysis and these should be used for basins where there is an adequate history of snow surveys. It is hoped that the procedures described, or modifications thereof, can be used for the prediction of runoff on other prairie streams with similar topographical and climatological characteristics.

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Paper presented at the summer meeting of the Institution of Mechanical Engineers, Automobile Division, in Netherlands at Delft, on June 16, 1954.

Automobiles and Petroleum

Past, Present and Future

by

Professor J. J. Broeze

Director,
Royal Dutch Shell Laboratory,
Delft, Holland

There are no two industries that have been more closely allied since early infancy than the automobile and the petroleum industries, and neither would have grown to its present stature without the other. Together, they have become one of the most characteristic features of the century. It is proposed to review broadly what has been achieved specifically as a result of over fifty years of co-operation, which has become remarkably intense over the second half of this half-century. This recent, most fertile and successful period may perhaps be considered to have been initiated by the pioneer work of H. R. Ricardo on detonation and combustion chamber design, the first undertaken on behalf of a well-known oil company, the second in direct contact with the automobile industry.

After 1930 there was a great advance on a broad front, and added light was thrown on the main principles of combustion and lubrication and on the physical and chemical factors that unite to produce technical effects. Gradually engine development as well as fuel and lubricant technology emerged from their complete empiricism and obtained a scientific basis, thereby accelerating progress and rendering it more stable.

The Present, and How it Came About

The present automobile is largely made of steel, with a modicum of aluminium and plastics, far less, as a matter of fact, than is popularly supposed. Its tires are largely of natural rubber, which, together with natural textiles and sometimes natural leather, form the contributions of the vegetable and animal worlds, the use of wood belonging practically to the past.

Its fuel is almost exclusively of petroleum origin, overwhelmingly petrol with some Diesel distillate; its lubricants even more so. Part of the plasties, lacquers, plasticizers and such also originate from petroleum gases, as does the carbon black that is an essential component of the tires.

Of course, this present situation may be only a passing phase; but it is the stable result of very attentive, painstaking quantitative evaluation of possibilities and also as regards the petroleum products used, of mutual adaptation between the two industries on the statistical basis of millions of units produced and used during billions of operating

Fig. 1. The acme of accessibility.

The author deals first with the main events leading up to the present stage of development of the combination automobile-petroleum, then with the near future, cautiously extrapolating what is known, and finally speculates on things further ahead.

hours. This is more than can be said of any other equally complex piece of machinery.

Let us look more closely at the centre of things, the engine: as a matter of fact, this is now no longer the centre of interest to the customer, who is no longer so proud of it as to parade it under a ridiculously big bonnet in front of him, but is rather showing annoyance at the useful space it takes up in his car. This is real progress. The engineers' task will not be finished until the engine is tucked unobtrusively out of the way. In trucks and buses, this has often been attained already, but not always is it then so conveniently accessible as in some Dutch designs (Fig. 1). It has to be either that, or a continuation of our effort to package it effectively for hundreds of thousands of miles without any service: a most worth-while goal from the point of view of availability as well as of running economy.

In passenger cars, the best accessibility so far has been achieved by the popular rear-engine cars (Fig. 2), but the ideal has not been achieved, as there is less space available in these designs. In view of the high degree of reliability of present-day engines, the narrow front-end position has its merits even with Italian styling (Fig. 3) and does not even necessitate front-wheel drive for maximum compactness, as the divided rear axle combined with hypoid or worm drive has resulted in some very flat, low floors. At any rate, there is more luggage space and less oversteering tendency.

Engine

Coming then, to the engine itself, it is of interest to note that in the great majority of cases this is the four-stroke petrol engine. Why is this so?

Primarily, the petrol or spark-ignition engine gained an early lead over the compression-ignition one, thanks to its greater simplicity and the fewer demands it makes on engineering skill and manufacturing technique, so that it acquired certain features of compactness, specific

Fig. 2. Rear-engine accessibility.

power, reliability, flexibility, and ease of maintenance long before the road-vehicle Diesel engine. Its relatively low operating pressures, its complete air utilization, and the beautiful simplicity of its fuel system, enable it to maintain the lead on the scores of specific weight, space, and cost.

The latter is of the greatest importance in view of the extremely low utilization factor of the average automobile engine. If this be expressed as the quotient of the

Fig. 3. Italian-style engine compartment.

number of b.h.p.-hr. actually produced per annum and the maximum possible at full power, 24 hours per day, this utilization factor for an American-type passenger car is only some 0.5 per cent, increasing to some 3 per cent in the case of commercially used passenger cars. The figure for commercial vehicles would often be higher, and there is already found the C.I. engine, with its lower fuel consumption, entering the field, powerfully assisted by taxation schemes which originated in the days when the horseless carriage was a luxury of the taxable few and persist to the present day under a different pretext in every country.

The simplicity of the fuel system of the petrol engine, where if need be a single carburettor can feed several cylinders with explosive mixture, is based on the volatility of the fuel. It is of interest to note that this is not an unmixed blessing. Not only does it give rise to dangers that are all too familiar, but it has also led to compromises which in an earlier period of history have had almost disastrous results, as will be made clear.

One may define a somewhat abstract ideal volatile fuel as one which gives the greatest power to a given cylinder charge. Inasmuch as volatility has an influence here, it is clear that the most volatile fuel will allow complete volatilization at the lowest temperature; hence the greatest density of the cylinder charge can be utilized, and thus the greatest power produced. However, the most volatile hydrocarbons are so light that their vapour claims a considerable part of the mixture volume. The result is that the optimum value is in the hexane region, and actually the very first practical carburettor fuels had something like that volatility. With increasing demand, the boiling range was extended considerably until it became so difficult to evaporate the fuel that the incoming charge had to be artificially preheated. Now there is no lack of waste heat available around a petrol engine, and perhaps it was this superabundance that lured engine-designers and petroleum technologists downhill together along a road of danger and destruction, the road of increased preheat and boiling range. About thirty years ago the lowest point was reached, particularly in the United States of America.

What made matters worse was that all this preheating promoted the tendency to detonation, which was already very strong in the higher-boiling fractions of the directly distilled (so-called straight-run) petrol; and, necessarily, this had to be taken care of by lowering the compression ratio. Engines around that time were in consequence very inefficient.

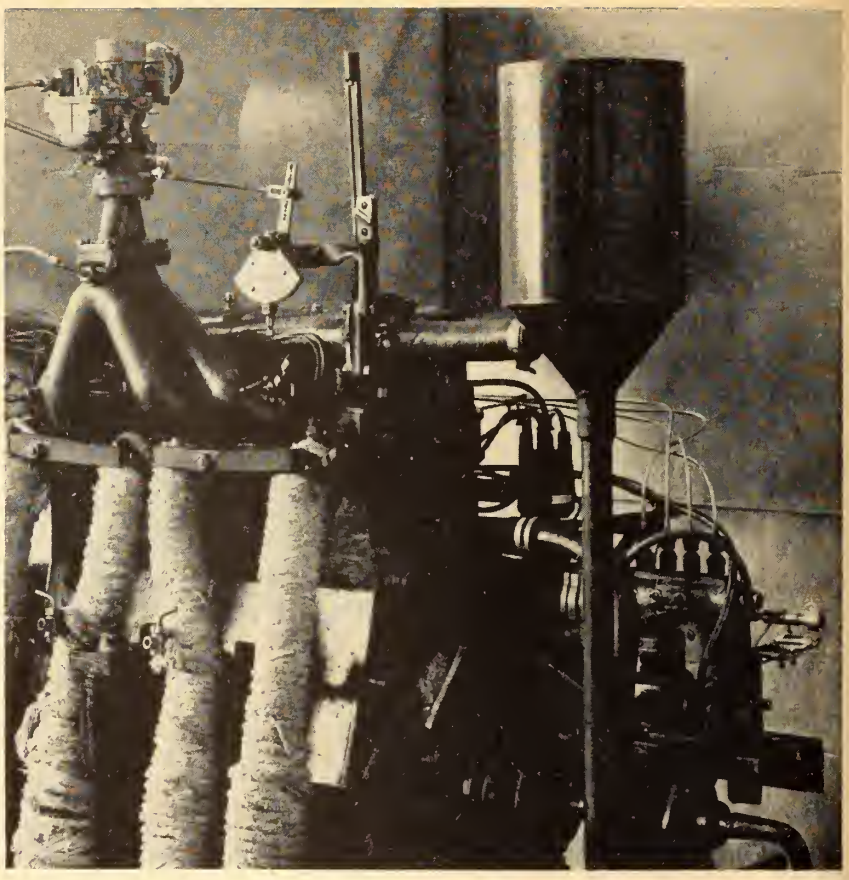


Fig. 4. Experimental engine.

Nor was this all. When, in 1932, the 'Co-operative Fuel Research Committee' proposed the variable-compression-ratio C.F.R. engine, it also proposed a standardized operating method, known as the Research Method (later renamed F-1), in which intake and coolant temperatures were chosen arbitrarily but more or less reasonably, as one would have thought. However, the first confrontation with actual practice, in the famous Uniontown road-rating tests, showed no correlation at all, and it was not until intake and coolant temperatures had been adjusted to somewhat unorthodox conditions that a method was found, that could be used commercially at that time, because of its better correlation (the motor method or F-2).

The fact that there was such a difference in correlations showed for the first time clearly what a profound influence operating conditions have on the relative merit ratings of different types of fuel. Actually, the Motor Method (that is, the average 1932 automobile in the U.S.A.) was very severe on cracked fuels because of their high content of aromatic and other unsaturated hydrocarbons. Tetraethyl lead, on the other hand, was very effective. Owing to the fact that the C.F.R. engine was specifically built for comparative rating purposes, for eminently practical reasons it was coupled to an electric generator which 'floated' on the electric mains. This enabled the operator to switch fuels and adjust mixtures without having to nurse a faltering engine. But it made the engineers overlook the damage that the change from Research to Motor Method conditions did to the power and efficiency of the engine, otherwise the reaction against the unhealthy conditions would have been more rapid and drastic. As a matter of fact, it was, to the author's knowledge, a contribution from his laboratory to the First World Petroleum Congress in 1933 (Peletier 1933)* that first drew attention to this state of affairs (Fig. 8).

Outside the U.S.A. conditions were at that time possibly somewhat better. The lesser use of cars

*An alphabetical list of references is given in the Appendix.

specifically for city traffic and the more general use of gears in accelerating made conditions more favourable for carburation, so that less drastic preheating was applied. Perhaps fuels were somewhat better, too, on this side. Certainly, Europe had great success with fairly aromatic, non-leaded fuels which were widely different from the U.S.A. pattern of that time.

A circumstance which did much to improve the situation in the U.S.A. was that cars were becoming more a means for travelling long distances. This greatly increased the need for adequate cooling, hence improved casting technique and directed coolant flow, which much reduced cylinder-wall and valve temperatures. Competition led to still more rapid warming-up characteristics and to the thermostatically controlled hot spot, which could heat up rapidly yet not get too hot under constant load conditions. Competition also led to improved carburation: dual or even multiple carburettors and separate inlet porting made lower intake temperatures possible. All this helped to make the engine less severe on sensitive fuels.

The oil industry added cracking capacity and was able to improve the volatility as well as the octane rating of the fuels. As to the latter, chemical conversion processes (generally known as reforming processes) which could enhance the anti-knock quality of low-octane gasolines were also introduced.

The cars of about 1939 were already a great improvement on those of the early 'thirties. More recently, the introduction of the automatic transmission in the U.S.A. has still further eased the position, in that no longer is stress laid on top-gear performance with its most difficult feature: the low-speed behaviour. Apart from severe preheating as a measure to improve mixture quality and distribution, this low-speed behaviour had also led to the adoption of relatively intense turbulence. This in turn easily led to high-speed harshness and the result was very elaborate combustion-chamber design with complicated shapes for the promotion of turbulence, correct volume distribution, and knock suppression.

As things are now, the American designer can look, and has been working, more frankly towards high power output, and here finds himself in the company of his European contemporaries, who have been doing this for many years, trying to get some performance out of cars built to the most restrictive tax formulae. Different though conditions are on the two sides of the Atlantic, it is yet curious to observe the parallelism in design that results (Figs. 5 and 6). The only difference is that we have four small cylinders and the U.S.A. eight big ones.

Road ratings are well on their way back to being represented by Research rather than by Motor Method. With this trend the oil industry is in many ways very satisfied. The catalytic cracking process, which started its triumphant development about 1939, not only proved another potential means of extracting more petrol from the crude oil, but specifically produced a type of hydrocarbons that perform well under research conditions. New catalytic reforming processes, which increase the octane rating of straight-run petrols, also produce aromatics, which are at their best under these conditions.

The experience gained from working with aero-engines in the use of rich mixtures for knock suppression is now also being utilized more fully with the higher-precision carburation in these newer cars: here, also, the newer types of petrol respond particularly well.

The present situation with regard to the petrol engine may thus be described as follows: the (four-stroke) engine is generally developed for a high specific power, obtained under conditions of good volumetric efficiency at moderate r.p.m., the low intake temperatures and precision carburation enabling the full benefit to be derived from present-day fuels. Supercharging has nowhere taken hold, on account of its being an expensive complication.

Two-stroke engines, which have become immensely popular in the smaller sizes: small motor cycles, portable saws, and so on, have never been able to find much favour with the automobile public. The few successful makes prove the rule by being the exceptions. It is

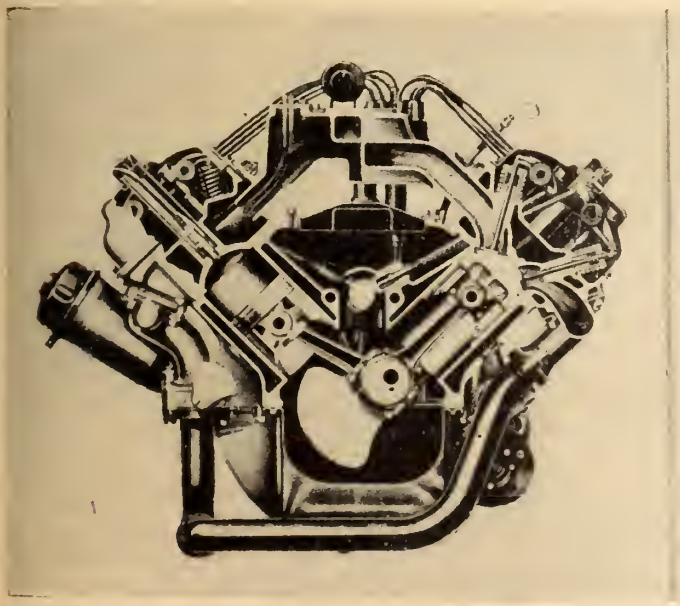


Fig. 5. Modern American eight-cylinder overhead-valve engine.

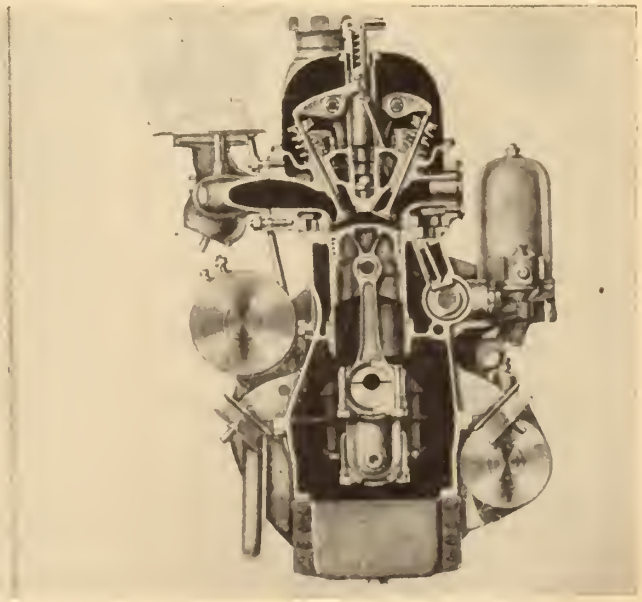


Fig. 6. Modern European four-cylinder overhead-valve engine.

somewhat difficult to say exactly why this should be so: one would expect either the irregular stutter at idling and low loads, the relatively high lubricating oil bill, or the more frequent need for cleaning, to be the dominant factors in this obviously unfavourable reputation.

Yet, especially since loop scavenging was introduced and flat-topped pistons became possible, the few two-stroke engines on the market have given a good account of themselves, and the recent introduction of petrol injection has cut the otherwise rather high specific fuel consumption. Curiously enough, this has never been a real reason for the unpopularity, the few cars with two-stroke engines being inherently of an economical character. Carbon formation, which used to be quite troublesome, has been reduced also, thanks to improved lubricating oils. However, the fact remains that the two-stroke petrol engine is, as yet, a negligible factor.

A closer look at the speed of revolution reveals the curious fact that generally speaking all engines, irrespective of cylinder size, produce their peak power at some 4,000-4,500 r.p.m. As considerations of scaling-up laws and of heat flow would both lead one to expect higher maximum speeds for small engines than for big ones, there must be other factors to consider.

It would seem that the most important of these is the danger of piston-ring flutter, to our present knowledge about which Britain (Dykes 1947) has made such an outstanding contribution, and particularly the lowering of flutter speed with wear.

Hence the question of durability is involved, and reveals another aspect, the interrelation between engine and lubricant.

One of the worst disappointments which automobile manufacturers have experienced has been the persistence of cylinder wear after improved methods of machining had resulted in precision-made parts of highly satisfactory surface quality. Other parts, like crankshafts and their bearings, had responded very well, the precision attained added to structural stiffness ensuring such a complete oil film that wear was practically banished. True, the reciprocating movement of pistons precluded the perfection of full-film lubrication, but nothing, and least of all the experience of many previous years, prepared the public for the appalling cylinder wear of twenty years ago.

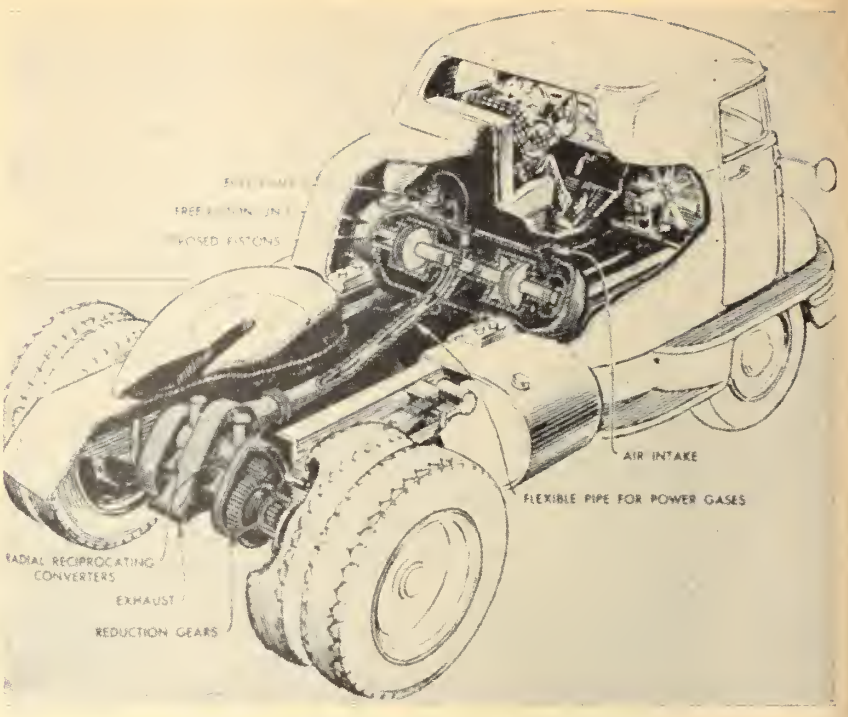


Fig. 7. Pescara free-piston gas generator.

It is almost certain that the fuel factor of low volatility was also involved here, but more significant is, perhaps, the more general utilization of the motor car in everyday life, and the shortening of the average ride, in other words the increasing influence of the starting period. The disclosure of the influence of corrosion on the wear problem by Ricardo (1933), Williams (1940), and Broeze and Gravesteyn (1938) cleared up much of the mystery. Since then, the situation has been rapidly improved by the introduction of thermostatically controlled cooling systems and inlet manifolds, while more or less concurrently materials have been improved. Chromium-plating of cylinders and rings made its experimental entry into the field.

The oil technologist was, for a long time, unable to contribute much. Other difficulties were overcome, the most pressing one being that of manufacturing lubricants with satisfactory viscosity characteristics and oxidation resistance in the quantities demanded by the gigantic growth of automobile utilization.

Apart from some abortive attempts at introducing synthetic oils made by hydrogenation or polymerization, this was largely achieved by selective extraction processes which served to separate the desired naphthenic and paraffinic hydrocarbons from the oxidation-prone higher aromatics. At first, mainly naphthenic oils of great oxidation stability were thus obtained, and these still form the backbone of Diesel and turbine lubrication, but much attention was brought to bear on the question of flattening the viscosity curve, and gradually the paraffinic extracted oil developed.

It was shown once more that lubrication is a slippery business, and one of the nastiest skids developed when the introduction of highly extracted, high-viscosity-index paraffinic oils coincided with that of lead-base and cadmium-base bearing materials. The latter were a consequence of the trend, referred to earlier, to use cars more on long-distance trips in the U.S.A., and were also typical of the U.S.A. tendency to solve problems by introducing new metals or improved oils rather than by more complicated engineering.

The European engineer is sometimes tempted to sneer at this tendency, and certainly in some cases calculated design might have been preferable to what may seem almost exotic engineering with substances unknown to many of us. In the present case, the discovery was made that almost pure paraffinic hydrocarbons rapidly turned very acid at the high bearing temperatures encountered in sustained

high-speed runs. These excessive temperatures were proving too much for the white metal then in general use. Where Europe would have introduced oil cooling, America changed from babbitts to the harder alloys, which turned out to become catastrophically corroded by the oxidation acids. By the same token, however, they thought up an antidote — indium — and effected a complete cure by the subtle process of diffusing this unheard-of metal into the bearing alloy. The result was: no mechanical complication. Another result was to stimulate the search for anti-oxidants to put in the lubricating oil, one of the rivulets out of which grew the broad stream of premium and heavy-duty oil development.

In the meantime other interrelated problems had been brought under control: carbon formation in the combustion chambers and lubricating-oil consumption, both mainly through improved design and finish of cylinders and pistons and notably through the development of the slotted scraper ring. Improved carburation and diminished wear contributed to these results, as did the lighter oils that became possible through this combination of engine improvements: a very fine story in itself of interaction leading to overall improvement of considerable importance. Gone were the days of frequent decarbonization, and cars could make long high-speed runs without the need to look at the engine for periods of 50,000 miles and more. The disappearance of the need for decarbonization meant the end of that curious compromise, the side-valve engine: from there on the overhead-valve arrangement reasserted itself to become, ultimately, practically exclusive. In order to complete the story of the gasoline engine to date, the author refers here to the conception in the U.S.A. around 1935 of the detergent oil for high-speed Diesel engines.

It was one big manufacturer of such engines who, convinced that he had done everything engineering could do to make a good Diesel engine, called in the help of the oil technologist to cure the piston-fouling and ring-sticking that plagued his engines. In the light of later experience, the particular combustion system used in these engines turned out to be a contributory cause, no matter how well the engines were made, but the call was answered and the oil technologist went to work and conceived first the detergent oil, in which surface-active additives kept oxidation products in a colloidal form and prevented them from flocculating to form solid deposits. The experimental engines of the manufacturer just mentioned form a part of every oil laboratory's equipment, and as events have turned out it is suggested that the whole internal-combustion engine world owes a debt of gratitude to C. G. A. Rosen for bringing this problem out into the open. Before him, Diesel engineers were trying, and ever since they have been trying, to live with the problem as if it were inevitable or, worse, as if they had insufficient engineering ability to cope with it.

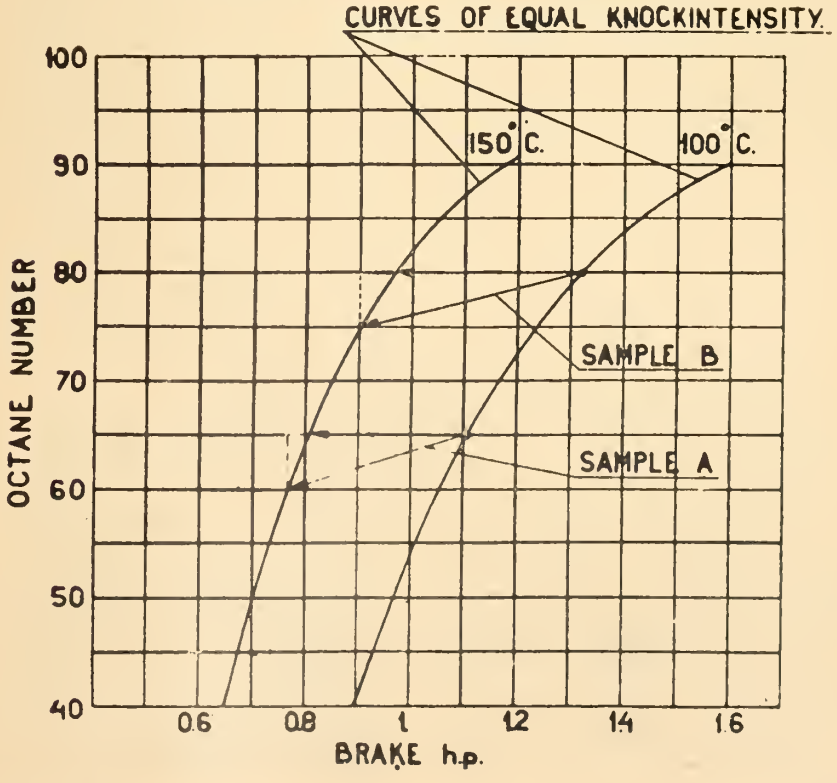
In 1938 this problem was shown in an entirely new light: the deterioration of the oil that led to all the piston troubles in the high-speed Diesel engine was not due solely to its oxidation by the excess air of the Diesel cycle, nor was it in most cases due to inherent incompleteness of combustion, as had frequently been thought. An influencing factor turned out to be the sulphur in the Diesel fuel which was already known to be responsible for more rapid wear. This provided a strong incentive for looking for additives that could more specifically combat acids or even perhaps the formation of acids, and this line of investigation proved exceedingly fruitful.

After 1945, it was found that much development had taken place and that the same experience had led to the same principles being incorporated in Diesel lubricants, and, by virtue of the reasoning that much of the wear in the cold gasoline engine in the first minute or so after starting is due to condensation of acids, also in motor oils.

Again leaving the Diesel engine on one side for a moment, the next phase in the development of motor oils is where anti-oxidant, detergent, and anti-corrosive (anti-wear) action begins to be actively introduced by means of additives. A powerful incentive was the conception of the heavy-duty oil, intended by its sponsors, the Co-operative Research Council, to become a universal oil for gasoline and Diesel engines. Apart from the fact that originally only Diesel fuels with extremely low sulphur contents were used, so that the anti-acid actions were not yet particularly stressed, this conception has long remained the basis of motor-oil development.

Its widespread use in recent years has contributed, together with further development from the engine side, to reduce piston-ring and cylinder wear to a record low level: referring particularly to the almost universal chromium-plated top ring and the heavy-gauge wet liner of

Fig. 8. Effect of temperature on knock rating.



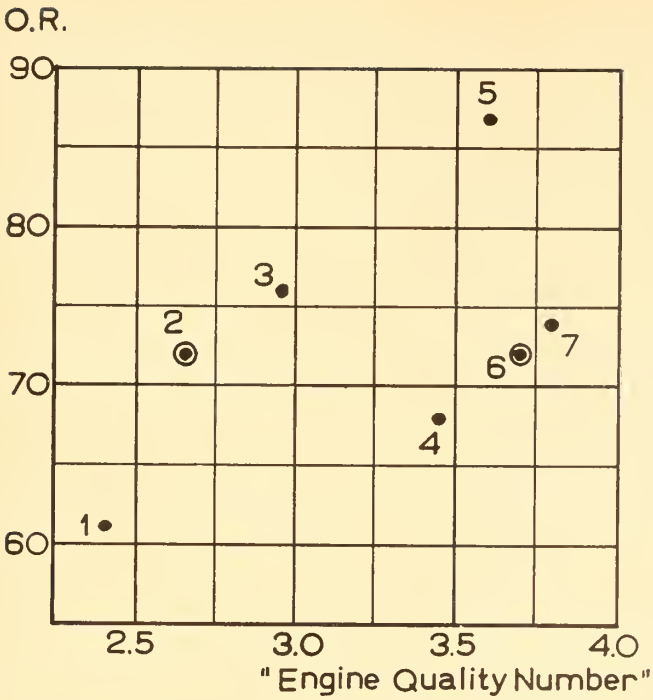


Fig. 9. Wide spread between performances of different engines on an octane-number basis.

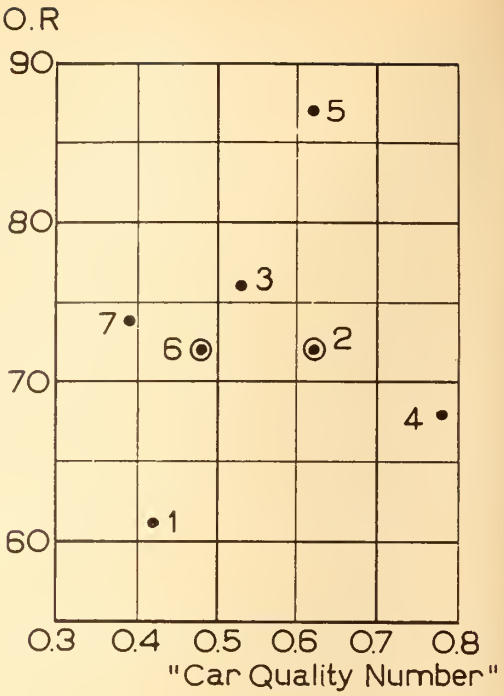


Fig. 10. Car characteristics also influence performance.

especially hard material. Also, in a case that is almost isolated, yet has received much prominence, air-cooling has proved its worth in combating cylinder wear due to quick warm-up. The result is that even small hard-working engines normally run 60,000 miles between overhauls and sometimes considerably more, as against the 20,000-30,000 of pre-1939 days.

Against all these unmistakable gains, which have resulted in the superior engine of today, there is only one direction in which no further progress has been made, where even some regression must be noted: there is more trouble about combustion-chamber deposits than there used to be. This is not only because their nefarious role in upsetting the smooth routine of progressive combustion initiated by the spark has become better understood, but because the recent high-compression engines designed for the modern premium gasoline appear to be more prone to pre-ignition and its attendant, irregular 'wild ping'. This, and the increased difficulty of keeping the ever smaller spark plugs in proper working order on leaded fuels, has given rise to extensive experiments to find suitable antidotes, but there is still a clamour for a more systematic investigation, prevention being better than cure.

Transmission

Enough for the moment about the engine. Although clearly the most important piece of engineering in the car, it could not work without its companion, the transmission system. In Europe, this is still a somewhat refined edition of a very old idea: a mechanical gear-change arrangement, a propeller shaft, bevel gears with built-in differential, characterize nine out of ten cars. The engine is engaged by means of the equally old, but also refined, friction clutch, and the only help to the driver's own handiness or otherwise is the synchronization device on two or more gears in the gear-box. Automatic over-drive shifts have virtually disappeared, as have pre-selective epicyclic gear-boxes that promised so much twenty years ago. A few hydraulic couplings relieve the monotony.

How different is the situation in the U.S.A., where a multitude of automatic gear change or torque conversion systems relieve the driver — who already practically drove on one gear — of the irksome task of selecting the proper transmission ratio! In principle, apart from more hydraulics, the layout is not so dissimilar and also relies largely on the mechanical item of gears. There is little doubt that drivers long for this improved simplicity in operation: it is only that there are big objections in the added engineering as well as in the sometimes very important drop in efficiency, which could hardly be afforded: the former relate to the automatic gear-change devices, the latter more particularly to the hydraulic torque converter.

But the desire remains. The time when the average motorist just loved to fiddle with all the knobs, levers, and pedals has passed here as elsewhere; it is a pity that the experts in the industry are sometimes too much of fiddling enthusiasts themselves to understand this.

There is, within the limits of this general review, little to remark about the partnership of the two industries except that the development of high-performance gears has gone hand-in-hand with that of appropriate lubricants. The most striking result of this has been the introduction of the hypoid gear, which has had such a considerable influence on back-axle design and has been so largely instrumental in bringing about the present low car floor. This would never have come to fruition without those lubricants with the unfortunate name of Extreme Pressure lubricants, the most outstanding characteristic of which is the ability to act protectively at the high local temperature flashes caused by excessive frictional heat. In the hypoid gear, these are partic-

ularly promoted by the mutual wiping action of the teeth, rather than by excessive specific pressures. But such is technical language; cars also have radiators instead of convectors.

Most of the remainder of the common sphere of interest is concerned with those bearings — in wheels, universal joints, steering, and suspension — where grease is used. And is it not wonderful what the oil industry has done in recent years in the matter of greases, or rather of one universal grease that fulfils all these tasks so satisfactorily? There have been times when cup grease was used even in transmissions, the automobile engineers of an earlier generation being unable to solve the problem of leakage in their units. Later, there was a time when it looked as if this extremely inferior stuff would give way even for general chassis lubrication to oil, with one-shot lubricators to keep things going regularly. But intense study of the properties of lubricating greases led to such improved understanding of their possibilities that the quality rose quickly, first through differentiation of specialized greases, until, under the stimulating influence of aviation requirements, there came the present all-purpose product, which is a veritable masterpiece of petroleum technology and lightens the burden of the designer.

It may be remarked here that designers are often ungrateful creatures, putting in rubber joints where dealers would like to turn an honest penny by doing a grease job. The petroleum industry, of course, retaliates by cutting engine repair bills to snippets by using anti-wear oils. Together, they serve customers well, as things stand at present.

The Near Future

The near future will see in most respects conservative developments along existing lines, that is: a further gradual improvement in the quality of petrol, notably in its anti-knock level, and a gradual adaptation of the engine to make use of this fuel.

With regard to both fuels and engine, the remark may be made that they are not all equal in performance. With particular reference to engines, and whole automobiles, there is so much difference in level of achievement that the least spectacular but the most important feature may well be the narrowing of the gaps between the *avant-garde* and the main body, so to speak, a levelling of the field.

Two graphs which were used in a discussion at the Fourth World Power Conference held in London (Broeze 1950), may serve to illustrate the desirability and importance of this levelling process. The first (Fig. 9) of these shows the performances of various (then) recent engines as functions of their octane requirements. The author took the liberty of concocting a performance index from the two important factors (n.m.e.p. and fuel consumption), necessarily in a somewhat arbitrary fashion.

Engine quality number

100—b.m.e.p. at 1,500 r.p.m.

Minimum specific consumption

kg. per sq. cm.

gal. per b.h.p.-hr.

The graph shows that there is a general trend, but an enormous scatter. Clearly, some designers make more of the fuel than others.

The second (Fig. 10) shows what happens when these engines operate in their respective vehicles. Again a performance index has been composed of factors the choice of which will be readily appreciated (acceleration times and fuel mileage).

This graph shows the order of sequence of the first to be quite upset: apparently, there are also car designers who make their engine perform better than others (note reversed positions of numbers 2 and 6). The cars were all medium-size vehicles, though not comparable in detail.

It is seen clearly what possibilities there are for catching up with the leaders. This type of review, on a larger scale and repeated regularly, would be most interesting to follow. Car quality number

Mileage at 70 km. per hr.

Accel. from 20 to 80 km. per hr.

km. per litre

secs.

As regards petrol engines, post-1945 face-lifting is now almost complete. Some impetuous manufacturers announced new designs that could 'take care of' new fuels with extremely high octane numbers, but cautiously adapted their new designs to market conditions. It would seem that this caution was not misplaced, in view of the growing importance of combustion-chamber deposits.

Much will have to be done in the way of fuel and oil technology to remove these obstacles, but it may well be that the engine designers will have to take this problem to heart and do something drastic about the combustion process. The Diesel engine, burning a heavier fuel, has a much cleaner combustion chamber: this points to the importance of working whenever possible with excess air; the extremely short spells during which full power is needed can be accepted if necessary.

Efforts to bring about such conditions in the petrol engine have not been lacking; it is, of course, the difficulty of igniting lean mixtures with a spark that has always forced the designer back to that narrow range around the theoretically cor-

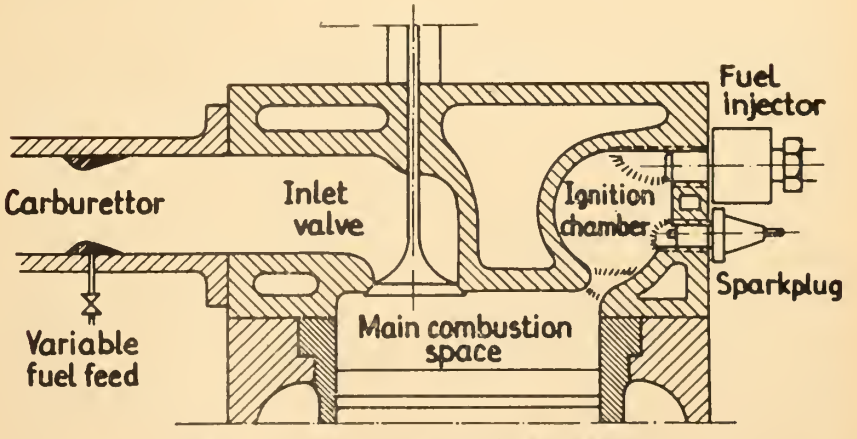


Fig. 11. Layout of new combustion system.

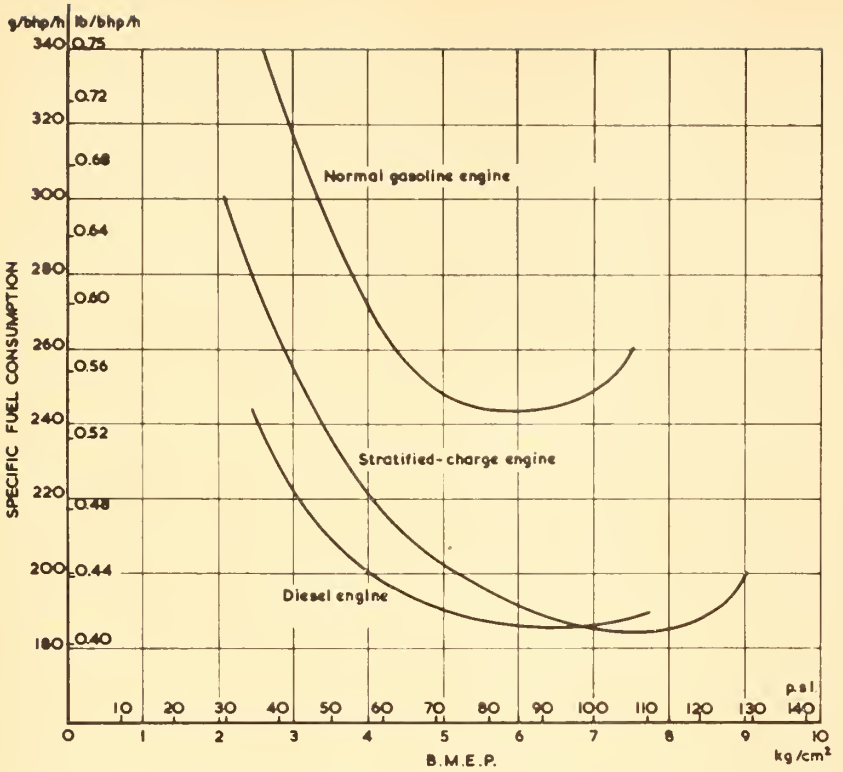


Fig. 12. Comparison of fuel consumption.

rect mixture. However, from the viewpoint of economy too, there is so much to be gained, as the automobile engine is used so much at low power.

When running in city traffic, one may visualize one-third of the petrol being used for sucking the mixture through the engine against the resistance of the almost closed throttle, one-third for overcoming engine friction, and the last third for actually propelling the car! There are great rewards to be reaped by those who take stratification seriously, notwithstanding all previous disappointments!

In the author's laboratory the idea of further perfecting the petrol engine was very much alive. A few years ago Mr. J. Th. M. Schlamann set himself the task of proving that stratification might be feasible. He separated functionally the ignition from the remainder of the combustion, by borrowing the precombustion chamber idea from the compression-ignition engine, and controlling the fuel/air ratio in this precombustion, or rather ignition, chamber, separately from that in the main chamber. It was subsequently found that such ideas were not new, but this had not deterred the experimenters, and, where earlier attempts had failed, by just being stubborn they obtained most promising results. It is thought that a forecast of future possibilities against the background of achievement would be of interest here.

Schematically, the Schlamann engine may be visualized as in Fig. 11, with an injection pump feeding petrol into the ignition chamber, and a carburettor adding the required fuel into the main air stream. It transpires that with suitable dimensions and controlled turbulence the flame issuing from the ignition chamber will regularly ignite the mixture in the cylinder under any condition of load and speed, so that even idling can be achieved of load and speed, so that even idling can be achieved with an unthrottled air inlet, although a slight throttling at lower loads has proved beneficial so far, and contributed to idling stability.

As was expected, thanks to the weak mixture in the main chamber the octane requirement is relatively low, and this feature is enhanced by the low evaporative load on the induction system, so that one might discard preheating. Also, the combustion chamber does indeed stay cleaner. The net result is that, for a petrol engine, very good power is produced, whereas the fuel-consumption graph (Fig. 12) can stand comparison with that of contemporary high-speed Diesel engines. These results were obtained on a four-cylinder engine (Fig. 4, which the author had designed in peculiar circumstances, and of which he could honestly say that it does not represent the peak of design ability, and this makes the achievement of the combustion system all the more noteworthy. In the low-load region so typical of passenger-car engines, improvements in fuel economy of the order of 25 per cent over conventional petrol engines are achieved. At the same time, it has the low mechanical loading of the petrol engine and even lower thermal loading, particularly as regards the exhaust valves. This might be of immediate interest inasmuch as exhaust valves remain somewhat critical elements in contemporary petrol engines. Of course, the pistons and bearings are much less stressed than in the Diesel engine, so that whereas the latter's fuel economy is approached, specific power output and weight will be strictly comparable with those of the petrol engine, which is so superior in these respects. Admittedly, the Schlamann engine must be considered more complicated than the petrol engine as to accessories, even though a simple injection pump has been designed for it, which has worked well.

Is this enthusiasm justified ? Time alone will show. The author is firmly convinced that the petrol engine has a future greater than its past.

In the meantime, in the realm of fuel technology provision will be made the world over for modern facilities for producing higher-octane fuels. Catalytic cracking and reforming installations are being erected in all parts of the world.

This petrol will remain by and large a leaded petrol, as nothing is in sight which would enable similar results to be obtained economically in large volumes without tetraethyl-lead.

On the fuel side, therefore, there is also a levelling process plus a gradual overall improvement. How far this general increase will go is the subject of much conjecture, but it would be wrong to pretend to know the answer. A very important question to be answered in this connexion is: what is the optimum compression ratio for the passenger-car petrol engine ? The fact that this question is being asked indicates the progress made already along the road of compression-ratio increase. Is the end in sight ?

The diminished wear on cylinders and piston rings, which has gradually become a general experience, may be simply reflected in prolonged life

or, in the *avant-garde* designs, it may be translated by means of higher rotational speeds into higher specific powers, with the aim of making the whole vehicle more compact. The lubricating oils which will assure the feasibility of such development may be the direct descendants of present premium and heavy-duty oils, usually containing metal compounds, although other means are being tried out.

At any rate, low-viscosity oils will be used, as these have proved such an aid to easier starting and improved mechanical efficiency, hence fuel economy.

The chromium-plated top ring is essential for success, as is also the heavy independent cylinder barrel, not deformable by cylinder-head studs, and possessed of rapid warming-up characteristics. Air cooling is attractive for these purposes, and may well proceed along lines already indicated occasionally: aluminium cylinders with chromium plating for lightness, hence also rapid attainment of equilibrium and low cooling power-loss.

At this juncture, it is interesting to speculate for a moment on the possibilities of the sleeve-valve engine on the Burt system. Through long acquaintance with its great protagonist, Sir Harry Ricardo, the author has been injected with some of his enthusiasm for this very efficient system, with its favourable piston-lubricating conditions and its attendant low wear rate. However, it was born too early: it needs the detergent oils of today to make it really attractive, and then there is the question whether its lubricating-oil consumption could be reduced so as to comply with modern standards. But it has considerable merits from the aspect of continued high-speed performance, and hence might play a part in the next stage of engine-size reduction. There are signs that it is not dead by any means.

Even now the author would not venture to predict much change in the near future for the two-stroke engine, though it stands to reason that much improved performance could be expected all round if all that the engineers and technologists know were concentrated on it and especially if fuel injection were further perfected.

In the review of the present, the Diesel engine has received only scant attention. In relation to its numbers, it has not deserved much more; in relation to its economic importance it was, perhaps, slightly unfair to neglect it; considering its technical interest this was, of course, a great omission. Always the prime mover with the lowest fuel consumption, the Diesel engine has progressed with the unique help of the oil technologists' creation, the heavy-duty oil, to hitherto unknown heights of reliability and overall economy.

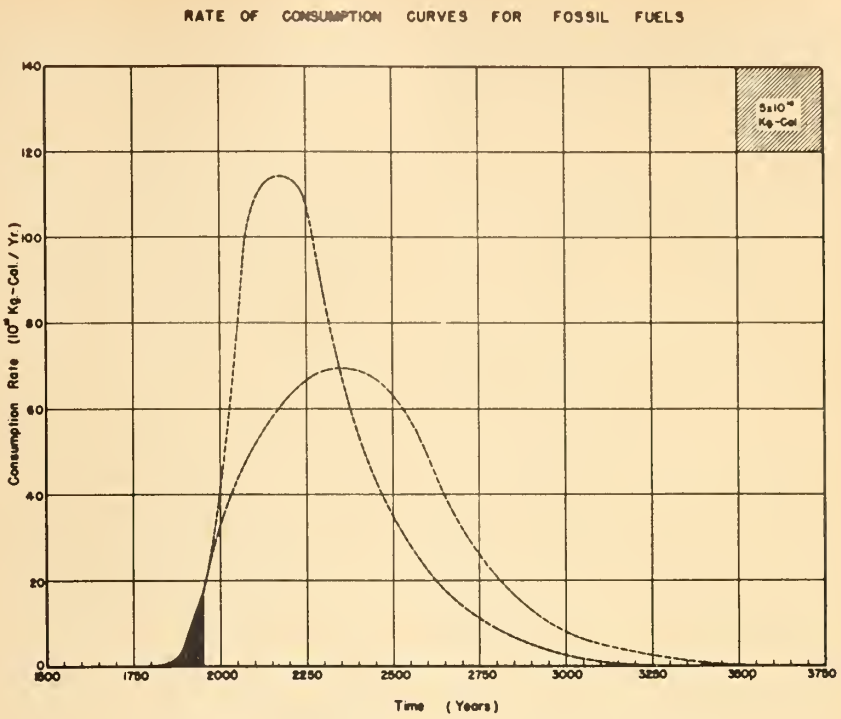


Fig. 13. Consumption curves for fossil fuels.

It is out-performing the petrol engine in terms of thousands of hours of reliable performance between overhauls. Moreover, it lends itself remarkably well to exhaust supercharging, thanks to its low exhaust-gas temperature, and to two-stroke action, thanks to its pure-air scavenging. Hence, higher specific powers are well within its reach, and are being realized as designers get the 'feel' of the new possibilities created by the new lubricants that guarantee clean engines and cut wear. The gradual lowering of the sulphur content of fuels for these engines, made possible by technological progress, will contribute to unheard-of achievements.

Already the field of application is spreading from the heavyweights to the lighter commercial vehicles and it will ere long make considerable inroads on that of the petrol engine, without, however, touching the great bulk of the small-mileage passenger and delivery cars, as the inherent cost differential as compared with the petrol engine remains.

Especially in the higher powers for heavy commercial vehicles, the author foresees as a direct and logical development of the Diesel engine the pressure-gas generator plus turbine transmission. As the two-stroke cycle becomes better known and its design controlled, the highly supercharged version which drives only its supercharger-scavenging pump comes within the range of the practical designer: in industrial, marine, and railway applications it is now definitely under way in the form of the Peseara free-piston gas generator (Fig. 7).

Why is this line of development so attractive? Because its basic principle is the C.I. or Diesel cycle, with which the highest fuel economies are obtained; the result is an exceedingly compact power unit plus a very efficient form of power transmission in which the turbine plays the part of torque converter. Already, in the Renault-Pescara locomotive, approximately 4:1 torque conversion has been applied (Picard and Huber 1951). The very fact of the gas generator's high efficiency results in very favourable conditions for the turbine transmission: relatively high pressure (4-7 atmospheres), low temperatures (1,000-1,200 deg. F. maximum) (537-643 deg. C.), overall efficiency up to 40 per cent (Farmer 1947).

The amount of highly alloyed materials will therefore be very

much less than that required for the full gas turbine with rotating compressor. Also, thanks to its higher efficiency and the higher energy conversion per pound of air used, the ducting for the piston/gas-generator/turbine set is very much less voluminous than that for the full gas turbine, and does not make the problem of its installation such a nightmare.

In all these features the piston-plus-turbine system is so incomparably superior to the full gas turbine, even in its most attractive two-rotor form, that it should have a very much better chance of application in the heavier types of automotive vehicle. But perhaps we are already passing beyond the near future and shall have to have somewhat more patience before this step materializes; it amounts to introducing a new form of drive, the pneumatic drive, besides the mechanical and the hydraulic.

With regard to other petroleum products, the near future may bring such an increase in the manufacture of plastic body-work, which is now just beginning to appear on the market, as to make plastics a major product. So far, however, the petroleum industry has furnished mainly base materials or intermediates for the chemical industries making these plastics, and it is unforeseeable how such an immense increase in off-take would be organized between the industries interested.

Similarly, but from entirely different causes, an increase in the application of synthetic rubber is possible if political stability in large rubber-growing areas deteriorates. This would mean that the interest of the petroleum industry in the rubber used in cars would no longer be limited to supplying the carbon black. The automobile industry is, from previous experience, familiar with at least some of the consequences.

Then, What of the Distant Future?

As long as petroleum is available its fuels will dominate the automotive picture, and even a very long forecast could not fail to present an overall picture similar to that adumbrated, with petrol and Diesel engines, and turbine drives.

How long will that be? The petroleum industry is known never to have proven reserves for more than twenty-five to thirty years ahead; however, this term has not diminished materially notwithstanding the increase in its significance due to the rapid multiplication of yearly consumption. The increase in effort and the advance in techniques have made exploration much more effective and production even from deep wells an economic proposition. The deepest wells obtain oil from over 17,000 feet, but in many areas of the world much shallower formations have not yet even been probed. A striking example is the region near Delft, where only recently the occurrence of oil was proven and production started at the moderate depth of about 5,000 feet (Ryswyk — Delft).

An interesting paper by Hubbert (1949) indicates that an expanding oil technology is foreseen for some few hundred years; coal, by comparison, will admittedly last much longer (Fig. 13).

In between oil and coal there are the shale deposits and the so-called tar sands. The former are a curious kind of mineral in which organic substances, consisting largely of hydrocarbons but also rich in oxygen, nitrogen, and sometimes sulphur, are chemically bound to shale. This shale can be mined and the organic material driven off by heat or possibly catalytic action. Tar sands, of which enormous quantities exist in the world, may be considered as oil reservoirs which have weathered through the ages and retained only the heaviest residues.

To produce liquid fuels from oil shales and tar sands would require a somewhat more complicated technology than is now available, but it is foreseeable that they could be made to produce petrol and Diesel fuels, in a flexible way. The same is true of coal, as is known from the intensive pre-war development in Germany. There is, therefore, no reason to fear a scarcity of liquid fuels for a long time to come, and every reason to foresee improvements and cheapening of the processes by which they can be made out of these less attractive raw materials.

The more complicated technology can be expected to bring higher costs in its train and this would point even more distinctly towards engines, transmissions, and cars of the highest economy. It would seem that the trend towards Diesel engines will continue to develop, the more so as lead is likely to prove a bottle-neck before petroleum.

If, in the meantime, great advances were made in nuclear power, and gigantic central power plants could produce power at low cost, the most likely way to make these contribute to the automotive-fuel problem would perhaps be to let these plants synthesize liquid fuels from carbonate rock and water, there being plenty of both.

Altogether, this means that the small, independent, lightweight, flexible internal-combustion power plant looks so sound that, whatever the primary energy available, technology will do its best to provide it with the most digestible fuels. This should be a challenge to the electrical engineers to do something extremely drastic about storage as well as about motor design, but if betting were allowed, the author's money would be on internal combustion.

Acknowledgements

In conclusion, the author records his thanks to the Institution for the privilege of presenting a paper on his favourite subject, to the Management of the Bataafsche Petroleum Maatschappij for allowing him permission to publish the information, and to his colleagues B. H. Moerbeek, C. Stillebroer, and G. R. Davies for their constructive criticism.

Appendix

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The Engineer and Patents

by

Alan Swabey

Alan Swabey & Co.,
Patent Attorneys.
Montreal.

A paper given at the Engineering Institute of Canada, Montreal Branch, under the auspices of the Industrial Engineering and Management Section. Thursday, March 4, 1954.

Probably few engineers have any close contact with Canadian patents. I shall assume that nobody here knows much about them. I assure you that you are by no means alone and that, if you do not mind the suggestion, you are in somewhat the position of a Senator's wife, whose husband had brought back a pretty little medal coin for her from Hong Kong. She used to wear it around at functions, all over the place.

One day at a United Nations meeting, she ran into a Chinese diplomat. He got her into a corner and said "Madam, I wonder if you know what those characters mean on that medal?" She said, "I'm sure I don't. I like it and I wear it quite a lot, but I have no idea what they mean." "Well", said the diplomat, "literally translated they mean 'Licensed Prostitute, City of Shanghai'."

Many technical and business men know just about that much concerning patents. So don't feel badly if you have not had intimate contact with them. Even those who do, make mistakes. For example, there was the examiner in the U.S. Patent Office who quit his job in about the year 1860. He said, "Everything has been invented that is likely to be invented. I am going somewhere else where there is a future."

Since that time, the tremendous aluminum industry has been built largely as a result of invention by Hall of the electric furnace. Without Hall's invention, it would have been impossible to produce aluminum. The modern oil industry has been built largely as a result of the heat and pressure cracking process of Dubbs. The U.S. patent, I am told, has yielded over 100 million dollars in royalty. Just recently, several United States companies have paid over half a million dollars each, just to get in on the patents of the I.C.I. on polyethylene.

So, I think you can count on it that "Patents are Here to Stay", despite what that examiner in the U.S. Office thought in 1860.

Patents by the Thousands

Besides these large patent developments just referred to, there are certain other phases of patent business. Did you ever hear about the famous tape worm trap? The inventor produced this trap, baited with something the worms like. You let it down your throat into your stomach and the tape worm grabs the bait. It traps them and you haul them out and get rid of them. Then, there is the toilet seat with rollers on it, to prevent you from standing on the seat.

I assure you that patents like that are just a small fringe of the many hundreds of thousands of patents that have been issued in the United States and all over the world. But they stick in the public mind. Some people I am sure think all we patent attorneys work on are gadgets.

To give you some idea of the large number of patents that issue in one week — the February 23rd issue of the U.S. Official Gazette contains about 700 patents. This happens to be a small issue. Over 2½ million patents have been issued in the United States, and over 500,000 in Canada.

There are so many patents, for example, in the radio and television field today, that they don't attempt when you take a licence, to find out what patents you are using. They merely give you a blanket licence. The organization which administers radio and T.V. patents in Canada have a licence which lists hundreds, probably thousands of patents. They merely give you this licence for a flat fee. The administrative job of trying to tell who is using what patent would be too great.

Importance to the Company

An engineering concern of any size today, has to make elaborate provisions to take care of its patent situation. Most industrial companies are actively taking out patents. One of the jobs for an engineer is designing around the patents of others.

To show you how patent situations develop and how you get all these patents, I want to take the example of an invention made at Shawinigan Falls in the early 1930's. They developed a new species of resin (plastic), known today as polyvinyl acetal. They got a basic patent. Today there are roughly a thousand patents which have emanated from that one single basic patent. And that is exactly what happens in any field. Once a patent comes out, it is published and all the firms in the field start working on it, trying to improve it, and as a result patents breed at a tremendous rate.

Unfortunately, or perhaps fortunately, the Canadian engineer is not exposed to patents, as much as the engineer in the United States. This is because most companies are controlled from abroad. They actually do their original patent work outside the country. Much of the

Pointing out that patent thinking and engineering thinking are as far apart as the poles, the author nevertheless expresses his belief that an elementary knowledge of patents and the procedures for taking them out will be helpful to the engineer.

Discussions as to what patents are, when and why they should or should not be taken out, the company's and the employee's interests in patented inventions and the question of patent attorneys' fees, are appropriately illustrated with humorous examples.

activity in Canada is merely "rubber stamping" the U.S. patent. As a matter of fact, 70 per cent or more of the patent applications filed in Canada come from the U.S.A. That is not surprising, when you consider the comparative population figures — about 15 million for Canada and in the United States about 160 million. The actual patent figures work pretty much on a population basis.

The situation is changing a bit in Canada, as far as local activity is concerned. There are quite a few Canadian firms today who have patent departments, Northern Electric, C-I-L, Marconi, General Electric, the Polymer Corporation, Shawinigan Chemicals, Dominion Rubber and Dupont, to mention only a few.

What You Don't Know May Hurt You

The fact that the engineer is not exposed often enough to patents may leave an opening for rather serious things to happen. For example, the other day an engineer dropped into my office and said, "I have an invention which I want to patent." To explain the invention, he showed me a copy of a Trade Journal containing a description of his invention. The journal was dated a year and 11 months previously. In other words, he had just one month in which to file an application to get a valid patent in Canada. If he had waited another month and a half, he would have been too late.

While research and development is carried on mainly outside the country, the patent system does have the effect of causing production facilities to be established in Canada. You cannot sit on a patent in this country. You must work it. If you don't, inside of three years somebody else can ask the commissioner of patents to grant him a licence. In extreme cases, the patent can be revoked.

Probably the only reason we have an active television industry here today, is because we have a patent system. Patents forced them to manufacture in the country. The benefit of the Patent Law to Canada is not only to *stimulate invention* by giving inventors patent rights. Another advantage is to get venture capital *to invest* in this country — to put up manufacturing establishments under patent protection.

Warning Signals

I was interested in the preface of a little book called "Patent Notes for Engineers put out by the R.C.A. Victor Company, Princeton, N.J. It says, "a little knowledge is usually a dangerous thing" when it is a question of taking some affirmative action. But when it is a question of knowing about something that may happen, it is not a bad thing to have a little knowledge. And that is the kind of thing that you run into in the patent field.

A little knowledge may be quite helpful. If you know there are time limits and even a smattering of other aspects of patents — just the fact that you know the warning signals, may help you to save the day. Actually, one of the most important things to watch for is time limits. Time limits are *absolute* in certain cases. Once they pass, it is just too bad.

To illustrate the importance of time limits, a clerk with a patent agent in London had been asked to go over to the Patent Office and file an application on the evening of the last day on which this application could be filed. It was long past the time when all the employees of the Patent Office had left, and the door was locked. He saw a policeman coming around the street, so he tied the bundle of patent papers to a brick. Then when the policeman got close to him he threw the brick through the window and broke the window. Immediately, of course, the policeman arrested him. He said to the policeman "Now look at your watch." — it was just fifteen minutes before this case had to be filed. So, he was able to establish by the policeman's evidence that he had filed the case on time. And that is just how important it is to file on time.

Priority Abroad

The U.S. situation on priority is troublesome for Canadians. I can illustrate this by a story about an American army sergeant over in Europe who had a girl friend in America. She heard that he had been fraternizing with the German girls and she wrote him a letter and said "I hear you have been fraternizing with the German girls. What have they got that I haven't got ?" He wrote back "Nothing, but they have it here!"

That is just the situation with the U.S. Patent Law. You must have it there! Anything you do in Canada as far as inventing is concerned, is of no value to you unless you establish priority in the United States. Supposing you are working on an invention in Canada, and somebody else is working along similar lines in the United States. The dates you are setting up, the date of conception and other evidence is valueless until you establish some date in the United States. That point is often overlooked, even by companies doing chemical research on a large scale.

What we usually do in such a case, is to try to get a document of some sort of disclosure into the United States as fast as we can. Even that is temporary, because there is another factor in the United States that we don't have in Canada, and that is diligence. The U.S. says that with two men working along the same lines, the second inventor who is diligent, may be in the eyes of the law the first inventor and may win over an earlier inventor who has waited too long to file his application or to reduce the invention to practice.

By-Products of Patent System

You don't need to be an inventor for the patent system to be of value to you. The Patent Office library, particularly in the United States, is one of the finest and most complete sources of engineering information to be found anywhere. They have over 2½ million patents classified, and you can search for them there and look up any field you like in the application index.

A few years ago, I was working on an open hearth steel process which was very important. The engineers gave all the information they had, but I wasn't quite satisfied that we had fully explored the situation. So, I spent several days in Washington going through the search files. One of the problems is classification. This process was for making steel. I found the patents in the steel-making art and then, if the trick of the patent happened to be in combustion rather than the actual metallurgy, it was classified in the combustion class. I found there was also another class — heating. I found patents on heating grapes to make raisins, next door to patents on heating to melt glass, heating steel and so on.

The classification system is highly developed, and at first seems rather complicated, but once you get onto it, you will find it possible to track down any art in the United States. You will find unbelievable details on almost every engineering subject.

We also have in Canada now, the classified U.S. records. I suggest you search the U.S. as well as the Canadian. For every one Canadian patent taken out, there are probably six U.S. And if you go to Ottawa, you can ask the Classification Examiner to guide you to the proper

class so you can make a search on any subject you like. They also have quite a few foreign patents in Ottawa. In the U.S. they have the patents of many foreign countries.

You Might Be an Inventor

Now an engineer in his everyday work is likely to run into patentable inventions, because he is exposed to problems which breed patents. For example, a few years ago, Dr. Jane of Shawinigan Chemicals said to us, "Two of our plant engineers have developed a process for making coke. We ran into trouble getting coke because there is a shortage of supply. So two of our engineers found that if we put coal through an ordinary chain grate stoker to burn off the volatile of the coke, it would not attack the carbon to any great extent. We get a pretty good grade of metallurgical coke for our purposes." The two engineers had been working on the problem and had found a solution. This might happen to any engineer.

The engineer may also be in a position to save his company money on royalties, particularly if he is a designer. The company for example, may be licensed under patents on equipment which he can design around. Supposing for example, you are making a lighter. You take the "Ronson" lighter. Actually, the Ronson patent has expired now, but there is another company in Montreal, the Presto Company. They developed a movement which was not dissimilar to the Ronson, and I think they got around the patent.

That can happen in almost any field. That is the way the patents work. Some people have a feeling that you are doing something wrong — you are cutting corners when you design around someone else's patent — but that is not the case at all. Anything a man fails to claim, it is perfectly legitimate to take. He has, in effect, dedicated it to the public.

So, if your company has any licences and you have anything to do with the licensing, I would suggest that they be checked every so often, first as against the possibility that you are not still using the invention. Patents have a habit of expiring. Seventeen years and they are gone. Perhaps the basic patent has expired and you are not using the improvements. Perhaps you don't need the licence anymore. There are cases where companies have gone on paying royalties for five and ten years just on improvement patents which they are not using at all, but which were included in the basic licence which had not been checked regularly.

What About that One Dollar?

There is another question with which we are confronted quite often by engineers. "Should I sign an employment contract in which I agree to give my rights to my company for a dollar ?" That is a rather difficult point, because there are a lot of companies that have such a contract. Personally, I don't like a contract as limited as that. The purpose of the patent system is to create incentive — to encourage people to invent. Once you tie a man down to a dollar for anything he may invent, you decrease his incentive. The Northern Electric has an incentive plan whereby they pay the inventor a sum of money on any invention which they consider to be patentable.

One large Montreal Engineering Company has a good employment agreement. They take the rights for Canada. Abroad, they just take an option. And if they pick the rights up in any foreign country and exploit them, the inventor gets a share. If they decide not to take up the option, the inventor has the right to go ahead and take patents out himself.

In the absence of a patent agreement, the circumstances of the employment determine the rights of the respective parties. If the inventor is paid to do research, the general principle is naturally that he is working in a laboratory — one man out of 35 in a lab, let us say — and as a group, their job is to invent. He may not invent anything for five years, but maybe he will invent something next year. Generally speaking, any invention made by a group like that, belongs to the company.

When you get into production — a man's job is to run a plant, and it is a question as to whether or not anything he invents belongs to him or the company. Usually the principle there is, that the company has "shop rights". In other words, they are able to use in their own establishment, anything the employee invents. Outside of that, they have no claim. Of course, if the inventor develops something out of the class of work of the company, then usually the company has no claim on it.

Another tricky point arises in the case where more than one person gets mixed up in an invention. What happens then ? Who is the inventor ? It is very important that the *actual* inventor be named as the inventor on a patent application, although the patent itself may be worthless.

There is an interesting case, for example, relating to chewing gum which we prepared for Shawinigan Chemicals. The basic thought needed some work done to find out the limits. The invention was a mixture of polyvinyl acetate, which is a resin made at Shawinigan. When the resin was mixed with wax and rubber, using the rubber as a blending agent, they got a mixture, very much like chicle. When chicle was in short supply, this invention became useful.

In order to work out how much rubber and how much wax, two other chemists got into the picture. When the patent application was filed, unfortunately we had to tell these two gentlemen that their names could not appear, as they were not the inventors. All they had done was testing, as opposed to inventing. It is often a borderline case as to whether or not a man's name should be on the patent. It is a question for experts, and not something that should be decided arbitrarily by technical men without consulting a patent man.

The Question of Fees

The question of fees is always a touchy point. Generally speaking, a simple patent application today runs into the two hundred dollar plus category to prepare and file. This includes the filing fee but not answering Official Objections or paying the Final Fee. Some cases run into thousands. Actually, much like the consulting engineer, the patent attorney bases his charges on time, training and experience. "Readiness to Serve", is a big factor.

In other words, you are there day after day. You have to pay your overhead, you have to pay your staff whether any clients come or not. When you walk into a patent attorney's office, you are somewhat in the position of a man who is placing himself in the hands of a skilled surgeon. The surgeon has to concentrate upon the operation. He can't stop in the middle of it and worry about his fee and let the patient die. So if it is a tough job, the patent attorney must be allowed a reasonable charge to do it properly.

Foreign work is expensive, particularly in South America. The Government fees are very high.

Perhaps you are in the sales field and you may have some dealings with the Government. You may have a patented article, or a patented process with which the Ca-

nadian Government is involved. Now, that's a very tricky point, because trying to get money out of the Canadian Government is not easy. After all the officials feel they have to protect the public who pay the bills. Section 19 of the Patent Act says that the Government can use any invention it wants. It is supposed to pay for it, but what it pays is up to the Government. Then there is Section 20 of the Defence Production Act, which holds Government contractors harmless in case they infringe patents. Dealing with the government is a special job beyond the scope of this discussion.

To Patent or Not to Patent

The more I deal with technical men on patent matters, the more I realize how hard it is for them to make decisions in an unfamiliar field like that of patents. Patent thinking and engineering thinking are quite different. It is awfully hard, unless you have had a lot of experience in the patent field, to know how the patent people think.

For example, as an engineer, you may think that taking out a patent or not taking out a patent is an *optional* thing, but, it is not quite so. When Doctors Banting, Best and Collip developed insulin at the University of Toronto, as scientists, they did not like the idea of patents. Patents smack of commercialism. So their first inclination was *not* to patent.

Luckily, they got the good advice of a Toronto Patent Attorney. He said, "If you don't take out a patent, what's going to happen is this. You are giving the basic invention to the public. There is nothing to stop somebody else, five years from now, from making an improvement which is fundamental. Biological development moves very fast, and unless you take out a basic patent, you are at the mercy of this fellow with an improvement patent. He is going to corner the field."

So they took the attorney's advice and took out a patent. Exactly what he said would happen did happen. In about five years another man came along with a slower acting insulin. This was the really commercial product. Without the basic patent, they never would have been able to corral the improvement patent. They were able to buy it because the improvement patent wasn't any good without the basic patent. They got about 10 patents eventually from people who improved upon the original insulin. Toronto was thus able to control the field through their basic patent.

It is not wise for any technical man to make a judgement as to whether or not a thing is patentable. If there is any possibility that it is, the patent attorney should be consulted. Much time is lost by technical men in discussing whether or not a patent can be got by actually applying. It often takes years to find out. The best thing to do is "throw away your crystal ball", file an application, and leave it up to the Patent Office to decide.

I remember doing a job for Shawinigan Chemicals on carbon black acetylene black, which is used in dry-cell batteries. It has qualities that no other carbon black has. The inventors found that if they scraped the burner (introducing the acetylene into the cracking chamber), they kept the quality of the carbon black constant and uniform. There was a lot of debate among the engineers as to whether they should try to patent or not. Eventually they gave us the green light, but it took us six years to get that patent through. First we tried to patent the *uniform black* as a product and they wouldn't give us that. Arguing over the product held the application up. Eventually we got a patent on the process, and that process has been most successful. You simply cannot tell — and often there is no use trying to guess — what is patentable and what is not.

There is a question that is very often asked — what does 'patent pending' mean? All it means is that somebody has filed a patent application and may or may not get it. You don't have to worry, because anything you make before the patent issues will not make you liable for infringement. If it is a big plant or project, the one thing you have to watch is whether there is a large capital investment involved. If so you have to be sure you are not getting caught with a $200,000 plant on your hands and not able to make the product.

Conclusion

First, patent thinking and engineering thinking are poles apart. You can't solve patent problems with a slide rule. They are "value judgments". You might call them "guesstimates". A large margin of error usually has to be left, as compared, for example, with an engineering measurement which is usually exact.

Secondly, a little knowledge of patents may be quite helpful. In other words, an engineer may profit well by knowing a little about the time limits and a little about the other principles. You can never tell when you are going to run into a patent situation, and it helps you if you can recognize it early enough to get it to a specialist.

Finally, "patents are here to stay" and are a boon to Canada by encouraging industry to invest in this country.

The Impact of the New Plastics on Engineering

(Continued from page 414)

Looking at the situation from a material point of view, the industry in the U.S.A. and Canada found itself by the end of 1953 with an annual resin producing capacity of close to 3 billion pounds. Conservative estimates place the 1955 capacity at upwards of 4 1/3 billion pounds. This would represent more than 27 lb. of plastics available per capita per year, which compares with a probability of 1,600 lb. of steel and 20 lb. of aluminum per capita. In literally every resin field therefore we are unlikely to face sustained shortages in the foreseeable future. The promise of plastics' availability alone is proving to be a terrific inducement to technologists engineers and business men.

From the time new plastics come out of the test tube, engineers become involved in the building of factories, developing processes and designing equipment and machinery to produce these materials. Engineers are also closely allied to the manufacture of the final product and to its use and inclusion in parts of other equipment. Proper and accurate specifications must be carefully prepared to assure the desired qualities in the finished articles. The manufacturing of these articles must be accomplished by suitable machinery to keep the quality up and the cost down. All of these are engineering jobs, and are playing an increasingly important part in the lives of many engineers.

The author wishes to acknowledge assistance he has received from sources, including the Society of the Plastics Industry Inc.

Discussion of Technical Papers

Foundation Investigation for the Kitimat Smelter

by R. M. Hardy, M.E.I.C., Dean of Engineering, University of Alberta, Edmonton, and Charles F. Ripley, M.E.I.C., Consulting Engineer, C. F. Ripley and Associates, Vancouver

The Engineering Journal, November 1954, page 1460

R. Peterson, M.E.I.C.[1]

The Aluminum Company of Canada and their consultants are to be complimented on the courageous approach which has been taken in the solution of a difficult foundation problem rather than delaying this important project until the settlement pattern became more clearly evident.

The authors have mentioned that because of complex soil conditions accurate predictions of settlements were not possible utilizing conventional methods of testing and analysis. However, further elaboration on the reasons for the discrepancy between actual and predicted settlements would be of interest. Even the excellent observations which have been taken over a period of nearly two years have not yet positively established the magnitude of total and differential settlements that can be expected to occur. This is due in part to the fact that the settlement of the surface is the summation of the compression of at least three soil strata each having different properties and consolidation rates. Had it been possible to take elevations of subsurface observation points in the drill holes at the boundaries of the main soil layers more accurate predictions of future movements might now be possible. While the techniques for installing such devices in core holes in rock and in embankments during construction have been well developed the writer knows of no device satisfactory for installation in drill holes through the type of overburden at this site.

On many projects such as the one described, field observations are essential to finalize the design and grades. On other projects even where soil conditions are more favourable and less variable, making it possible to finalize the design in advance of construction, field observations of movements are highly desirable; first of all, to warn of any unforeseen conditions which might be critical and secondly, to verify predictions based on the application of soil test results. Further advance in some fields of soil mechanics is restricted because of a lack of reliable field observations to substantiate partly proven theories. In addition information on tolerable differential foundation movements beneath various types of structures is still very limited. It is therefore worthwhile to measure movements of earth structures and foundations resting on compressible soil. In some cases water level or pore pressure determinations are highly significant.

The value of the settlement observations taken at this site is apparent when it is realized that had no measurements been recorded prior to construction of the footings the grade adjustments would not have been possible.

F. Lionel Peckover, M.E.I.C.[2]

It is interesting to consider this paper in the light of some remarks made by Dr. Terzaghi, who has inspired many of the recent advances in foundation engineering, when he spoke to the Montreal Branch of the Institute in 1944. He considered then that the science of foundation engineering has passed through two stages in its development, the empirical and the scientific stage, before reaching the present and final one, which he called the state of maturity.

In the first or empirical stage, foundation design was made by trial and error, and native intuition played a major part in important advancements. The lessons learned from experience were often forgotten, however, and progress was intermittent and slow.

In the scientific stage, from about 1915, attention turned to the solution of problems by theoretical means on the basis of test data and a few fundamental assumptions. It seemed that there was no limit to the solutions available in this way, and foundation design appeared about to take its place beside the more rational procedures of steel and concrete design. However, it had been forgotten that soil, rather than being a single material, is an infinitely variable medium, and it was not long before practical applications of the theoretical approach demonstrated its deficiencies.

Now, in the third stage beginning about 1940, the pendulum has swung back. The enthusiasm of the mathematician has been dampened by the realization of the restrictions which Nature imposes on his assumptions. Theoretical analyses are still essential, but their conclusions are now considered along with observational data which both supplement and qualify the results obtained. Hence, in the opinion of Dr. Terzaghi, progress in this so-called mature stage of foundation engineering is made on a semi-theoretical, semi-empirical basis.

The paper which has been presented is a particularly good example of such an approach to foundation problems and the benefits which may result from it. The foundation analyses made from soil test data were tempered throughout by carefully planned field observations to obtain the desired results. In this instance, it is clear that a satisfactory solution of the problem would never have been possible without the use of this flexible, two-fold technique.

The soil conditions at Kitimat are most complex and difficult and the systematic investigation of these deposits to the depths described is a job of some magnitude and considerable interest. In particular, the recovery of relatively undisturbed samples of fine sand and silt from such depths is worthy of note on account of the great difficulties in such operations, and it is hoped that the authors may be able to give some details of the procedures which were used. Some idea of the cost of the soil exploration program in terms of the total capital cost of the smelter plant would also be of value.

It would be of interest to hear if in-place tests were made in the finer-grained soils with apparatus such as a penetration cone to classify soils

[1] Soil Mechanics Engineer, Prairie Farm Rehabilitation Administration, Saskatoon.

[2] Senior Assistant Engineer (Soils), The St. Lawrence Seaway Authority, Montreal.

according to consistency. In a co-ordinated soil sampling and testing program, the value of the results of such in-place tests should increase rapidly with depth as they reduce considerably the number of "undisturbed" samples which must be recovered and tested in the laboratory.

The paper has described an ingenious method of allowing for the differential and total settlements which were predicted. This prediction was based on a general knowledge of the distribution of soil deposits and the stresses to which they would be subjected, and time-consolidation curves obtained from tests in the laboratory. The actual settlement which has taken place in a typical location is shown in Fig. 98 (Settlement Gauge — Time Settlement Curve), and the rapid primary consolidation, which would be expected in a predominantly non-cohesive soil, is apparent. At the same time, the settlement curve shows that secondary consolidation is tending to continue at a more rapid rate than is normally found with compressible soils. It would be most interesting to have the authors' opinion on the cause of this phenomenon, and its possible effect on future settlements.

When a construction schedule allows, the surcharge-fill method is sometimes used to hasten the consolidation of soil beneath a building site where settlements are expected. This method consists in placing a surcharge of fill over that required in the final design and leaving it in place as long as possible. By this means the subsoil is consolidated at an accelerated rate until the extra fill is bulldozed off to make way for construction. As a result, settlement of the final structure is considerably reduced. At Kitimat, one would expect that this procedure would be especially effective on account of the rapid consolidation of the soil and the absence of appreciable rebound. However, it would involve double handling of a large volume of material and may have been considered uneconomical on that account.

The paper has demonstrated how a difficult foundation problem has been dealt with by engineering judgment of a high order. On account of its general interest, particularly in illustrating clearly the application of the semi-empirical approach to foundation problems, it is hoped that it will lead to a subsequent paper when the observations and construction described have reached an advanced stage.

G. G. Meyerhof, M.E.I.C.[3]

The authors have described an interesting application of soil mechanics principles to the design and construction of building foundations on an extensive site.

On account of the variable nature of the soil deposits, the observed maximum differential settlement of the foundations was of the same order as the average settlement, although the well-compacted fill acted as a raft, which decreased the variation of settlement over the site. Since the foundation movements were comparatively large and necessitated elaborate construction procedures I wonder whether preconsolidation of the soil by placing an additional height of fill which is subsequently removed had been considered. This procedure has been economical in many cases and would have been particularly suited to the present soil conditions because the authors found that about two-thirds of the total consolidation due to the weight of the fill occurred within one month after placing the fill.

It would also be interesting to know what settlement stresses, if any, have been observed by the strain gauges fixed to the steelwork of the carbon paste plant for comparison with the writer's previous measurements on a large steel-framed building in London.[4]

J. F. Braun, M.E.I.C.[5]

The excellent paper on the foundation design for the new smelter plant of the Aluminum Company of Canada Limited at Kitimat, will remain of lasting interest to all civil engineers. It is a great contribution to the general knowledge and appreciation of soil and foundation conditions likely to be encountered anywhere along the northern coast of British Columbia. It constitutes therefore a valuable source of reference for foundation engineers, in connection with future industrial developments which undoubtedly will take place in this region in due course of time.

The authors have presented in a clear and concise manner and in chronological sequence all steps taken, which were deemed essential for the design and construction of a suitable subfoundation for the large smelter buildings. The adoption of a compacted fill foundation blanket or pad as a base to support the buildings was a logical conclusion in view of the widespread extent of the building site, the existence of a 200 to 300 ft. deep underlaying strata of moderately compressible material, and the fact that a relatively deep fill was required in any case, to provide a level surface for the entire group of smelter buildings. On the other hand, the use of cheap hydraulic fill, available at practically no extra cost from the dredging operations of the adjacent ships channel, was equally well justified for the relatively unimportant storage area to the south of the potlines.

It has been pointed out that the trucked-in fill was laid up in 6-inch lifts and was compacted by multiple passes of 50-ton pneumatic rollers, which incidentally were available from the Kenney dam project. Although results obtained with this equipment were excellent, other means of compaction could have been employed, such as the depth or surface vibro-flotation process, which is particularly effective in loose, granular material, such as was used at Kitimat. This novel method however would not have prevented or minimized predicted settlements of the compacted fill, which settlements are entirely due to the consolidation of the underlaying strata of compressible material; nor would it have increased the bearing capacity of the fill.

The knowledge that limited differential settlements would occur during and after erection of the buildings was recognized, as far as possible, in the design of the structures. Maximum flexibility was therefore provided to prevent overstressing of individual structural members and to avoid possible future damage to the buildings. In accordance with the foregoing requirements, all steel building frames were designed on the basis of simple beams or trusses supported on pin connected columns. Calculations made, indicate that stresses induced by a differential settlement of one inch across the building bents are well within safe limits.

Furthermore, the design of the concrete substructure of the 1200-ft. long potroom buildings was arranged to permit making compensating adjustments in elevation at any time prior to the erection of the steel frames. Fig. 108 (page 1470, November issue, *Engineering Journal*) shows some of the details of the construction used. It illustrates the

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[3]Supervising Engineer, Foundation of Canada Engineering Corporation Limited.

[4]G. G. Meyerhof "Some Recent Foundation Research and its Application to Design". *Struct. Engr.* (London), 1953, Vol. 31, p. 151.

[5]Superintendent, Ore Plants, Aluminum Company of Canada, Limited, Arvida, Que.

individual spread column footings of a potroom building.

The lower precast curtain wall panels were set and shimmed up to predetermined elevations on the basis of forecast future settlements, in their respective locations, between the time of installation and the target date of January 1955 at which time the buildings are expected to settle to level position, at originally designed elevations.

These panels are provided with projecting reinforcing rods, anchoring them into the subsequently poured-in-place column pedestals.

Final adjustment was made at the top of the column pedestals and spandrel beams. This adjustment became necessary to take care of the adoption of a revised pattern of settlement, affecting both magnitude and rate of settlement, which became apparent only after construction had been under way for about 2 months.

The careful scheduling and coordination of pouring foundations, agreed upon by the combined field staff, after consultation with the foundation experts, was of major importance in minimizing the adverse effects due to future differential movements on adjacent structural elements of the completed buildings.

Our experience at Kitimat has clearly demonstrated that, with the free and close co-operation of the foundation consultants, the structural design engineers, and the construction staff in the field — the complex problems of temporarily yielding subfoundation can be dealt with successfully.

The Authors

The extent of the discussion of the paper is most gratifying to the authors and it has served a very useful purpose in emphasizing the essentials of the foundation problem involved.

Mr. Peterson asks for further elaboration on the reasons for the discrepancy between the actual and predicted settlements. It is essentially due to the variation in the subsoil conditions at the site. Even with the advantages of "hind sight" it is difficult to see how a sufficiently extensive program of subsoil exploration and laboratory testing could have been undertaken within the limitations of the construction schedule which would have permitted the settlement pattern to be predicted to a degree of accuracy that would have avoided field adjustments during construction. Even greater difficulties exist with such deposits in forecasting the rate of settlement. Moreover, even if the rate of settlement had been more accurately predicted the construction schedule precluded the use of conventional procedures such as preloading to increase the rate of settlement.

As Mr. Peterson suggests the settlement readings for the one gauge shown in Fig. 10 do not permit the magnitude of total and differential settlements to be positively established. However, an analysis of the complete settlement data available now permits reasonably accurate estimates to be made.

Mr. Peckover inquires concerning the sampling procedures used. Conventional drilling and sampling techniques and equipment were employed and no great difficulty was encountered in securing samples. The major troubles were the result of the isolated location and difficulties of access on the project during the early stages of the development. For these reasons the drilling and sampling costs were somewhat higher than average for Canadian conditions. Data concerning the actual cost of the foundation investigation in terms of the total cost of the smelter plant are unfortunately not available at this time.

In-place tests such as cone penetration tests were not used in the exploration program because in the comparatively deep test holes required at the site they would have seriously delayed the drilling and sampling program.

Mr. Peckover's comment concerning what is "primary" and what is "secondary" consolidation in the time-settlement plot shown in Figure 10 is of interest. His interpretation is similar to our own in the earlier stages of the progress of settlement. However, it is now evident that all of the settlement shown in Figure 10 is primary consolidation and the shape of the curve is the result of the comparatively rapid settlements in the granular materials at comparatively shallow depths being superimposed on the settlement curve for the finer grained soils at greater depths.

Both Mr. Peckover and Dr. Meyerhof raise the question of the possibility of preconsolidating the soil by use of a surcharge load. At the sites of potlines 1 and 2 the construction schedule was such that this method was not praeticable. Moreover its cost would have exceeded the cost of the field adjustments employed to compensate for the settlement. The method however is being used to a limited extent on certain areas at the site of potlines 3 and 4 and at speeific building sites in the dock area.

Regarding Dr. Meyerhof's request for information concerning the settlement stresses measured to date in the Carbon Paste Plant steel frame significant data as yet are not available. It appears however that in jacking the frame out of plump stresses were induced in the frame which are being relieved as the frame moves towards the plump position.

The Kitimat Harbour

by W. L. Pugh, M.E.I.C., Chief Engineer,
Aluminum Company of Canada Limited

The Engineering Journal, November 1954 issue, page 1451

Per Hall[6]

Mr. Pugh's paper on "The Kitimat Harbour" is a fine report on engineering and construction methods which have led to the successful completion of a large marine terminal on the west coast.

Problems related to site investigations do not seem to have presented anything of particular interest.

The design conditions would seem to be about normal with the exception of measures taken to ensure drainage of the backfill to avoid excessive lateral pressure during the falling tide. It is felt that the six-inch-diameter weep holes through the longitudinal walls may in time become ineffective. However, the 12-inch drain in the transverse diaphragms which can be cleaned out by mechanical means should be adequate to relieve excess hydrostatic pressure.

It is felt that a design stress for reinforcing steel of 20,000 p.s.i. is high for a structure continuously exposed to sea water. It is common practice to design for 12,000 to 15,000 p.s.i. under such conditions to avoid excessive cracking of the concrete when the reinforcing steel

[6]Vice-president, Foundation of Canada Engineering Corporation, Montreal.

elongates under tension. However, the relative proportion of steel and concrete may in this case have been selected to justify the higher stressing of reinforcing steel.

The launching method is particularly interesting in as much as the method of building the caissons on the side in a temporary graving dock is not commonly used in North America. In this case, where the height of the caissons is considerably greater than the width, it offers the advantage of much less water depth for launching purposes.

From Mr. Pugh's paper it appears that careful consideration was given to other launching methods, involving the use of a small dry dock in Prince Rupert from where the caissons could be towed to Kitimat, launcing from a rigid scow and launching from launchways. These methods were discarded for good reasons in favour of the graving dock method.

In this connection it might be worth pointing out that in Europe it is common practice to build caissons on the side when the height is greater than the width and such caissons have been launched, either from launchways or from graving docks. In the case of a large port in the Baltics a great number of concrete caissons were built on the side on dry land and later launched by dredging the supporting ground away starting at the bottom end of the caisson. In other instances, and that is particularly where large bridge piers are built by the caisson method, it has been found economical to build the caisson in an upside-down position and overturn it 180 degrees at the site of the future bridge pier.

Finally I should like to mention that The Foundation Company of Canada Limited has recently developed an entirely new method for launching of large concrete cribs which is being used successfully in connection with construction of a wharf section for National Harbour Board in Montreal Harbour at the present time. With this method a portion of the first caisson is built in dry dock, launched and covered by a watertight deck. The remaining caissons are then built on this floating platform which is provided with wing tanks just like a floating dock to assure stability when flooded sufficiently to float the caisson it has supported during its construction. This method facilitates the use of sliding forms for caisson construction. High grade concrete surfaces can be attained provided the operation of the sliding form and the pouring of concrete is properly controlled.

This method is essentially a refinement of the previously used methods of launching from scows but it is safer and more flexible and, last but not least, it is the most economical method of launching so far devised. For this reason we believe it is likely to be commonly adopted for marine caisson work in the future and the method might well be considered in connection with future extensions to the Kitimat wharf.

Dr. G. G. Meyerhof, M.E.I.C.[7]

The author has described an interesting design and construction of caissons for the terminal wharf.

In connection with the design of the caissons, I wonder why a variable thickness of 6 to 8 inches has been used for the central longitudinal wall while a constant 8 in. thickness was used for the internal cross walls of similar span. Moreover for a water structure where cracking and deterioration are to be avoided, a working steel stress of 20,000 p.s.i. would seem to be rather high, unless the sections have been checked on the alternative assumption that the concrete can resist tensile stresses, and unless such stresses are limited to say one tenth of the compressive strength. I wonder if this has been done in the present design.

In the author's section dealing with the foundation pressure and blanket, he mentions that for the submerged medium-dense sand with an angle of internal friction of 30 degrees the ultimate bearing capacity given by Terzaghi's formula is 12,000 p.s.i. According to this formula, however, the ultimate bearing capacity of the 49-ft.-wide caisson foundation on the surface of this sand is of the order of 30,000 p.s.i. This bearing capacity provides therefore an adequate factor of safety for the maximum toe pressure of 12,000 p.s.i. below the caissons so that, as far as the bearing capacity is concerned, there would have been no need to provide a rock blanket over the sand. Finally, it would be interesting to know what foundation movements, if any, were observed for the caissons.

Charles Miller, M.E.I.C.[8]

Mr. Pugh and his associates are to be congratulated on solving a most difficult wharf problem. Further the operation of careening or rotating the precast units into their final position certainly was a remarkable feature, which took foresight and courage to do.

I was amazed at the size of the units which were 250 ft. long, 45 ft. wide, and 60 ft. high. This caisson is larger than an ordinary canal boat. The building of these in an artificial basin and manoeuvering them into place was also a difficult construction task.

Summing up, engineering history has again been written, not only in the huge aluminum development and the expansion of Canada, but in a new construction method of building a huge terminal wharf.

D. H. Sharp, M.E.I.C.[9]

I was most interested to read Mr. Pugh's paper, particularly is it of interest to see how obstacles of tide and location have been overcome on the West Coast while we have been busy with similar problems on the East Coast.

I think the method of construction most ingenious and it certainly appears to meet the needs of the situation. The finished dock looks like a workmanlike job and as Mr. Pugh has pointed out was placed very close to the desired location.

I have some questions on design and construction and they are as follows:

1. I note there was a very large tide variaton, 22½ ft., and temporary dock facilities must have been necessary but rather hard to provide. Will the author please tell us how these facilities were provided.

2. The location seems to be well sheltered from three directions, but quite vulnerable from the fourth side, and the paper makes mention of waves 7 ft. high. What loss of time was suffered due to bad weather on this account ?

3. We note that there is not any toe on the land side of the caissons and are rather surprised that this was not added as it would have provided further stability.

4. We would inquire what type of bollard was used. This is of interest due to the high tide variation which added to the variation of the draft of the ships must lead to quite a sharp angle on some of the mooring ropes.

5. Again I am interested in the type of fenders described and wonder if there is any precedent for this type on the West Coast.

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[7]Supervising Engineer, Foundation of Canada Engineering Corporation, Limited.

[8]Consulting Engineer, Montreal.

[9]Project engineer, C. D. Howe Company Limited, Montreal.

6. The author mentions the decision to use boulders instead of 18 in. stone. We wonder if there was any trouble with these during dredging, or were they obtained from beyond the dredged area.

7. The author has called for quite close tolerances when dragging the gravel fill below the caissons and shown a picture of the equipment above water. I would be interested to know just how it was possible to check depth so closely and am rather surprised that weather conditions permitted this work to be done to such close tolerances.

8. What is the length of the shipping season ?

9. Can ships stay berthed during rough winds and high seas ?

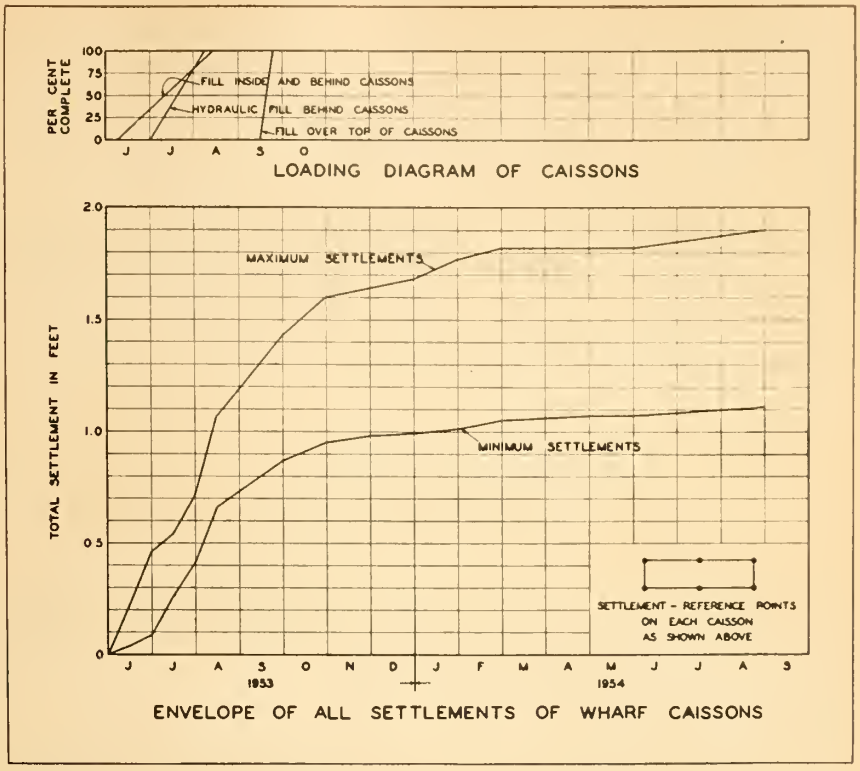
The Author

I would like to submit the following comments regarding the questions raised in the discussions submitted on my paper entitled "The Kitimat Harbour":—

Mr. Hall expresses some concern regarding the possibility of the 6-in.-dia. weep holes becoming clogged in time. As explained in the paper, this possibility does exist although it is felt it is rather a remote possibility with the porous rock and gravel backfill. The most important weep holes located along the caisson front wall are always accessible for cleaning at low tide.

Both Mr. Hall and Dr. Meyerhof have questioned the use of a design stress in the reinforcing steel of 20,000 p.s.i. This stress does exist at some locations and results from combined bending and direct tension stresses. Most of the steel, however, is proportioned for a lower stress of around 18,000 p.s.i. It is felt that this is conservative as the designs are based on theoretical fill pressures on the walls. Actual pressure loading on the walls from the rock and gravel fill packed into the cell compartments probably is very much less than the theoretical loading, and the danger of excessive cracking of the concrete should be very small. The concrete has not been considered as taking any tensile stresses.

Dr. Meyerhof has questioned the variable thickness of the caisson cell walls. The thickness of each of the transverse diaphragm walls is 8 inches. This is the minimum thickness specified for pouring a vertical reinforced wall. The central longitudinal wall was poured in a horizontal position as a slab with a minimum thickness of 6 inches. The greater thickness of the lower part of this wall is required for bending stresses due to the pressure from the water ballast during the careening operation.



Dr. Meyerhof has also questioned the ultimate bearing capacity of the soil under the base of the caisson as figured by the Terzaghi formula, and the need for the rock blanket. This formula is not based on a very exact science and different authors have different interpretations for the bearing capacity factors or constants in same. I assume that this is why Dr. Meyerhof obtains a different bearing value from that of the consulting engineers who made the original design. Besides the distribution of the wharf load over the original sub-soil, the rock blanket provides a drainage path under the caisson to prevent sand boils and piping when the tide is ebbing. This factor is an important design consideration for such a structure arrangement.

Mr. Sharp has raised several questions concerning the design, and I will answer these in the same order:—

1. A temporary creosoted timber pile wharf was built at the start of construction and was located about three-quarters of a mile south of the permanent wharf. This wharf construction is described in the companion paper "Design and Construction of Kitimat Smelter" and is located at point "A" in Fig. 101 of this paper.

2. Waves with a maximum height of 7 feet were specified as a design condition and have occurred at some time in the available historical records. However, no waves of this magnitude occurred at any time during the construction period.

3. A toe on the land side of the caisson base slab would have added to the draft of the caisson for launching and also the depth of the casting basin. It was not needed to spread the foundation loads as the base pressures are trapezoidal in shape with the maximum pressure at the edge of the toe slab on the water side of the caisson.

4. The bollards used were 14-inch horned bollards and are located close to the face of the wharf. This type of bollard has been used extensively in eastern harbours with high tidal variations quite successfully.

5. The floating fender system described is used extensively on the West Coast, as well as at many other eastern locations. It operates quite successfully where tidal variations are large.

6. The boulders used in the fill were not obtained near the wharf site.

7. It was a very difficult task to get the crushed rock blanket under the caisson leveled properly. This was accomplished by the repeated use of the steel drag attached to the dredge going over the area many times. I doubt that it was possible to adhere too closely to the specified tolerance of plus or minus 3 inches.

8. The port of Kitimat is open for shipping the year round.

9. No difficulty has been experienced so far in docking vessels at the wharf due to weather conditions. The alignment of the wharf is in line with the prevailing winds which are either up or down the valley, depending on the season. The high mountains on either side of the valley prevent severe cross-winds.

Dr. Meyerhof has expressed interest in the settlement movements of the caissons, and I think this may be of interest to others as well. Settlement observations were made of each corner of each caisson, as well as the midpoints of the outside longitudinal walls of each caisson. The enclosed diagram illustrates the envelope of the maximum and minimum settlement readings, as well as the rate of loading on the caissons. The settlement of the water side of the caissons was less in all cases than the backfill side of the caisson.

The Kenney Dam

by Harry Jomini, M.E.I.C., Resident Engineer,
Aluminum Company of Canada Ltd.

The Engineering Journal, November 1954, page 1386

John Kilgour, Jr.E.I.C.[10]

I would like to offer my congratulations to the *Journal* for the very fine job that was done on the Alcan Nechako-Kemano-Kitimat Development in the November issue.

I have read the paper entitled "The Kenney Dam" by Harry Jomini with great interest and could not help comparing it with a similar paper by D. J. Bleifuss and J. P. Hawke called "Rock-Fill Dams — Design and Construction Problems", which was presented at the 1953 convention of the American Society of Civil Engineers.

I noticed that Fig. 9, on page 1394 of the *Journal*, "Sluicing dumped rock-fill" is similar to Fig. 15 in the Bleifuss and Hawke paper entitled "Wrong way to sluice". Bleifuss and Hawke say "The streams, or better, jets (of sluicing water) should . . . be directed toward the face of the rock-fill slope, never parallel to or down it".

In addition, I would like to object to the use of the term "clay-fill" by Mr. Jomini. The reasons for this are as follows:

1. The maximum amount of clay in the impervious core material was 30 percent while the minimum amount of sand allowed was 50 percent. This would place the material in the range of a clay sand or a silty sand.

2. Many people think that the ideal impervious material for a dam is clay. Nothing could be farther from the truth and is especially not so for sloping core rock fill dams. In fact, it is doubtful that the sloping core of Kenney Dam would have been considered in design if the impervious core material had been clay. Its low shear strength would have made it unsuitable. It is the sand that gives structural strength to the Kenney Dam.

I think that the term "clay-fill" might be misleading to some people who might some day have to look for or consider impervious fill material.

The Author

I would like to thank Mr. John Kilgour, Jr., E.I.C., for his complimentary remarks and to state that, in writing the paper on the Kenney Dam, I wrote it in such a manner as to make it readily understood by the layman as well as the technical reader.

Mr. Kilgour makes a comparison with a similar paper by Messrs. D. J. Bleifuss and J. P. Hawke called "Rockfilled Dams — Design and Construction Problems" and notes that Fig. 9 on page 1394 of the *Journal* is similar to the illustration in the Bleifuss and Hawke paper entitled "Wrong Way to Sluice" and that streams, or, better, jets of sluicing water should be directed toward the face of the rockfill slope, never parallel to or down it. I quite agree with Mr. Kilgour's comments and might say that shortly after this picture was taken the operation of sluicing the dumped rockfill was changed. Large 4-in. hydraulic monitors were mounted on heavy, steel, cantilevered beams which extended out beyond the slope of the rockfill some twenty-five feet or more and the jets of sluicing water produced by the monitors were directed back towards the face of the rockfill slope in order that the fines might be washed into the voids between the larger pieces of the fill rock. I might say that the hydraulic giants were ingeniously air-operated and could be actuated at any angle vertically or horizontally by the operator stationed at the monitor simply by turning one of the two quick-acting valves.

Mr. Kilgour, in addition, objects to the use of our term "clay fill", stating his reasons. Again, I agree with Mr. Kilgour. However, as I have pointed out that the article was written for both the layman and the technical man, I have included the word "clay fill" which was the term used on construction by the many men working on the project to differentiate between it and the other components in the dam construction. I would ask Mr. Kilgour if he could suggest a better term as I know of none to describe succinctly this particular mixture of clay and sand.

The Editor invites discussion
on papers
appearing in the *Journal*

[10]Soils Engineer, H. G. Acres & Co., Niagara Falls, Ont.

Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

MAN AND MACHINE BETWEEN ATMOSPHERE AND SPACE

Heinz Haber, *Aeronautical Engineering Review*, v. 13, n. 11, November 1954, pp. 56-61.

Since the beginning of flight our vertical advances have been measured in feet above sea level. Feet of altitude are used in compiling data of ceilings and altitude records of aircraft. We must realize, however, that in doing so we use an arithmetic measure while traversing a zone—namely, the atmosphere—in which the principal physical characteristics—density and pressure of air—decrease in a geometric progression.

The region of the atmosphere where its various functions for man and machine begin to cease and where space-equivalent conditions are gradually approached is called the "aeropause". The aeropause encompasses approximately the region between the 10- and 120-mile levels; this region is equivalent with the upper last 12 per cent of atmospheric mass. We recognize that present, and future, altitude flights take place in the region of the aeropause. During these flights, the failing functions of the atmosphere must be replaced by artificial means in order to enable man and machine to operate at these heights successfully.

Further Progress

Any further progress in the direction of greater altitudes can only be made with the use of the rocket engine. This type of engine, however, consumes fuel at such high rates that we are forced into adopting a radically new type of operation of aircraft—that is, attaining a great velocity during a brief period of powerful propulsion and following through the rest of the trip by coasting with dead engines. From this principle it follows that the maximum attainable altitude and the duration of flight are dependent upon the maximum velocity of the rocket craft.

We must indeed expect that any further progress into the aeropause beyond the height reached in the past will have to be accomplished in coasting maneuvers because the structure of the atmosphere appears to be unsuitable for sustained flight.

Two Basic Conclusions

From an examination of certain aerodynamic facts, and their interrelated effect, two conclusions are reached:

(1) For a long time to come manned flight will be restricted to the aeropause and will last between 3 to 6 minutes only. Upon approaching a speed of 4.5 to 5 miles per second, aviation will develop into space flight in an extremely rapid transition.

(2) We are about to enter a new phase of operation of aircraft which will lead into what can be called space flight for a limited period of time. Once we have reached a speed of about 1 mile per second in manned flights, the conditions to which man and craft will be subjected will not change materially all during the period when the speed of airplanes increases to about 3 miles per second.

At heights above 25 to 28 miles the atmospheric ozone no longer affords protection against ultraviolet radiation from the sun. Buettner has evaluated the hazard to health from these radiations using available data on the biological effectiveness of ultraviolet rays and on atmospheric ozone. His results indicate that erythema of the skin and damage to the eyes can be expected to occur in the aeropause 10 to 50 times faster than at sea level. This means that an exposure to solar radiation above the ozone layer lasting a few minutes only will have damaging effects. For this reason, window materials capable of absorbing ultraviolet light must be used in all vehicles designed to fly in the aeropause.

Visual Problems

At greater altitudes visual problems arise because the diffuse illumination provided by the light of the sky becomes more and more attenuated. These problems deserve attention even though the exposure is short, because degree and kind of illumination inside and outside the cockpit are of great importance for the visual comfort of air crews.

Progressing to greater altitudes, the number of air molecules above the observer is gradually depleted, and, as a consequence, the light of the sky decreases. By the same token, the pilot of a high-flying aircraft is partially deprived of the diffuse illumination provided by the light of the sky, and he finds it increasingly more difficult to perform visual tasks such as reading instruments and orientating himself inside the cockpit. For this reason it becomes necessary to obtain information concerning the attenuation of the light of the sky at increasing levels of altitude.

Owing to the decreasing brightness of the sky with increasing

altitudes, stars become visible during the day. The observability of stars at higher altitudes is of aeronautical interest insofar as celestial objects other than the sun can be used for purposes of celestial navigation.

Discomfortable brightness contrasts will be encountered inside the cabin of a high-flying ship where sunlit patches will be seen adjacent to deep shadows. Owing to the small illumination afforded by the light of the sky, the interior of the cabin will be rather dark, making orientation inside the cockpit and the reading of instruments difficult or impossible. These conditions of lighting will produce fatigue, strong visual discomfort and glare.

Weightessness

If a rocket airplane, coasting with dead engines, operates at extremely high altitudes, little or no force will be exerted on its occupants, since the aerodynamic forces of lift and drag gradually vanish in the aeropause. These mechanical conditions result in the partial or entire loss of weight on the part of the occupants. It follows that the craft and its occupants become weightless, as soon as lift and drag vanish. We then recognize that the coasting phase in the operation of aeropause vehicles will be attended by a novel factor of man's mechanical environment, namely, the phenomenon of weightlessness.

The experimental results on the effects of weightlessness obtained so far are based on a duration of this state lasting up to 30 seconds. No immediate conclusion can be drawn as to its effects if the exposure is prolonged to durations of 4 to 6 minutes. The observations made during the short periods, however, indicate that weightlessness occurring during flights in the aeropause will demand the attention of the medical research workers in the field of aviation medicine and space medicine.

The human problems of flight in the aeropause—which constitutes the frontiers of flight in the next future—will differ from today's problems only by degree. The only exception is weightlessness, which will be a novel experience for air crews. Barring any undue surprise in man's ability to live and perform under conditions of weightlessness, it appears that man will be ready to fly in the regions between atmosphere and space as soon as the engineer will furnish the machine that can do the same.

PRACTICAL FOUNDRY APPLICATION OF RADIOISOTOPES

V. G. Behal, *Canadian Metals*, v. 17, n. 8, July, 1954, pp. 22-23.

One of the many practical applications resulting from pure research in atomic energy was the development of artificially produced radioisotopes.

This article describes some of the uses and benefits derived from the inspection of steel castings by means of a Gamma-Camera with an Iridium 192 source, as employed at Dominion Foundries and Steel Limited, Hamilton.

The Camera

The camera is merely an elliptical lead housing, equipped with a lead door, which may be opened or closed without hazard of exposure to the operating personnel. The camera, complete with source, weighs 36 pounds. The source is located in the centre of the camera and exposure may be made by simply opening the door, which permits the gamma-rays to be emitted at a 60° angle, through the opening.

For panoramic set-ups: that is, where a number of exposures are to be made simultaneously on different castings, which may be advantageous from the production point of view, the source may be projected by remote control, through the door opening, enabling the radiographer to utilize, to the best advantage, radiation throughout 360°, in all directions.

While other types of sources and cameras are available, the advantages of the type used lie in the portability of the equipment, the ability of Iridium 192 to produce radiographs of two per cent sensitivity in steel sections of from ½" to 2½" thick and the particular type of radiation qualities emitted by this source.

The half-life of Iridium 192 is approximately 70 days, which means that it takes this period for the amount of radiation emitted to be reduced to one-half of its strength at the start of the 70 day cycle. After another 70 days, a further reduction of one-half strength occurs and so on.

No Risk to Operator's Health

With the type of radiation emitted by Iridium 192, because of its relatively low wavelength, as compared to that of radium or cobalt 60 or "soft" radiation, high strength sources may be used without jeopardizing the health of the operating personnel. Further, by using initially high strength sources, replacements are not required for several months and the decline in radiation output is compensated for simply by increasing the time of exposure.

While the use of radiographic examination of castings is now new, radioactive isotopes offer certain advantages over the methods employed in the past, using x-rays or gamma-rays produced by disintegration of radium.

Since the advent of non-destructive testing in general and radiography in particular, it has been possible to inspect each individual piece of material more thoroughly than was formerly possible by destructive testing and still place the fully inspected part into service.

Another advantage lay in the fact that flaws which would eventually cause the failure of a part could be detected prior to its being placed into service; further, the flaw could be frequently detected in an early stage of production, thus saving costly machining operations of material destined for eventual rejection and finally, in the foundry, to allow for complete examination of pilot castings and the study of effects of individual improvements upon the castings as a whole, until a perfect pilot casting has been produced and a major production run might be started.

The Particular Advantages as Against X-Rays

The particular advantages of isotopes as against x-rays are the low initial investment, portability, low maintenance costs and ease of operation. Compared to radium, the advantages are the availability of sources stronger, and therefore faster, than could be commercially possible from the point of view of initial cost and protective facilities with an equivalent amount of radium, and further, the diversity of the available isotopes, by far more suitable for specific applications than radium; the sensitivity, in light alloys or thin sections of steel with radium is rather poor and the price of radium and protective shielding required for an amount capable of radiography of heavy sections of steel such as 6"-8", would be commercially prohibitive.

SUPERVISORY AND TECHNICAL PERSONNEL

E. T. Hart, *SAE Journal*, v. 62, n. 10, October, 1954, pp. 51-53.

Expanding industry is confronted with a shortage of management and technical personnel. There is need for an ever-increasing number of trained men and an equally pressing need for extensive training of all ranks of supervision.

Twenty years ago, the foreman was not much troubled by budgets, cost control, labor contracts, employee relations, and the like. Now he must be familiar with, if not expert in, all these subjects to do his job effectively. Training him to meet these demands will make him a better foreman and pay off in a better running organization.

Today's job of developing a team breaks down into four parts:

1. Selection of the most apt, talented and best suited man.
2. Training the man for the peculiar skills needed.
3. Trying to improve the skills of the man who was poorly selected.
4. Following up to insure a man's proper placement.

Where to Find Good Men

The findings and proper assignment of men to take over supervisory and technical positions is a difficult task. Competent superintendents don't walk in off the streets; really effective foremen don't appear out of thin air. Yet they must come from somewhere, and they do. They come from all over the place—from work benches, from the job level just below, from colleges, and from other, sometimes rival, companies.

The colleges are supplying personnel in ever-increasing numbers. The college recruiting program, now used by practically all large companies, draws to industry the best of the technical graduates. These men respond to the offer of a good job, well paid, with opportunities for advancement and get a training program to insure getting ahead. Generalities may not move the prospective engineer to join your organization, but specific plans for the future may induce him.

To retain promising supervisory personnel you must show them the ropes, demonstrate the opportunities for advancement. This is being done more or less successfully through training programs.

The kind of training program depends largely on the size of the organization and the peculiarity of replacement requirements. A small, non-expanding company, may have a fairly simple program. A small, expanding company may have a more complicated one, while a large corporation will require some sort of program if they are not to be faced with a problem when supervisory employees die, quit, or retire.

Should training be done by the line organization or by specialists? Proponents for the line hold that the man doing the job is best qualified to teach because he is familiar with requirements. Those who believe specialists should be used, think skill in applying efficient testing and training devices and procedures is most important. Actually, a combination of the two has been found the best.

Type of Training

Should training be given on an individual or group basis? This depends largely on company needs and the objective of the training. Group training can be effective in disseminating information, training in human relations, explaining company policy and the intricacies of labor contracts. Here the specialist can be used to advantage. But individual training is important, too. The superior should take a hand and see to it that the man below him is well trained. It is not enough to suggest available lecture courses and technical discussions; the supervisor must play an active part. It isn't always done—sometimes it is impossible—but the need is recognized. As one expert puts it.

"I think the sort of unspoken aim of all of our group supervisory training programs is to get the supervisor to carry out individual development programs for the people under him. That is true from top to bottom of the organization".

Training Technique

In preparing men for advancement, some organizations use industrial psychologists to guide and counsel those who supervise in the better understanding of the men under their control. Understanding why men react as they do helps the foreman or superintendent to handle situations which might become ticklish without that understanding. There is also need to understand the individual and his particular situation. Even a good workman is not at his best when plagued with domestic trials or financial difficulties. Playing the role of family counsellor is difficult for a supervisor, but to be aware of troubles is of inestimable help in the improvement of human relations.

It is almost impossible to achieve the desirable supervisor-subordinate relationship if the group is so large that the supervisor hardly knows the men's names or their personal idiosyncrasies. Employees work together better, know each other better, and feel more intimately associated with the company if they consider themselves an important part of a group, no matter how small. This sense of belonging is acquired better in small units where identity is not lost.

One company holds fortnightly meetings of supervisory personnel on what is called "current events". Emphasis is on labor relations. At each meeting a different group is brought up to date and information passes by word of mouth.

Another company uses a module conference plan. There are eight sections dealing with such topics as personnel administration, job planning, job problem, and so forth. Sections may be used singly or in combination. Specialists are used for some parts of the program, and material is provided to help in the conference.

Now in development is a program in which supervisory personnel make up their own job programs, listing requirements of the job and outlining methods they think best suited to achieve training in those requirements. All information thus derived will be pooled to help in developing a successful program.

Rating a Training Program

To measure the results of a training program, a factual rating can be made of what supervisory and technical people are doing on their jobs. Instead of relying on subjective opinion we can take a cold look at such things as:

What have our technical people developed that is new?

What have they done to improve a product and make money out of it?

What have they done in their design to facilitate tooling and manufacturing processes?

Of supervisory personnel we can ask such questions as:

Does he get quality and quantity?

Is he running his department efficiently?

What is his labor turnover?

What is his safety record?

Does he operate within his budget?

Do his employees turn in suggestions ?

How much scrap is made in his department ?

What about his use of tools and processes ?

Does he know his people ?

What is his grievance record; how well handled ?

If a training program is aimed at things of this nature then all we have to do is examine the performance to know whether or not we are getting the job done.

OUR PRIMITIVE NEIGHBOURS

Civil Engineering and Public Works Review, v. 49, n. 579, September 1954, p. 927.

Day by day there is news of some new engineering enterprise that brings the engineer in contact with peoples of a much lower stage of cultural development than that of the western world. These contacts throw a great responsibility on the men who control these undertakings. Too often the seed of much labour or political trouble is sown in the early days of a construction job.

How far has the engineer any responsibility for the results of these contacts ? Legally, perhaps none, but morally, much. Certainly his self-interest demands that the burden of this problem shall be shouldered in addition to his professional duties.

The Tragedy of Expansion

The history of the spread of civilised man over the many sparsely populated parts of the world has not been devoid of tragedy and the creation of many problems both social and political. Those who have followed the expansion of any of the great colonising powers must at times have been moved with the deepest feelings of sympathy and pity for the primitive races which have had the misfortune to lie in the advancing path of the expanding powers.

That this expansion brought hardship and tragedy to those who stood in the way of these more progressive people is no new phenomenon. The Assyrians and the Egyptians, the Hittites and the Mitanni cared little for the feelings of the early inhabitants of Palestine. When the Moguls invaded India and the Mongols invaded China there was little regard for the toiling masses of those lands. It was only the need of the conqueror that was of any account.

Even today so-called civilised peoples at times pay but scant regard for their less fortunate human beings. It can be said, however, that where the Christian rule of life and behaviour is recognised as the desirable standard, there has grown a recognition that however hard the personal needs may press, those of others must be respected. Needless to say, this code of behaviour is not attained by many, but at least it is the goal for which the western world in its imperfect way strives to attain.

It is often said that all the world is known and that there is no more to be discovered. This, in a broad general way, may be true, but it completely ignores the fact that while the surface of the earth, from a physical geographical point of view, may be known, it has not yet been explored.

Year by year the expansion of civilisation is encroaching on these undeveloped areas. There is no part of the world that is not witnessing this taming and subjugation of the marginal lands. In Australia, in Brazil and especially in Canada, this drive of civilised man is eating into the edges and even the heart of areas inhabited by a few backward primitive people. Similar waves of expansion have occurred in the relatively near past. The history of these make sad reading in three particular cases, viz., Tasmania, Tierra del Fuego and certain areas of arctic Canada. The suffering that these expansions of civilisation brought to the native populations of these places is a tragedy indeed. Where are the aboriginal inhabitants of Tasmania, the Ona and the Yaghans of Tierra del Fuego and the Ilhalmiut of Canada ?

The Engineer's Problem?

What has all this to do with the engineer—especially the civil engineer ? At first sight there appears little connection between the problem of the preservation of some small primitive tribe of hunters and the work of the civil engineer. The engineer is often, especially when it comes to the development of untamed lands by means of roads, and dams and power stations, the first to come into real contact with these primitive people. He is the first to do anything that in any important way disturbs the balance of nature and so to dislocate and often completely destroy the very foundations of the life of local tribes.

Work, as understood by civilised man, is something quite incomprehensible to these primitive people. The food of the European and even clothing itself can be a curse to their hardy weather-exposed bodies. The problem of the handling of these people on the early impact with civilisation must be solved by the individuals concerned or the tragedies of the past will be reenacted in the future. It is not a problem for governments only. By the time governments, with their sluggish and somewhat cumbersome machinery, have been able to move, the trouble has begun and the tragedy is fast moving to its inevitable end.

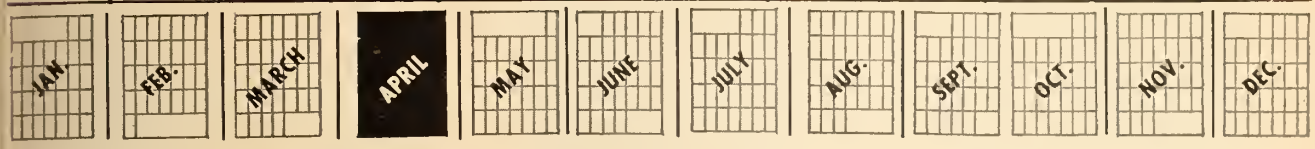
The pioneering civil engineer can at times be faced with this great moral problem of the proper relationship between himself and the primitive. The proper solution of his problem may well determine the fate of a whole tribe or race, to say nothing of the creation of future political difficulties that may conceivably nullify the value of all his skill and all his labour. Every engineer on work in the "outback" dare not neglect relations with his primitive neighbours.

ANNUAL MEETING

Toronto, Royal York Hotel, May 11, 12, 13, 1955

The program of the Annual Meeting appears on pages 473-476 of this issue.

Month To Month



Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Architects Versus Engineers

The relationship between the work of architects and the work of engineers has been an interesting subject for discussion, even for dispute. The most recent development in this field has taken place in Toronto. The Ontario Association of Architects brought a firm of consulting engineers into court on charges of holding themselves out as architects "contrary to the provisions of the architects' act".

The case was heard before Magistrate Elmore, and in his good judgment the charges were unfounded.

The *Journal* is pleased to be able to present herewith a copy of the judge's ruling. Doubtless every member of the Institute will find it of interest.

Toronto, Ontario,
Friday,
February 11, 1955,
2 o'clock p.m.

Judgment

The Magistrate: This case is a charge against A. D. Margison and Associates Limited, a Toronto corporation, alleging that they did, during a certain period, hold themselves, or itself out as an architect, contrary to the provisions of the Architects' Act of 1950 and amendments thereto.

The Architects' Act provides that every person or corporation who, not being a member of the Association, or having been a member, and who has been suspended, and so on, applies to itself the term "Architects," alone, or in combination with any other term, or which holds itself out as an architect, shall be guilty of an offence.

The Act also provides that nothing in this Act shall prevent, or be deemed to prevent any partnership, association or persons or corporation that is entitled to practise under its own name, under the Professional Engineers' Act, in accordance with the conditions therein prescribed, from performing architectural services in the course of any work undertaken, or proposed to be undertaken by such partnership, corporation or association, as pursuant to the Act.

The defendant, it is conceded, are entitled to practise under their own name under the Professional Engineers' Act. Under the Professional Engineers' Act, it says that a professional engineer is a person who practises professional engineering.

Professional engineering is defined to mean the advising of, the reporting on, the designing of, the supervision of the construction of, among many other things, steel, concrete, and reinforced concrete structures.

I am of the opinion, in the light of the evidence, that the defendant here was asked to do, and did so advise on—that is rather to indicate that they were prepared to advise on, on the designing of, to report on the designing of, the supervision of the construction of a steel, concrete and reinforced concrete structure; and that anything they offered to do, and work that they would perform, though the services would be architectural, they would be work properly undertaken or proposed to be undertaken by them as professional engineers.

I find that the accused did undertake to do this work, or offered to undertake this work as engineers.

Reference was made to one of the employees in the defendant's office, making reference to his certificate as an architect. I do not think I need go into that, but, if, even though the word "architect" seems very important in this case, yet I think it was just an incident that reference was made to that.

The accused, through their employ made perfectly clear that as professional engineers they were prepared to undertake what they intimated they would.

Cover Picture

An aerial view of Toronto taken from the vicinity of the Harbour Commissioners Building. The large building on the extreme left is the Royal York Hotel at which the 69th Annual General and Professional Meeting of the Institute will be held—May 11, 12, 13, 1955.

Canadian Pacific Railway Photo.

There was further mention made of the fact that under one of the clauses in the Act, that offering to prepare the plans of over the value of $10,000, for a fee, would in itself constitute a holding out that they were architects.

In view of the fact that professional engineers are taken right out of the Act, with respect to architectural services, undertaken in the course of any work, by them as an engineers, that section would not have any bearing.

For these reasons the charge must be dismissed.

CERTIFIED CORRECT

(sgd) A. Spitzer

OFFICIAL COURT REPORTER

Extension for Juniors

It will be of interest to all members, but of special interest to Juniors, to know that at the February meeting of Council it was agreed unanimously that the time limits in by-law section number 9, which relates to Junior members, have been extended by a period of two years.

This will mean that in the future a person may remain in the classification of Junior for nine years after graduation instead of seven years and may transfer then without payment of transfer fee. Or he may remain as a Junior for ten years (instead of eight years) and then transfer to Member classification but with the payment of a transfer fee.

This change has been made possible by virtue of the by-law itself, which states "Council may extend the above limits if, in its opinion, special circumstances warrant such extension". The special circumstances that apply now are that Council is encouraged to believe that some satisfactory form of confederation will be established shortly, and that it would be advisable to permit Juniors to remain in their present classification until confederation is realized.

This change in the regulations should be advantageous to Juniors. It will give them two years more of training, with natural increases in income before it becomes necessary for them to pay out the substantial increase which is necessary upon being transferred to Member. Council is quite hopeful that this extension will be welcomed by all Juniors.

Life Members Meet

The Life Members in and around Montreal held a social gathering in the auditorium of the Institute on Thursday, February 17.

The Institute's new film Leonardo da Vinci was shown for the first time to an Institute audience. It was particularly appropriate that the Life Members should be the first to see it, in view of the fact that from their own funds they have contributed $1,000 towards the $4,000 cost. This very generous gesture has been much appreciated by the Council of the Institute.

The meeting assembled at six o'clock and a light buffet supper was served. This gave many of the members an opportunity to talk with old friends who, in many instances, they had not seen for a long time. Altogether it was a very happy occasion.

In this issue of the *Journal* there are reproductions of a few photographs taken on this occasion. Members in various parts of Canada will see in these pictures faces of several old friends who, in the past, have rendered a real service to the Institute. Incidentally there is a scattering of younger "fry", inasmuch as some members of the executive of the Montreal branch were also present.

Another pleasant feature of the gathering was that Dr. D. M. Stephens, the president of the Institute, and Mrs. Stephens were in the city and were able to participate in the meeting.

It was the general opinion of the Life Members that the Leonardo film was an outstanding accomplishment, and they were fully justified in assisting the Council of the Institute in purchasing it for showing before all the branches.

Distinguished Visitor

Sir Hugh Beaver, M.E.I.C., of London, England, was a visitor to Montreal on March 17. That evening he delivered a paper before the Montreal Branch dealing with air pollution, and at noon he was guest of the Institute at a luncheon, and in the evening the guest of the Montreal Branch for dinner.

Sir Hugh joined the Institute as a Member in 1937. He is not a stranger to Canada, inasmuch as he gets over here every four or five years in connection with business for his company. He is managing director of Arthur Guinness' Son & Co. Ltd.

In 1952 the City of London experienced a major disaster during

Sir Hugh Beaver, M.E.I.C.

which approximately four thousand people died from the results of air pollution. Shortly thereafter the United Kingdom Government set up a committee to investigate the causes of such incidents, and to make recommendations of means by which they might be avoided in the future. Sir Hugh was chosen as chairman of that committee.

This year he was chosen as the Calvin W. Rice lecturer by the American Society of Mechanical Engineers. He spoke before that organization at a special session dealing with air pollution, which was held in New York in March. Between that time and his visit to Montreal he has been in several other cities including Detroit and Toronto. From Montreal he went back to the United States where he is making a further tour to study air pollution conditions in a number of cities.

Sir Hugh has been active in a number of organizations, including

the Institution of Civil Engineers, the Institution of Chemical Engineers. Last year he was chairman of the British Institute of Management.

He is a director of the Colonial Development Corporation, governor and honorary treasurer of Wellington College, member of the court of governors of the London School of Economics, and chairman of the Shoreditch Hackney & Highbury Housing Association.

For a long time he was a partner in the firm of Sir Alexander Gibb & Partners, and some years ago did a lot of work for that firm on the harbour at Saint John, N.B. From 1940 to 1945 he was director general and comptroller general of the Ministry of Works, and in 1946 and 1947 he was a member of Lord Reigh's committee on New Towns.

Fellowship Offered

The Canadian Good Roads Association announces that Armco Drainage & Metal Products of Canada, Ltd. has offered a fellowship, valued at $2,000, for award by the Association to assist a Canadian engineer to take postgraduate study at a university in the United States in any phase of highway engineering, such as construction, highway and bridge design, traffic control, safety studies or highway economics. The fellowship is tenable for one academic session and preference will be given to candidates wishing to attend courses of a type not available at Canadian educational institutions.

Applications for the academic session 1955-56 should be submitted to the Canadian Good Roads Association, 270 MacLaren Street, Ottawa 4, on or before May 15, 1955. Applicants should state their age, marital status, educational qualifications, experience in highway work, their special field of interest in the highway engineering enterprises and the educational institution at which they would like to undertake their studies.

Preference will be given to those who have had experience in highway work and the award of the fellowship will be contingent upon the candidate being eligible for admission to the course of his choice. A candidate's intention to work in Canada will also be taken into consideration.

A One Hundred Year Old Engineer

J. O. Martineau of Quebec City, vice-president of the Engineering Institute, congratulates F. X. T. Berlinguet of Three Rivers on his one hundredth birthday.

The members of the Institute from coast to coast will be interested to hear that one of the members of the Institute reached his one hundredth birthday on March 15. He is F. X. T. Berlinguet of Three Rivers.

Mr. Berlinguet is not only the oldest member in the Institute, but he probably has been a corporate member longer than any person living today. He joined the Institute as an Associate Member in 1887. He has been a Life Member since 1931.

In recognition of this important event, a message was sent to Mr. Berlinguet from the Council of the Institute, and Vice-President J. O. Martineau of Quebec City went to Three Rivers to participate in the ceremonies.

The program starting out with a special mass, was restricted to the family, with the exception of a few friends, the Institute vice-president, and a representative of the Land Surveyors Association. After mass a reception was held at the home of Dr. Lorne Berlinguet. Mr. Berlinguet Sr. was able to participate in all parts of the program.

Many members will remember Mr. Berlinguet, who was present at the annual meeting of the Institute in 1951. He attended a great many of the technical sessions and was a head table guest at the banquet.

Mr. Berlinguet was born in Quebec City and studied at Laval University. He was employed by the Federal Government on harbour work in Quebec and in Three Rivers, becoming chief engineer of public works for the district. In all he was with the department for forty-six years.

Engineers everywhere will join in sending their congratulations and their good wishes to this distinguished member of the profession.

The accompanying photograph shows vice-president Martineau greeting Mr. Berlinguet.

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

Meeting in Washington

In line with continuing discussions, Canadian and American parties met in March in Washington to confer on the following topics:

1. Progress of the work on the various sections of the Seaway.
2. Co-ordination of the work in these sections.
3. Engineering data concerning locks, booms and fenders.
4. Tolls.
5. Ground-breaking ceremonies to be held at Massena, N.Y. and at Cornwall, Ont., in early summer.

The Hon. Lionel Chevrier, president of the St. Lawrence Seaway Authority, was accompanied by Charles Gavsie, vice-president of the Canadian authority. A. G. Murphy, chief engineer, Lawrence Burpee, assistant chief engineer, and George Scott, economist of the Department of Transport.

Heading the U.S. group at the meeting was Lewis G. Castle, administrator of the St. Lawrence Seaway Development Corporation and Martin W. Oettershagen, the deputy administrator.

John R. Akin

John R. Akin has been appointed information officer for the Authority. He will have headquarters at Ottawa.

Mr. Akin, who was born at Montreal, graduated in 1938 from McGill University with the degree of bachelor of arts. He joined the staff of the Montreal Gazette shortly thereafter and filled various editorial positions, particularly in the coverage of marine and business news.

After service at sea as an officer in the Royal Canadian Navy during World War II he returned to the Gazette and was assistant financial editor when he joined the Department of Public Relations of the Canadian Pacific Railway in 1946.

The same year he was transferred to New York as assistant public relations officer for the company in the United States, and has recently returned to Canada. While in the United States he became well known to financial, transportation and travel writers and editors in New York, Chicago, Philadelphia, Washington and other cities. Helping to tell the story of Canada, her transportation and her rapid development, he wrote numerous articles for newspapers and magazines, appeared on radio and television programs in New York and delivered addresses on Canadian transportation to various organizations.

Mr. Akin has a wide acquaintanee among editors and writers in Canada from coast to coast, and has travelled widely both in this country and in the United States.

Donald H. Stevens

Donald H. Stevens has been appointed administration officer (construction), with headquarters at Montreal.

Mr. Stevens will have immeidate supervision over the several divisional administration officers throughout the Seaway construction.

A native of Halifax, N.S., Mr. Stevens received his education at Humberside Collegiate, Toronto, and at Queens University. Prior to joining the Seaway Authority he served for 13 years with The Goodyear Tire and Rubber Company of Canada, Ltd. at New Toronto, Ontario. Engaged primarily in personnel administration and industrial engineering he served in official capacities as manager, supervisional training department; manager, plant and wage efficiency and manager, personnel division of Goodyear, from which latter position he comes to The St. Lawrence Seaway Authority.

Mr. Stevens has been active in community activities, having been president of the Lions Club of Oakville, chairman of the management committee of Oakville-Trafalgar Memorial Hospital, president of Halton County T. B. and Health Association and chairman of the Lakeshore Red Cross, campaign committee.

Work Commences at Iroquois

Work began early in March on the most westerly part of the St. Lawrence Seaway to date with the slash of a 24-ton bulldozer on the upstream southwest side of Iroquois Point, just up river from Iroquois, Ontario.

The latest Iroquois Point work is essentially part of the navigation system. This section is due for completion November, 1957.

Parallel to the lock approaches and the lock itself, which will constitute the 6,000 foot Iroquois Point work, runs the present Galop Canal from Lock 25 at Iroquois up to Locks 27 and 28 beyond Cardinal, Ontario.

Pentagon Construction Company, Ltd., who were awarded the $6,470,000. lock and approaches contract, established a small advanee party at the site, under Kenneth Mohun, engineer-in-charge. Douglas Cameron is the resident engineer representing the St. Lawrence Seaway Authority on this location.

With work in preliminary stages, a black and white centre line stake was driven in the primary bulldozer path and construction of a haul road was started to enable the earth dug up by the scrapers to be stockpiled alongside the digging for eventual use as fill for the old Galop Canal and for low areas elsewhere.

Equipment working at the site was not considerable as yet, for brush must be cleared to accommodate more of it and as the cut lengthens more will be brought in to push forward the work. On hand were two 24-ton bulldozers, four 12-cubic yard scrapers, and a two-and-a-half yard power shovel was being moved to the job by Pentagon. Trucks were also moving in. Land clearing and other preparations were being made for the excavation season.

The rock structure on Iroquois Point—an artificial island made by the construction through a penin-

sula of the present Galop Canal on the north side of the St. Lawrence —is described by the contractor as dolomite limestone, characteristic of the area; and very hard, heavy earth has been encountered in the digging along with uneven frozen ground conditions. Excavation will go as deep as 90 feet in places as required by the conformation of the land.

The new lock to be built at Iroquois Point will replace present locks 25 and 27 on the Galop Canal and will be 30 feet deep over the sills, 80 feet wide and 768 feet long. Approach channels will be 27 feet in depth. These dimensions are the same as those in the Welland Canal.

Excavation will be going on until late this summer and then the concrete work is due to commence. This summer Pentagon will have to build a coffer-dam at the upstream end to protect their operation on the island point and in the summer of 1957 will construct a coffer-dam at the downstream end to enable the lower approach to be completed.

Labour Agreement Reached for Ontario Hydro's St. Lawrence Project

Signing of a far-reaching labour agreement covering Ontario Hydro's share of the St. Lawrence power project was announced on January 27 by Dr. Richard L. Hearn, Ontario Hydro chairman, and G. Russell Harvey, chairman of the Allied Construction Council, A.F. of L. - T.L.C. Effective January 27, 1955, and applicable to all Ontario Hydro and contractors' staffs engaged on the Commission's phase of the international power project, the new agreement covered wage rates, working conditions and other benefits.

In effect, the agreement was an extension of the Allied Council principle which proved so successful at Hydro's Sir Adam Beck-Niagara G.S. No. 2 project and other Commission developments, wherein a number of A.F. of L. unions have negotiated with "one voice" through the Ontario Hydro Construction Allied Council. For the St. Lawrence power project, 17 unions known as The Allied Construction Council A.F. of L. - T.L.C. (see list following) reached an agreement with The Labour Relations Association St. Lawrence Power Project, representing Ontario Hydro and its contractors. Future contractors engaged by Hydro on the project will become members of The Labour Relations Association St. Lawrence Power Project.

The joint announcement stated that wage rates, working conditions and other benefits on the St. Lawrence Hydro job would be identical to those prevailing at Niagara. All of the 17 unions included in the new St. Lawrence agreement are engaged on the Niagara project.

Describing the settlement as extremely vital to the successful completion of the Hydro part of the St. Lawrence Power Project, both Dr. Hearn and Mr. Harvey expressed their satisfaction with the agreement reached and with the spirit of co-operation manifest throughout the negotiations.

Allied Construction Council A.F. of L. - T.L.C. (St. Lawrence power project)

International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers.

Bricklayers, Masons and Plasterers' International Union of America.

Building Service Employees' International Union.

United Brotherhood of Carpenters and Joiners of America.

International Brotherhood of Electrical Workers.

International Union of Operating Engineers.

International Association of Firefighters.

Hotel and Restaurant Employees and Bartenders' International Union.

International Association of Bridge, Structural and Ornamental Iron Workers.

International Hod Carriers, Building and Common Labourers' Union of America.

International Association of Machinists.

Sheet Metal Workers' International Association.

Office Employees' International Union.

Brotherhood of Painters, Decorators and Paperhangers of America.

Plasterers and Cement Masons' International Association of the United States and Canada.

United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada.

International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America.

Four Dredging Contracts Awarded

The St. Lawrence Seaway Authority announced on March 18 the award of four dredging contracts, covering Lake St. Louis Channel and Lake St. Francis. Approximate total amount of all four contracts is $13,983,000. Marine Industries was the lowest bidder on the contract to dredge Lake St. Louis Channel which involves the removal of 3,800,000 cubic yards of over-burden and 100,000 cubic yards of solid rocks. Its bid was $8,219,000.

The second lowest bid, from Canadian Dredge and Dock Company Limited, Toronto, amounted to $8,538,000 and the third lowest bid, tendered by McNamara Construction Company Ltd., Toronto, totalled $9,242,000.

The Seaway engineers being satisfied that the company is capable of doing the work according to specifications and on schedule, the Authority, with the approval of the Treasury Board, awarded this contract to Marine Industries Limited.

This contract includes 10 miles of dredging from the easterly end of the Beauharnois Canal to just west of the Caughnawaga Indian Reservation. This work must be completed by September 30, 1958.

McNamara Construction Company Limited, Toronto, was the lowest bidder on the contract to dredge a channel in Lake St. Francis at the approach to the Beauharnois Canal, which involves the removal of 1,100,000 cubic yards of sand, silt and clay. Its bid was $682,000.

There were other bids as follows: The J. P. Porter Company Limited, Montreal, $715,000, Canadian Dredge and Dock Company Limited, Toronto, $737,000, Marine Industries Limited, Montreal, $759,000 and St. Lawrence Dredging Company Limited, Montreal, $880,000.

This contract was awarded to McNamara Construction Company Limited. It includes the dredging of any material found above grade between the westerly limit of the Beauharnois Power Canal and the Quebec-Ontario boundary.

Marine Industries Limited, Montreal, was the lowest bidder on the contract to dredge part of the Lake St. Francis Channel, at Lancaster Bar, which involves the re-

moval of 600,000 cubic yards of sand, silt and clay. Its bid was $384,000.

Other bids were made by McNamara Construction Company Limited, Toronto, $402,000, Canadian Dredge and Dock Company Limited, Toronto, $414,000, the J. P. Porter Company Limited, Montreal, $468,000 and St. Lawrence Dredging Company Limited, Montreal, $750,000.

This contract, including the dredging of any material found above grade from the Quebec-Ontario boundary to South Lancaster, including Lancaster Bar, was awarded to Marine Industries Limited.

Canadian Dredge and Dock Company Limited, Toronto, the lowest bidder, was awarded the contract to dredge over-burden to form the Seaway Channel in Lake St. Francis at the westerly half of the lake which involves the removal of 2,700,000 cubic yards of over-burden. Its bid was $4,698,000.

The second lowest bid, from Marine Industries Limited, Montreal, amounted to $5,022,000, and the third lowest bid, tendered by McNamara Construction Company Limited, Toronto, totalled $5,616,000.

This contract includes some 10 miles of dredging of any material found above grade scattered from Fraser Point to the International Boundary south of Cornwall Island.

Work on the three contracts for Lake St. Francis is to be completed by June 30, 1958.

Engineer and Technician

Almost since the beginning of engineering there has been a discussion of a proper definition of an engineer and engineering. Today the interest in these definitions seems to be increasing, and several organizations are making a study of it.

Believing that definitions as approved by certain important engineering conferences might help many people in their thinking, the *Journal* publishes herewith the two definitions which were developed and adopted by the European and United States Engineers' Conference (EUSEC) and were approved subsequently by the Conference of Commonwealth Engineering Institutions.

EUSEC is made up of representatives from the five senior engineering organizations in the United States, the three senior Institutions in Great Britain, and the senior engineering organizations in each of the European countries outside the Iron Curtain.

The Commonwealth Conference is made up of representatives of national engineering organizations in Great Britain, South Africa, India, New Zealand, Australia and Canada. The Engineering Institute of Canada is the Canadian member.

It should be kept in mind that in the older countries the technician is much more clearly defined than he is in the United States or Canada, and there are more recognized means for his training than there are on this side of the water. In fact, in the United Kingdom some of the professional institutions have drawn up complete courses of training and standards of recognition for technicians, in their particular field of practice.

It is hoped that a wide distribution of these definitions across Canada will be interesting and helpful to those people who are now contemplating these problems.

Here are the definitions:

Professional Engineers

A professional engineer is competent by virtue of his fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He is able to assume personal responsibility for the development and application of engineering science and knowledge, notably in research, designing, construction, manufacturing, superintending, managing and in the education of the engineer. His work is predominantly intellectual and varied, and not of a routine mental or physical character. It requires the exercise of original thought and judgment and the ability to supervise the technical and administrative work of others.

His education will have been such as to make him capable of closely and continuously following progress in his branch of engineering science by consulting newly published work on a world-wide basis, assimilating such information and applying it independently. He is thus placed in a position to make contributions to the development of engineering science or its applications.

His education and training will have been such that he will have acquired a broad and general appreciation of the engineering sciences as well as a thorough insight into the special features of his own branch. In due time he will be able to give authoritative technical advice, and to assume responsibility for the direction of important tasks in his branch.

Engineering Technician

An engineering technician is one who can apply in a responsible manner proven techniques which are commonly understood by those who are expert in a branch of engineering, or those techniques specially prescribed by professional engineers.

Under general professional engineering direction, or following established engineering techniques, he is capable of carrying out duties which may be found among the list of examples set out below.

In carrying out many of these duties, competent supervision of the work of skilled craftsmen will be necessary. The techniques employed demand acquired experience and knowledge of a particular branch of engineering, combined with the ability to work out the details of a task in the light of well-established practice.

An engineering technician requires an education and training sufficient to enable him to understand the reasons for and purposes of the operations for which he is responsible.

The following duties are typical of those carried out by engineering technicians:

Working on design and development of engineering plant and structures; erecting and commissioning of engineering equipment and structures; engineering drawing; estimating, inspecting and testing engineering construction and equipment; use of surveying instruments; operating, maintaining and repairing engineering machinery, plant and engineering services and locating defects therein; activities connected with research and development, testing of materials and components and sales engineering, servicing equipment, and advising consumers.

69th
ANNUAL GENERAL
AND
PROFESSIONAL MEETING
OF
THE ENGINEERING INSTITUTE OF CANADA
AT THE
ROYAL YORK HOTEL, TORONTO
May Eleventh to Thirteenth, 1955

COMMITTEE

Chairman	C. D. Carruthers
Vice-Chairmen	J. G. Hall
	M. W. Huggins
	M. McMurray
	W. H. Paterson
Secretary	H. Fealdman
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Entertainment	H. I. Stricker	Plant Visits	W. E. Hickey
Finance	K. F. Tupper	Publicity	D. R. Abbey
Junior Activities	R. C. Norgrove	Reception	J. H. Ross
Meeting Arrangements	T. Dembie	Technical Papers	E. R. Davis
"Muriel's Room"	D. O. Robinson, E. B. Jubien	Transportation	R. C. A. Pittis
Ladies	Mrs. C. D. Carruthers		

REGISTRATION
Convention Floor

3:00 p.m. to 6:00 p.m. — May 10th
9:00 a.m. to 6:00 p.m. — May 11th-13th
Members $5.00
Juniors $3.00 — Non-Members $6.00
Ladies, guests of the Institute, speakers, authors and students — complimentary.

"MURIEL'S ROOM"

The hospitality of "Muriel" will be extended, as usual, to all registered members, ladies and guests, thanks to the continued co-operation of Canadian industry.

Registration Badges Must Be Worn

ATTENTION - MEMBERS!

PLEASE NOTE

Prices for meals include gratuities. Tickets must be obtained in advance and refunds cannot be made less than three hours before any function. Attendance at social functions will tax all available accommodation. Members are urged to indicate their ticket requirements by completing and mailing advance registration cards well before the meeting. Tickets not paid for will not be held after 4:00 p.m. on the day of the function. To ensure admission to all social affairs send remittance for all tickets with advance registration whether from out of town or not!

All times are Eastern Daylight Saving.

*PROGRAM

Wednesday, May 11th

9:00 a.m. REGISTRATION
CONVENTION FLOOR

10:00 a.m. CONCERT HALL
ANNUAL GENERAL MEETING

2:00 p.m. CONCERT HALL
RECENT DEVELOPMENTS IN THE DESIGN AND MANUFACTURE OF HYDRAULIC TURBINES IN CANADA
R. S. Sproule, M.E.I.C., Manager, Hydraulic Division, Dominion Engineering Works, Montreal.

Private Dining Rooms Nos. 1-4
THE JETAIRE CIRCUIT BREAKER
J. P. Skillen and D. H. McKeough, Engineers, Canadian Westinghouse Company Limited, Hamilton, Ont.

Parlour C
THE DESIGN OF COMPRESSED BEAMS
D. T. Wright, Professor, Department of Civil Engineering, Queen's University, Kingston.

3:00 p.m. CONCERT HALL
NIAGARA RIVER REMEDIAL WORKS
Otto Holden, M.E.I.C., Chief Engineer, Hydro Electric Power Commission of Ontario, Toronto

Private Dining Rooms Nos. 1-4
POWER TRANSMISSION BY UNDERGROUND CABLES
L. G. Brazier, Research Department, British Insulated Callender's Cables Ltd., London, England.

Private Dining Room No. 10
FROM FIRESTICKS TO JET ENGINES
J. M. F. Vickers, Professor, Department of Mechanical Engineering, University of Toronto, Toronto.

Parlour C
SILICONES IN INDUSTRY
D. C. R. Miller, M.E.I.C., General Manager, Dow Corning Silicones Limited, Toronto.

4:00 p.m. CONCERT HALL
PRECIPITATION AND RELATED FACTS RE HURRICANE HAZEL
Ronald Clinch, H. G. Acres & Company, Niagara Falls, Ont.

Private Dining Rooms Nos. 1-4
DEVELOPMENT AND OPERATING EXPERIENCE WITH GAS TURBINE
Paul J. Lusser, M.E.I.C., Manager, Brown Boveri (Canada) Limited, Calgary, Alta.

Parlour C
FATIGUE LIFE OF STEEL I-BEAMS AT NORMAL AND SUB-ZERO TEMPERATURES
G. Welter, Head, and J. P. J. Dubuc, Jr.E.I.C., Associate Professor, Strength of Materials Department, Ecole Polytechnique, Montreal.

Toronto Stock Exchange — 234 Bay Street, Toronto
ELECTRONIC EQUIPMENT AT TORONTO STOCK EXCHANGE
E. L. Schmidt, Vice-President, The Teleregister Corporation, Stamford, Conn.
(This paper will be followed by a demonstration of the equipment in action.)

6:30 p.m. RECEPTION
CONCERT HALL

7:00 p.m. DINNER
BANQUET HALL - $4.00 per perso
Chairman: M. W. Huggins, M.E.I.C. Chairman, Toronto Branch.
Speaker: Dr. D. M. Stephens, M.E.I.C., President, The Engineering Institute of Canada.
(Dress Informal)

*** Subject to minor changes.**

Thursday, May 12th

):00 a.m. BANQUET HALL

ECONOMIC ADVANTAGES OF HYDRAULIC MODELS
J. B. Bryce, M.E.I.C.,
Hydraulic Engineer,
Hydro Electric Power Commission of Ontario, Toronto.

Private Dining Room No. 9

POSSIBILITY OF COMPLETE SOLAR HEATING IN CANADIAN HOUSES
F. C. Hooper, Professor,
Department of Mechanical Engineering,
University of Toronto, Toronto.

Private Dining Room No. 10

AUTOMATIC ELECTRODE BOILERS FOR THE IRON ORE COMPANY OF CANADA
M. Eaton, M.E.I.C.,
Chief Electrical Engineer,
Shawinigan Chemicals Limited,
Shawinigan Falls, P.Q.

):00 a.m. BANQUET HALL

THE INTAKE FOR SIR ADAM BECK GENERATING STATION No. 2
O. E. Johnston, M.E.I.C., and
D. G. Harkness, Engineers,
Hydro Electric Power Commission of Ontario, Toronto.

Private Dining Room No. 9

TOMORROW'S EDUCATIONAL CRISIS
G. E. Hall, President,
University of Western Ontario,
London, Ont.

Private Dining Room No. 10

ELECTRICAL EQUIPMENT IN LARGE TRANSPORT AIRCRAFT
Clayton Glenn,
Engineering Department,
Trans-Canada Airlines, Montreal.

Private Dining Rooms Nos. 1-3

CUTTING CONSTRUCTION COSTS WITH MODERN TECHNIQUES
W. Sefton, M.E.I.C.,
Chief Engineer,
W. V. Zinn & Associates Limited,
Toronto.

1:00 a.m. BANQUET HALL

POWER DEVELOPMENT ON THE NIAGARA RIVER
R. L. Hearn, M.E.I.C., Chairman,
Hydro Electric Power Commission of Ontario, Toronto.

Private Dining Room No. 9

WATER POLLUTION - A PROBLEM OF GROWTH AND INDUSTRIAL EXPANSION
A. E. Berry, M.E.I.C., Director,
Sanitary Engineering Division,
Ontario Department of Health,
Toronto.

Private Dining Room No. 10

NEWER TYPES OF MAGNETIC AMPLIFIERS
R. R. Jackson,
Radio and Electrical Engineering Division,
National Research Council, Ottawa.

Private Dining Rooms Nos. 1-3

THE PART HELICOPTERS ARE TAKING IN ENGINEERING AND CONSTRUCTION DEVELOPMENT IN CANADA
W. H. D. Hanchet, Jr.E.I.C.,
Canadian Pratt and Whitney Company, Montreal.

1:45 p.m. PLANT VISITS

Ontario Hydro Models of Niagara and St. Lawrence River Power Developments,
Islington — $1.50 per person.

Orenda Engine and Aircraft plants,
A. V. Roe Canada Limited,
Malton — $1.50 per person.

Ford Motor Company Plant,
Oakville — $1.50 per person.

6:30 p.m. ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

ANNUAL DINNER

Roof Garden

Chairman: E. A. Cross, M.E.I.C.
Speaker: Rt. Hon. C. D. Howe, Hon. M.E.I.C.

(Tickets obtainable from Association)

9:00 p.m. SPECIAL ENTERTAINMENT

Private Dining Room No. 9

Film — Leonardo da Vinci.

Private Dining Room No. 10

Colour Photography.

Parlour A

HiFi Recordings at their Best.

HOTEL ACCOMMODATION AND TRANSPORTATION

The Royal York is the headquarters hotel and all meetings and functions will take place there unless noted otherwise. Additional room accommodation has been arranged for at The Barclay and Walker House hotels nearby.

Room reservations at the Royal York cannot be assured unless received one week or more in advance. You are urged to make requests for room reservations as soon as possible after receipt of this notice. If you are coming alone it will almost certainly be necessary for you to share a twin-bedded double room. It is desirable therefore that sharing arrangements be worked out in advance and indicated on the application for reservations.

All requests for reservations should be addressed to:—

The General Secretary, The Engineering Institute of Canada
2050 Mansfield Street, Montreal 2, Que.

Reduced convention fares have been authorized for rail travel in Canada. A special fare certificate will be mailed to you from headquarters if requested on your registration card. This entitles you and members of your family to round-trip tickets at one and one-half times the one-way fare plus twenty-five cents.

Trans-Canada Air Lines have convention rates for parties of ten or more. Your local T.C.A. agent will gladly supply details.

No matter how you travel, be sure to make your reservations now to avoid disappointment.

Friday, May 13th

9:00 a.m. BANQUET HALL

CANADA'S OIL AND GAS PRODUCING INDUSTRY
G. M. Furnival, M.E.I.C.,
Vice-President,
The California Standard Company,
Calgary, Alta.

Private Dining Room No. 9

GROUND WATER PROBLEMS IN SOUTH WESTERN ONTARIO
W. M. Walkinshaw, M.E.I.C.,
Professor,
Department of Civil Engineering,
University of Toronto, Toronto.

Private Dining Room No. 10

LOW FREQUENCY COMMUNICATIONS AND ENGINEERING
R. S. Thain,
Defence Research Board, Ottawa.

10:00 a.m. BANQUET HALL

POSSIBILITIES OF GENERATING ATOMIC ELECTRIC POWER AT COMPETITIVE RATES
W. B. Lewis, Vice-President,
Research & Development,
Atomic Energy of Canada Limited,
Chalk River, Ont.

Private Dining Room No. 9

A COMPLETE SANITATION PROGRAM FOR METROPOLITAN TORONTO
L. B. Allan, M.E.I.C.,
Commissioner of Works and Roads,
Municipality of Metropolitan Toronto.

Private Dining Room No. 10

RADAR ECHOES FROM AURORA AND THE USE OF DOPPLER TECHNIQUES
A. G. McNamara, Physicist,
Radio and Electrical Engineering
Division, National Research Council,
Ottawa.

11:00 a.m. BANQUET HALL

NEW DEVELOPMENTS IN THE CANADIAN MINING FIELDS
H. R. Rice, Professor,
Department of Mining Engineering,
University of Toronto, Toronto.

Private Dining Room No. 9

PROBLEMS IN CONSTRUCTION IN THE FAR NORTH
Squadron Leader
H. D. Monteith, Jr.E.I.C.,
R.C.A.F. Headquarters, Ottawa.

Private Dining Room No. 10

PHOTOELASTICITY FOR DESIGN IMPROVEMENT
I. W. Smith, Assistant Professor,
Department of Mechanical Engineering,
University of Toronto, Toronto.

2:00 p.m. BANQUET HALL

MANAGEMENT —
A PANEL DISCUSSION
Chairman, T. R. McLagan, M.E.I.C.,
President,
Canada Steamship Lines, Montreal.

3:30 p.m. BANQUET HALL

THE TRAFFIC PROBLEM IN CANADIAN CITIES —
A PANEL DISCUSSION
Chairman, W. E. P. Duncan, M.E.I.C.
General Manager,
Toronto Transit Commission,
Toronto.

6:30 p.m. RECEPTION - BALL ROOM

7:15 p.m. THE ANNUAL BANQUET

CONCERT HALL - $5.50 per person
(including dance)

Chairman: Dr. D. M. Stephens,
President of The Institute.

Speaker: Dr. F. K. Hare, McGill University.

Presentation of Medals and prizes and introduction of the new president, Dr R. E. Heartz and new members o Council.

9:00 p.m. ANNUAL DANCE

BALL ROOM — $2.50 per person
(dance only)
(Dress optional).

RECEPTION

There will be an informal reception after the banque when members and guests may meet the incomin and retiring presidents, the Chairman of the Toront Branch, and their wives.

*LADIES' PROGRAM

Morning coffee: 10:00 a.m. daily — The Palm Court
Wednesday May 11th, 3:00 p.m. "May Frolics"
Fashion Show and Tea

Entertainment

Simpson's Arcadian Court — $1.50 per person.
Thursday, May 12th, 1:45 p.m. - Plant visits with men
(Other entertainment can be arranged if desired)
Friday, May 13th, 11:00 a.m. - Bus Trip and Luncheon
Guild of All Arts — $2.75 per person.

Separate Ladies' Program will be available at meeting.

The Branches Entertain The President

Sudbury. (Top) Meeting with branch executives, Sudbury, Sault Ste. Marie, Nipissing and Upper Ottawa. Left to right, T. C. Robertson, G. L. Hood, E. A. Watson, A. D. Finlayson, W. D. Adams, H. M. Whittles, E. R. Eaton, T. L. B. Hamlin, W. J. Ripley, A. M. Wilson, Peter E. Semler, W. S. Black, L. T. Lane, President Stephens, F. A. Orange, Kelvin Sproule. (Right) The president visits R. D. Parker, vice-president and general manager, International Nickel Company of Canada.

Chatham. Three photos in right-hand column. The first: Mayor A. E. Stirling calls on the president. In the second picture, among others, Hugo B. R. Craig, W. J. Fletcher, H. C. McMordie. The third, a general view of the meeting from the head table.

Belleville. Two pictures below, from left to right: Mrs. J. Both, Mrs. C. R. Whittemore, D. A. Lamont, Mrs. A. O. Drysdale, D. M. Stephens, A. O. Drysdale; Mrs. Stephens, J. Both, Mrs. S. Sillitoe, Mrs. D. A. Lamont, C. R. Whittemore, Mrs. Lillian Robertson.

Toronto

Toronto

(on this page)

Top left, a visit to the president of the University, Dr. Sidney Smith, on the left, and Toronto Branch Chairman Mark Huggins on the right.

Top right. Dinner with the executive. —Head table, left to right: Frederick Alport, Orillia, President Stephens, M. W. Huggins, and Sir Claude Gibb, chairman and managing director, R. C. Parsons and Co. Ltd., England.

Lower left. The general meeting. Several familiar faces in this group, including Mr. and Mrs. K. F. Tupper and Mr. and Mrs. Stewart Wilson.

Lower right. Signs of Confederation. The president talks it over with J. Herbert Smith at Hart House.

Hamilton

(top of opposite page)

Left hand column. Frank E. Milne, the chairman of the Hamilton Branch, President Stephens, and H. D. Davison, Niagara Falls.

The president presents the Hamilton Branch Students and Junior's first prize to F. S. Gue, Jr.E.I.C.

Right hand column. About 200 members turned out to hear the president.

Dinner with the branch executives, Hamilton, Niagara Peninsula and Kitchener. Left to right: Mrs. Stephens, the president, Frank Milne, Mrs. and Mr. W. A. Wheten, Mrs. and Mr. G. R. Henderson, James A. Vance.

Lakehead

(bottom of opposite page)

First row. The head table for the branch dinner meeting, left to right: Lloyd B. Walker, Mrs. G. S. Halter, Mrs. Walker, D. B. McKillop, Mrs. Stephens, F. E. Ayers, President Stephens, Mrs. Ayers, G. S. Halter, and Mrs. McKillop.

Bottom left. At the Lakehead Technical Institute, Harold S. Braun, principal, President Stephens, Frank E. Ayers, and W. Donald McKinnon, teacher at the Lakehead Technical Institute, and member of the Branch executive.

Bottom right. The president visits a senior, J. Antonisen (centre). On the left, the chairman of the Branch.

Hamilton

Lakehead

Montreal

(on this and the opposite page)

Left column, below. Visiting McGill University. In first group, C. R. Frost, R. L. Wright, the president, Wm. F. Hayes, E.I.C. student prize winner; Dean Jamieson, and I. R. Tait. Second. The president presents the E.I.C. student prize to William F. Hayes. Third. Left to right, Dr. Cyril James, principal and vice-chancellor, President Stephens, Dr. I. R. Tait, Institute vice-president, and Clifford E. Frost, chairman, Montreal Branch.

Right column, below. First picture. The president visits the University of Montreal. Left to right, the president, I. R. Tait, C. R. Frost, Leon Lortie, Mgr. Olivier Maurault, the rector. Second. The President presents E.I.C. prize to Jean Guay at Ecole Polytechnique. Dean Gaudefroy at right. Third. The president calls on Montreal's mayor. Left to right, Paul Pelletier, M.E.I.C., city councillor, the president, His Worship Mayor Jean Drapeau, and Dr. Tait.

On the opposite page. The Montreal Branch annual banquet and dance. Some of the head table guests are shown in the first four pictures. Left to right: Vice-President I. R. Tait, Mrs. Gray-Donald, George Demers, president of the Corporation of Professional Engineers of Quebec, Mrs. C. E. Frost, President D. M. Stephens, Chairman Clifford E. Frost, Mrs. Stephens, Mrs. Demers, E. D. Gray-Donald, R. L. Dunsmore, Mrs. Austin Wright, Mrs. Gaetan Ducharme, Gaston Masse, chairman of the Sherbrooke Branch; Henri Gaudefroy, dean of engineering, Ecole Polytechnique, Mrs. J. B. Stirling, R. E. Jamieson, dean of engineering, McGill; and Mrs. Gaetan Ducharme. The fifth picture. At this table are Mr. and Mrs. R. E. Heartz, Mr. and Mrs. Norman Coke, Mr. and Mrs. A. D. Ross, and Mr. and Mrs. E. B. Jubien.

St. Maurice Valley

(below)

At a St. Maurice Valley Branch meeting attended by the vice-president, I. R. Tait, and the general secretary. Left to right: C. M. Williams, J. O. Kelly, D. M. McKim, C. W. Kerry, J. K. Murphy, L. A. Pattison, L. A. Robillard, E. E. Copping, A. T. Farmer, J. W. Korez, J. U. Moreau, W. R. M. Wood, T. G. Edgeworth, I. R. Tait, J. Corbould, E. R. McMullen.

The Life Members at Montreal hold a meeting. In the picture above are Mrs. I. R. Tait, Mr. and Mrs. Howard W. Fairlie, George E. Templeman, E. D. Gray-Donald, and others. Upper left. Left to right: F. P. Shearwood, Professor and Mrs. R. DeL. French, and Mr. and Mrs. Huet Massue in the background. Lower left. Left to right: J. C. Kemp and daughter, and Dr. P. L. Pratley.

Scientists in the U.S. Labour Force

Under this heading the Engineer's Joint Council's Newsletter of March 14 presents some information which will be of particular significance to Canadians. It is the experience that the situation in the United States in many things is very close to the same conditions in Canada. Here are startling figures and statements:

In its Fourth Annual Report, for the year ending June 30, 1954, the National Science Foundation presents some alarming statistics. Graphically illustrating the growing development of a technological society are the figures on the number of scientific and technical workers in the U.S. labor force. Since 1870, the number of scientific and technical employed has increased from 1 in 1000 to 1 in every 60 individuals. Another indication of the trend is seen in the changing ratio of farm to nonfarm workers in the labor force. In 1820, about 72 per cent were classified as agricultural workers; by 1950, less than 12 per cent were so classified.

To support a technological economy, 4631 doctoral degrees in science were granted by American universities in 1953, as contrasted with 102 in 1900. This increase, however, conceals a serious loss that occurred during 1942-49, the low point being reached at 833 in 1945. The decreasing number of bachelors' degrees awarded in science, and lower undergraduate enrollments, will be followed by a smaller number of doctorates for the next few years, or until the youth of the higher birthrate years of the forties appear in the graduate schools. There is no present indication that the 1942-49 loss will be made up.

While high school enrollments go steadily upward, the proportion of college graduates who qualify to teach high school science and mathematics continues to decrease. Between 1950 and 1954, the total number of college graduates meeting certification requirements to teach in high school dropped 42 per cent, and the number qualified to teach mathematics and science dropped 51 and 56 per cent respectively. Of this number, many actually find employment in other fields. A recent study showed that only 40 per cent of the 1953 college graduates qualified to teach science and mathematics were teaching in November of that year.

Out of the relatively small group of high school students graduating in the upper quarter of their classes, about 47 per cent fail to continue formal education, and another 13 per cent drop out before completing college. Thus, about 60 per cent of the group with the greatest potential for leadership in all fields (including science) do not receive a college education, and only 2 per cent of all graduates, or one quarter of 1 per cent of the total age group, continue their education through the Ph.D. level.

The report deals also with various current aspects of American science and describes what the National Science Foundation has accomplished and what programs are in prospect. Recognizing the vital necessity of fostering scientific progress, Chester I. Barnard says in the Foreword, "as never before, the matter of incentives for the pursuit of scientific careers becomes an important social problem. To find ways to promote an (indefatigable interest in scientific discovery) is of first importance."

James Watt International Medal

The council of the Institution of Mechanical Engineers, England, has announced that the James Watt International Medal for 1955 will be awarded to Igor Ivan Sikorsky, engineering manager, Sikorsky Aircraft, Bridgeport, Conn. Mr. Sikorsky was recommended by the American Society of Mechanical Engineers.

The medal is awarded in recognition of Mr. Sikorsky's life work in applying science to the progress of mechanical engineering through pioneering development of aircraft of various types:—multi-engined, amphibians, and particularly helicopters.

The James Watt International Medal was founded to commemorate the bi-centenary of the birth of James Watt on January 19, 1736.

It takes the form of an award every two years of a gold medal to an engineer of any nationality who is deemed worthy of the highest honour the Institution can bestow and that a mechanical engineer can receive. In making the award, the Institution has secured the co-operation of the principal engineering institutions and societies in all parts of the world as nominating authorities.

Previous recipients of the medal have been: Sir John A. F. Aspinall (Britain), 1937; Henry Ford (U.S.A.), 1939; Professor Aurel Stodola (Switzerland), 1941; A. F. M. Mitchell (Australia), 1943; Dr. F. W. Lanchester (Britain), 1945; Professor Stepan Timoshenko (U.S.A.), 1947; Dr. Fredrik Ljungstrom (Sweden), 1949; Dr. H. H. Blache (Denmark), 1951; Sir Harry Ricardo, 1953.

The design of the first successful helicopter in the United States by Igor I. Sikorsky was based on three decades of brilliant achievement in aeronautics.

Before returning in 1939 to the helicopter studies which he had put aside in Kiev in 1910, Dr. Sikorsky had become world famous as the designer of large multi-engined aeroplanes and flying boats.

Dr. Sikorsky's first two designs had both been helicopters, but lack of suitable lightweight power plants was one of the main factors in his decision to put rotary wing design aside for a number of years. Through these years he had never forgotten the challenge of the helicopter and, in 1939, he felt that the progress of aeronautical knowledge and power plant design had reached a point where renewal of the project promised success. With the research and experimental facilities of United Aircraft at his command, he designed the VS-300, the first really successful direct lift machine produced in the United States. In the next five years, designs so improved performance that more than 400 in three different models had been built on military order.

Igor I. Sikorsky was born in May 1889, in Kiev. In 1909 he began his work in aviation by designing and constructing a helicopter with a motor of 25 hp. This power plant, the best available, proved inadequate.

He produced a second helicopter and six different types of aeroplane, and in 1913 completed the first large four-engined Sikorsky aeroplane, the first of its size and type in the world. Sikorsky planes received prizes and established Russian records for distance endurance, lifting capacity and altitude. Heavy bombers of his design were used by the Russian Army in the 1914-18 War.

Dr. Sikorsky was commissioned by the French Government after the Revolution in 1917, this work being discontinued after the Armistice. He arrived in the United States in 1919. Four years later the first aircraft company bearing his name was organized in the air field section of Long Island.

In 1924 the Sikorsky Aero Engineering Corporation completed the twin-engined, fourteen passenger, all metal, cabin landplane, the S-29, which was one of the first successful large passenger aeroplanes built in the United States.

During the following years, several more types of aircraft were designed and produced, among them the S-38, the first successful twin-engined amphibian. This aeroplane was produced in large numbers; it was used for the pioneering of air routes to Central and South America, for the carrying of the first load of airmail from the United States to the Panama Canal, and for a large number of other services. This aircraft was also extensively used by many private owners, as well as by the U.S. Army and Navy.

During this period, also, Dr. (then Mr.) Sikorsky became a citizen of the United States.

Since then many advances in aviation were made by the Sikorski organization — the four-engined flying clipper aircraft, the S-40, the forerunner of the trans-oceanic flying clipper; the famous S-42, a four engined long distance flying boat which was used to pioneer the commercial air route from the United States to Hawaii, and to inaugurate commercial air transportation to Europe; the Flying Dreadnaught, the XPBS-1, one of the largest and fastest patrol bombers in the world at that time.

Sikorsky planes established a large number of world records. The S-42 in particular at one time held ten world records for seaplanes.

During 1939, Dr. Sikorsky produced the VS-300 helicopter. This machine, of entirely novel design, piloted by its designer, proved capable of rising vertically with no forward run, of hovering in one spot, of flying forward, as well as backward, and sideways. This aircraft may be considered to be the first truly successful direct lift machine produced in the United States, as well as the first single-main rotor helicopter successfully produced in the world. It is interesting to note that this success marked the completion of Dr. Sikorsky's initial aircraft design projects first started thirty-one years earlier.

From the VS-300, Dr. Sikorsky supervised the development of three post war designs, the largest being a five-place helicopter for the U.S. Navy. By the close of 1948, Sikorsky-designed helicopters had amassed a total of some 75,000 flight hours.

This, and the models S-51 and S-52-1 helicopters gave to Dr. Sikorsky all seven major international helicopter records. In 1951 revolutionary combat tactics were introduced when a fleet of ten-place HRS Sikorsky helicopters flew an entire company of battle-ready marines, to an important objective on a 3000-foot mountain peak in Korea.

The world's first regularly scheduled helicopter passenger service was inaugurated in 1953 between the three New York airports, using Sikorsky S-55 helicopters. Service was later extended, linking many major suburban centres with the New York airports.

Dr. Sikorsky holds honorary degrees from Yale University, Wesleyan University, Lehigh University, Florida Southern College, Rhode Island State College, Northeastern University and the Univer-

sity of Pennsylvania. He is a Fellow of The American Society of Mechanical Engineers and holds fellowships in the Institute of Aeronautical Sciences, Rochester (N.Y.), Museum of Arts and Sciences, Aero Club of Pennsylvania, and American Helicopter Society.

He has been the recipient of many honorary medals and awards for his work, including the Silver Medal of the Royal Aeronautical Society, and the Daniel Guggenheim Medal, administered by a special Board on behalf of The American Society of Mechanical Engineers, Society of Automotive Engineers, and Institute of the Aeronautical Sciences. He was also the recipient, in 1943, of the A.S.M.E.'s coveted Worcester Reed Warner Medal for his "contributions to creative engineering".

Cognate Curricula

The following report of the Education Committee of the Engineers' Council for Professional Development was approved at the recent annual meeting which was held in Cleveland.

This report ties in with the concensus of opinion of the people who attended the recent ASME-EIC education conference at Clarkson College, Potsdam, last October. There were definite indications that the conference was in agreement on the dangers of specialization.

The complete report, as it was presented and approved at Cleveland, is presented herewith.

After due consideration, and after participation by several of its members in the deliberations and Interim Report of the ASEE Committee on Evaluation of Engineering Education, the ECPD Education Committee recommends as follows:

1. That the following curricula be accredited as Major Engineering Curricula: chemical engineering, civil engineering, electrical engineering, mechanical engineering, metallurgical engineering, and mining engineering.

2. That the following curricula be accredited as Cognate Engineering Curricula: aeronautical engineering, architectural engineering, agricultural engineering, ceramic engineering, geological engineering, geophysical engineering, industrial engineering, engineering mathematics, engineering mechanics, naval architecture and marine engineering, petroleum engineering, engineering physics, sanitary engineering, textile engineering.

3. That additional cognate curricula be approved by ECPD after specific authorization by ECPD based on recommendations from the Education Committee.

4. That a curriculum in engineering or in general engineering be accredited if it meets the criteria for other major or cognate engineering curricula.

5. That any curriculum be recommended for accreditation only when it meets the following criteria in addition to those heretofore adopted by ECPD:

a. At least the equivalent of academic year of the curriculum shall be devoted to mathematics and basic science about equally divided.

b. For major engineering curricula the equivalent of approximately one academic year shall be devoted to the engineering sciences, including at least six of the following: statics; dynamics; strength of materials; fluid flow; heat flow; thermodynamics; electrical circuits, fields, and electronics; engineering materials; physical metallurgy.

c. For cognate engineering curricula only the equivalent of approximately two-thirds of an academic year need be provided for coverage of the engineering sciences as listed in item 5b, provided that the remaining one-third of this equivalent academic year be devoted to other appropriate applied sciences, or basic sciences in addition to those listed in 5a.

d. Approximately the equivalent of one-half of an academic year shall be devoted to engineering analysis, design and engineering systems.

e. The curriculum shall be designed for an integrated sequential study in the scientific and engineering area. The mathematics and the basic science to be used proficiently in the work in engineering analysis, in the study of engineering systems, and in the preparation for creative design.

f. An appropriate portion of the curriculum shall be devoted to the humanistic and social studies.

6. In any case in which the Education Committee is persuaded that well-considered experimentation in engineering curricula is underway, it shall give sympathetic consideration to departures from the criteria of Section 5 and shall make appropriate recommendations to ECPD.

The committee recognizes that these recommendations constitute a departure from past practice in that an approach is made to quantitative criteria as to curriculum content and distribution of time. However, the committee feels that the principal justification for curriculum designations other than those in the "major" group is to provide engineers who are versed in one or more fields of applied science but who must have an adequate background in the items covered by the criteria outlined to assure that they are in fact qualified for admission to the engineering profession. Curricula of a vocation or technical institute pattern could not qualify.

The committee continues to favor the general policy of ECPD looking toward the minimum number of specially designated curricula, and endorsing whenever practicable the utilization of options in major curricula (as sanitary option in civil engineering) to designate specialization. October 28, 1954.

Employment Trends

Members of the profession are always interested in trends that will affect them personally or the profession generally. With this in mind the *Journal* presents a portion of a report made recently by the director of placement at Northwest University, Evanston, Illinois.

This is a portion of the ninth annual report on "Trends in the Employment of College and University Graduates — in Business and Industry". It tabulates the results of survey reports of 152 well known business and industrial concerns. Herewith are some of the interesting figures:

Field	Past Year No. Companies	Past Year No. Men	Next Year No. Companies	Next Year No. Men
Engineering, kind not stated	28	2,279	29	2,639
Mechanical	46	482	49	584
Industrial	21	98	23	105
Electrical	24	153	27	172
Chemical	25	353	25	571
Civil	14	95	12	73
Architectural	2	2	3	8
Metallurgical	6	14	5	19
Other	28	220	24	255
Total Engineering		3,696		4,426

These figures show that the demand for engineers in that area for 1955 as compared to 1954 is up 18.8 per cent. The percentage increase for all other fields at the university which includes such things as chemistry, economics, law, marketing, merchandising, physics, and so on is 2.2 per cent.

It is interesting to see that the demand for this year is greater in every classification except for civil engineering where there is a substantial reduction in the numbers required. Also it is interesting to see that the demand for chemical engineers appears to be increasing more than for any other branch.

In the non engineering university courses there is a substantial increase in the demand for physicists, merchandising and sales. There is a substantial falling off in the demand for people in accounting, economics, general business, law, and marketing.

These figures may or may not have application in Canada but regardless of that they make interesting reading.

International Standards

Canada has its standards association, Britain has the British Standards Institution and other countries have their national organizations for standardization, but not much progress has been made in developing standards which will be internationally acceptable. Some of the delay may be due to super-nationalism, though it is hard to see why love of one's country should enter into the consideration of standards.

There are very real obstacles to be overcome before any international standardization program can even be launched. Mr. E. F. Seaman calls attention to some of them in a paper — "Standardization and Engineering Achievement" — which he presented at the Panamerican Association of Engineers' meeting in Sao Paulo, Brazil, last August. Referring only to the Americas, he said: "It is important . . . that the nations of the Western Hemisphere develop . . . a . . . standardization program. The kind of plan . . . depends on current needs (and on) long range objectives. An understanding of basic principles . . . is important and . . . (so) an . . . educational program should be included . . . Plans should be . . . implemented through committees having . . . representatives of all interests involved."

One of the difficulties he mentions is that of language. Quite apart from the fact that the correct translation of technical terms from one language to another is often difficult, there are many such terms in the rich vocabulary of English, for example, for which there are no exact equivalents in other languages. Naturally, the languages of the less industrialized countries are poor in this respect. One would certainly find it easier to translate from English into, say, French, and vice versa, than into Arabic or Urdu. Of course, the situation improves as industrialization spreads; Arabic must have invented or adopted many technical terms from the oil industry in the last twenty years.

Another difficulty is the fact that the world has no common units of industrial measurement. We English-speaking peoples stick to an illogical and often inconvenient system of inches and pounds; the rest of the industrial world uses the more logical and simpler metric system. Nor, in spite of continuous propaganda in its favour, do we show much disposition to accept the metric system generally. The arguments for and against it are both strong.

When one remembers that it took a war to get even the English-speaking world to agree on such a relatively simple standard as one for screw threads, where there was no question of language nor units of measurement, the prospects for universal standardization look very dim.

Correspondence

As The Life Members See It

This is the first of a series of letters which we propose publishing in the *Journal*, and to which reference was made in the Month to Month pages of the January isue. Ed.

Dear Mr. Secretary:

I wish to acknowledge receipt of your letter informing me that I had been elected by Council to Life Membership in the Institute, I value this honour most highly.

It would be greatly appreciated if you would, on my behalf, extend my sincere thanks to Council for their courtesy in this connection. I also wish to thank you personally, as well.

As my record will show, I entered the Engineering profession as a student in 1908, by way of the Quebec Act, that is, I sat for, and passed the examination set by the Quebec Board of Examiners of The Canadian Society of Civil Engineers (E.I.C.) for admission to study the profession, under the powers of the aforesaid Act.

I remember writing these examinations in the study of the late Mr. Thos. Breen, C.E., of Quebec City, a most kindly old man and a competent engineer, who left me pretty well to my own devices but who could not resist a friendly and anxious inquiry at the end as to how I thought I had made out. He was almost more pleased than I was, if such a thing were possible, when he learned that I had got through.

In those days, to me, entrance to McGill, was only a hope, depending upon finances, etc., but my late father and myself were determined that if we couldn't enter the professional ship via the ladder up to the quarter-deck that we would enter at least by the forecastle and work our way gradually aft.

For some period in the Society's records my name was marked with the letter "q" for the above reason; it is possible that I am the only member who survives of those who followed this same trail.

I am also the only member of the Institute who held the dual position of chairman of the Montreal Branch of The Engineering Institute of Canada and of president of the Corporation of Professional Engineers of Quebec, which double mandate I used to the

utmost of my ability in finally bringing about the agreement between the Institute and the Corporation which established a much-needed "entente cordiale" between these two bodies to their mutual advantage. I consider this Agreement as one of the greatest benefits to the profession in this Province and am very proud of the part which I played therein.

With best personal regards,

C. C. Lindsay, M.E.I.C.,
Montreal, Que.
December, 1954.

E.I.C. and Public Information

Dear Mr. Editor:

In reading over the paper on "Fuel Transportation" by Dr. Hume, delivered recently at the Montreal Branch, I cannot help feeling that the Engineering Institute has not given the proper kind of reception to this paper, nor has there been sufficient publicity on the subject for members to have fully grasped the importance of it.

This may also apply to the attitude of the Engineering Institute towards the St. Lawrence Deep Waterways and its implications.

From my experience I believe that engineers, as a rule, are inclined to defer considering the economic importance of such projects, and they show it in many of their reports when called upon to pass judgment.

I am hoping therefore that when the discussion on the St. Lawrence Waterways comes before the Engineering Institute an attempt should be made to organize a few of the better qualified members to give a lead to full discussion after the paper has been read. It would also seem to me that another opportunity should be afforded the Institute to look further into the transportation of fuel from the West, and thereby stamp ourselves as being qualified to offer an opinion to the public at large, who are most inadequately informed upon the economics as well as the engineering of this undertaking.

During many years I have felt that the Engineering Institute of Canada has kept too much within itself. From now on I would like to see them express opinions, based upon the wide experience which many of the members have.

With best personal regards.

R. O. Sweezey, M.E.I.C.,
Consulting Engineer,
Montreal, Que.
March 2, 1955.

Fourth World Petroleum Congress

In Rome from June 6 to 15 this year, the Italians will be hosts for the Fourth World Petroleum Congress. At that time the representatives of 35 countries, mostly from the oil industry, will gather to participate in a program consisting of subjects of a scientific, technical and economic nature linked directly or indirectly with their industry.

In order to organize the congress on the widest basis, national committees were formed in the various countries. These committees, each in its own sphere, have cooperated with the central committee as far as science and organization are concerned by fulfilling functions of coordination and direction with regard to liaison work. For Canada the personnel of the committee consists of Dr. R. K. Stratford, chairman, with Dr. G. S. Hume and Dr. D. M. Morrison as members.

The program to be covered contains an interesting variety of nine subjects which will be as follows:

Geology and geophysics

Drilling and production

Oil processing

Production of chemicals from petroleum: properties and applications

Composition of petroleum; analysis and testing, measurement and control

Utilization of oil products

Construction of equipment, materials, corrosion

Transport, storage and distribution

Economics, statistics, education and training

If readers should require any further information concerning this congress, it can be obtained from Institute Headquarters in Montreal.

The ASME Boiler Code

Interpretations

The boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquiries and are published in Mechanical Engineering.

The following Case Interpretations were formulated at the Committee meeting January 21, 1955.

Case No. 1198

Inquiry: Par. UCS-66(d)(2) of Section VIII of the Code exempts carbon and low-alloy steels from impact tests when the operating cycle is such that the pressure at —20F is less than one-fifth of the maximum allowable working pressure at 100F. May this exemption be applied to vessels that operate at temperature below —20F and to vessels for which the pressure and temperature are not fixed by the saturation pressure — temperature relationship of the contained fluid?

Reply: It is the opinion of the Committee that the intent of Par. UCS-66(d)(2) will be met under the following conditions:

(1) No impact test is required for materials used in a vessel subjected in service to a pressure which is solely a function of the saturation pressure-temperature relationship, provided this relationship is such that the pressure at —20F and below does not exceed one-fifth of the maximum allowable working pressure, and provided the design pressure is not less than the pressure corresponding to 100F at saturation.

(2) No impact test is required for material used in a vessel that is to operate at temperatures below —20F provided the maximum design pressure of the vessel is determined on the basis of a reduced stress equal to 20 per cent of the allowable stress value prescribed for the materials by the rules of this Section.

(3) The vessel is equipped with a suitable relieving device set at a pressure not exceeding the maximum design pressure.

(4) The relieving device is adequately protected against freezing due to condensation of moisture in the surrounding atmosphere.

Proposed Case No. 1199

(Special Ruling)

Inquiry: Under what conditions may non-metallic materials be used as pressure-resisting parts if these parts are enclosed within an assemblage of metallic parts which are bolted together in such a way as to enclose the non-

metallic material except for possible narrow gaps between adjoining metallic parts?

Reply: It is the opinion of the Committee that non-metallic materials may be used as pressure resisting parts of Code vessels under the conditions specified in the Inquiry provided the following requirements are met:

(1) The metallic parts of the construction shall meet all the requirements of Section VIII of the Code.

(2) The chemical composition and mechanical properties of the non-metallic materials shall be made available to the authorized inspector and shall be subject to his approval. The mechanical properties shall include tensile strength, compressive strength, shear strength and elongation, and their change with time for temperature up to not less than 100F greater than the design temperature. The tests shall be made by independent competent testing laboratory.

(3) The enclosing metallic assemblage shall be so constructed as to produce compressive internal forces across any plane that may be assumed to be cut through the enclosed non-metallic material. The total value of these internal compressive forces across any plane shall be at least one and one-half times the total fluid pressure which act across the plane.

(4) The average compressive stress in the non-metallic material across any plane due to pressure applied to it by the enclosing assembly shall not exceed one-fifth of its compressive strength at the design temperature.

(5) When the parts of the enclosing metallic assembly are connected by bolting, the gaps between adjacent metallic parts shall not be wider than the thickness of non-metallic gaskets used in conventional bolted flange joints.

(6) This construction must not depend for its structural stability on the non-metallic parts.

Proposed Case No. 1201

(Special Ruling)

Inquiry: Is it permissible in welded construction conforming to the requirements of Section VIII of the Code to use arc-welded steel pipe conforming to Grade B of ASTM Specification A-139-53?

Reply: It is the opinion of the Committee that arc-welded steel pipe that meets the requirements of ASTM Specification A-139-53, Grade B, may be used in the construction of unfired pressure vessels under the rules of Section VIII of the Code provided the following requirements are also met:

(1) All welds used in fabricating the pipe shall be two-pass single-welded butt joints with backing, made by the automatic submerged arc-welding process.

(2) The manufacture of the pipe shall meet the rules for fabrication in Pars. UW-26 to UW-38 inclusive, of Section VIII.

(3) The limiting requirements in Pars. UCS-6(b)(1) to UCS-6(b)(5) shall apply, except that the maximum wall thickness shall be ½ in.

(4) The nominal inside pipe diameter shall not exceed 30 in.

(5) The maximum operating pressure shall be 250 psi.

(6) The maximum allowable SE value shall be 8,100 psi. This is the net stress value after deducting for joint efficiency and for exemption from spot examination.

(7) The final inspector of a vessel in which pipe permitted by this Case is used, may waive the partial data report required by Par. UG-120(b) for welding done in other shops, provided he assures himself by visual examination that the welds are free from cracks and other surface defects and that the requirements of Pars. UW-26 to UW-38 inclusive have been met.

Proposed Case No. 1202

(Special Ruling)

Inquiry: Is it permissibe to construct welded vessels for use in the range of —150°F to 650°F under the requirements of Section VIII of the Code using copper chromium nickel steel of the following chemical composition and physical properties?

Chemical Composition

Carbon, max., per cent	0.12
Manganese*, per cent	0.55 to 1.00
Phosphorus, max., per cent	0.04
Sulphur, max., per cent ...	0.04
Chromium*, per cent	0.50 to 0.95
Nickel*, per cent	0.50 to 0.95
Copper, per cent	0.40 to 0.75
Silicon*, per cent	0.10 to 0.35
Aluminum, per cent	0.04 to 0.30

Tensile Properties

Tensile strength, psi	60,000 min.
Yield point, psi	30,000 min.
Elongation in 8 in., per cent	21 min. (a)
Elongation in 2 in., per cent	24 min. (b)

(a) For material under 5/16" in thickness, a deduction from the percentage of elongation in 8 in. specified above of 1.25 per cent shall be made for each decrease of 1/32 in. of the specified thickness below 5/16".

For material over ¼ to ¾ in., inclusive, in thickness if the percentage of elongation of an 8 in. gage length test specimen falls not more than 3 per cent below the amount prescribed above, the elongation shall be considered satisfactory provided the percentage of elongation in 2 in. across the break is not less than 25 per cent.

(Note: A characteristic of certain types of alloy steels is a local disproportionate increase in the degree of necking down or contraction of the specimens under tension test; resulting in a decrease in the percentage of elongation as the gage length is increased. The effect is not so pronounced in the thicker plates.)

For material over ¾ in. in thickness, a deduction from the percentage of elongation in 8 in. specified above of 0.5 per cent shall be made for each increase of ⅛ in. of the specified thickness above ¾ in. This deduction shall not exceed 3 per cent.

(b) For material over 3½ in. in thickness, a deduction from the percentage of elongation in 2 in. specified above of 0.5 per cent shall be made for each increase of ½ in. of the specified thickness above 3½ in. This deduction shall not exceed 3 per cent.

Bending Properties

The bend test specimen shall withstand being bent cold (room temperature) through 180 degrees without cracking on the outside of the bent portion to an inside diameter which shall have the relation to the thickness of the specimen prescribed below. When the test is made on a specimen reduced in thickness, the rolled surface shall be on the outer curve of the bend.

Bend Diameters

Thickness of Material, In.	*Ratio of Bend Diameter to Thickness of Specimen*
1 and under	2
Over 1 to 1½, incl.	2½
Over 1½ to 3, incl.	3

All other requirements in accordance with Specification SA-212.

Reply: It is the opinion of the Committee that the material specified in this inquiry may be used in the range of —150°F to 650°F under the requirements of Section VIII of the Code with the following additional provisions:

1. The impact test requirements of Par. UG-84 shall be met.
2. The material shall be normalized before welding.
3. The maximum allowable stress value shall be 15,000 lbs. per sq. in.
4. The completed vessel shall be stress relieved.
5. All welded butt joints shall be fully radiographed.
6. The specification test bars shall be normalized and then stress relieved at 1100 to 1200 F prior to test.
7. The qualification of the welding procedure and the welders shall conform to the requirements of Section IX. A separate welding procedure shall be made for this material.

Proposed Case No. 1203

(Special Ruling)

Inquiry: Is it permissible to use a roller-equipped jig designed for bottom-ejection of test specimen in lieu of the "Standard Test Jig" for making guided bend specimens, as required by Section IX of the ASME Code? The roller test jig shall conform to the following limitations:

(1) The ram to be used with the roller jig shall be of identical dimension to the ram shown in Figure Q-8 and QN-8, Section IX of the 1953 ASME Pressure Vessel Code.

(2) One roller may be made adjustable in the horizontal direction, so that the specimens of "t" thickness may be tested in the same jig.

(3) Rollers are to be hardened and free to rotate.

(4) The rollers shall be high enough above the bottom of the jig so that the specimens will clear the rollers when the ram is in the low position.

Reply: It is the opinion of the Committee that a roller-equipped jig designed for bottom-ejection of test specimens, is satisfactory for use in lieu of the jig shown in Figure Q-8 and QN-8, Section IX of the 1953 ASME Pressure Vessel Code. Accordingly, the fundamental design features which are mandatory in the Guided-Bend Test Jig, Figure Q-8 and QN-8 are established as follows:

(1) Either hardened and greased shoulders or hardened rollers free to rotate.

(2) The shoulders or rollers shall have a minimum bearing surface of 2" for placement of the specimen.

(3) The ram shall be fitted with an appropriate base and provision for attachment to the testing machine; and

* AISI Standard Variations for Check Analysis shall apply.

shall be designed to minimize deflection and misalignment.

(4) If desired either the rollers or the roller supports may be made adjustable in the horizontal direction so that specimens of "T" thickness may be tested in the same jig.

(5) The roller supports shall be fitted with an appropriate base designed to safeguard against deflection or misalignment and equipped with means for maintaining the rollers centered, midpoint and aligned with respect to the ram.

Case No. 1177-1

(Reopened) (Special Ruling)

Inquiry: Expansion joints are being used in pressure vessel installations. The Code makes no specific provisions for them. Under what conditions may an expansion joint be used as an integral part of a Code pressure vessel?

Reply: The Code does not contain rules for the design of expansion joints but such joints may be used under the conditions of Par. U-2(c) giving due consideration to Par. UG-22. When the expansion joint is manufactured by other than the vessel manufacturer, the manufacturer of the joint shall execute a partial data report as required by Par. UG-120(b), using Form U-2 as far as applicable, plus any necessary supporting data in order that the final inspector of the completed vessel may have the information necessary to satisfy himself that the expansion joint is adequate for the vessel in which it is to be used and that the materials and welding are in accordance with Code rules. The expansion joint shall not be stamped with the Code symbol but the partial data report and any necessary supporting data shall be the final inspector's authority to witness the application of the Code symbol to the completed vessel provided the vessel manufacturer also satisfies himself that the joint is adequate and properly installed for the intended service.

Case No. 1174-2

(Reopened) (Special Ruling)

Delete allowable design stress values for temperatures of 350 and 400 F. in the REPLY—

Add the following Cautionary Note at the end of the REPLY: Appendix NF suggests that, in certain instances, the user should consult with the material producer to assure himself that the material is satisfactory for the intended use. With this alloy, one such instance is the use of cold-worked material held for a long period at temperatures near 212 F.

Table 1—Case 1197—Maximum Allowable Stress Value in Tension for Non Ferrous Bolting Metals, psi.

ALUMINUM AND ALUMINUM ALLOYS

Specification Number	Alloy	Temper	Specified Minimum Tensile Strength psi	Specified Minimum Yield Strength psi	Notes	For Metal Temperatures not exceeding, Deg. F. 100	150	200	250	300	350	400
SB-211	GS11A	—T6	42,000	35,000	7	8,400	8,100	7,700	7,100	6,000	4,800	3,400
SB-211	CG42A	—T4	62,000	40,000	7	10,000	9,700	9,400	9,000	7,800	6,200	4,600
SB-211	CS41A	—T6	65,000	55,000	7	13,000	12,200	11,600	10,400	7,200	4,400	3,000

Note 7. See Paragraphs UNF-12 and UNF-23.

COPPER AND COPPER ALLOYS

Spec. No.	Material	Condition	Size In.	Specified Minimum Tensile Strength psi	Specified Minimum Yield Strength psi	For Metal Temperatures not exceeding, Deg. F. 150	250	300	350	400	450	500	550	600	650	700
SB-12	Copper	Soft	All	30,000	10,000	2,500	2,400	2,200	2,100	2,000						
SB-98	Copper-Silicon	Soft	All	52,000	15,000	3,800	3,800	3,800	3,500							
	Alloys A & D	Quarter Hard	All	55,000	24,000	6,000	5,800	5,600	5,500							
		Half Hard	All	70,000	38,000	9,500	9,000	8,800	8,500							
SB-98	Copper-Silicon	Soft	All	40,000	12,000	3,000	3,000	2,900	2,800							
	Alloy B	Bolt Temper	Up to 1_2, incl.	85,000	55,000	13,800	13,100	12,700	12,300							
			Over 1_2 to 1, incl.	75,000	45,000	11,200	10,800	10,500	10,000							
			Over 1 to 1^1_2, incl.	75,000	40,000	10,000	9,600	9,400	9,000							
SB-150	Aluminum	—	Up to 1_2, incl.	80,000	40,000	10,000	9,900	9,800	9,800	9,700	9,500	9,400	9,000	7,500	6,000	4,500
	Bronze		Over 1_2 to 1, incl.	75,000	37,500	9,400	9,200	9,200	9,100	9,000	8,900	8,800	8,600	7,500	6,000	4,500
	Alloy No. 1		Over 1	72,000	35,000	8,800	8,600	8,600	8,500	8,400	8,300	8,200	8,000	7,500	6,000	4,500
SB-150	Aluminum	—	1_2 to 1, incl.	100,000	50,000	12,500	12,500	12,400	124,00	12,300	12,200	12,000	10,500	9,000	7,500	6,000
	Bronze		Over 1 to 2, incl.	90,000	45,000	11,200	11,200	11,200	11,200	11,100	11,000	10,800	10,500	9,000	7,500	6,000
	Alloy No. 2		Over 2 to 4, incl.	85,000	42,500	10,600	10,600	10,600	10,500	10,500	10,400	10,200	10,000	9,000	7,500	6,000
SB-150	Aluminum	—	Up to 1_2, incl.	80,000	40,000	10,000	9,900	9,800	9,700	9,600	9,500	7,000				
	Bronze		Over 1_2 to 1, incl.	75,000	35,000	8,800	8,700	8,600	8,600	8,400	8,300	7,000				
	Alloy No. 3		Over 1 to 2, incl.	70,000	32,000	8,000	7,800	7,800	7,600	7,600	7,400	7,000				

Note 1. Copper-Silicon Alloys are not always suitable when exposed to certain media and high temperatures, particularly steam, above 212°F. The user should satisfy himself that the alloy selected is satisfactory for the service for which it is to be used.
Note 2. See Paragraphs UNF-12 and UNF-23.

NICKEL AND NICKEL ALLOYS

Spec. No.	Material	Condition	Specified Minimum Tensile Strength psi	Specified Minimum Yield Strength psi	For Metal Temperatures not exceeding, Deg. F. 80	100	200	300	400	500	600	700	800	900	1000	1100	1200
SB-160	Nickel	Hot or Cold Worked—Annealed	55,000	15,000	3,700	3,700	3,700	3,700	3,700	3,700	3,700						
		Hot Rolled or Forged— Hot Finished	60,000	15,000	3,700	3,700	3,700	3,700	3,700	3,700	3,400						
SB-160	Low-Carbon Nickel	Hot Worked or Annealed	50,000	10,000	2,500	2,500	2,400	2,300	2,300	2,300	2,300	2,300	2,200	2,100	2,000	1,800	1 200
SB-164	Nickel-Copper	Class A & B Hot or Cold Worked Annealed	70,000	25,000	6,200	6,100	5,700	5,200	5,000	4,900	4,900	4,900	4,900	4,700			
		Class A Hot Rolled or Forged— Hot Finished (3)	80,000	40,000	10,000	10,000	9,600	9,100	9,000	8,500	8,500	8,500	8,300	4,000			
		Class A Cold Drawn— As Drawn (4) (5)	90,000	70,000	17,500	17,400	16,900	16,200	15,500	15,400							
		Class B Cold Drawn— As Drawn (4) (5)	85,000	50,000	12,500	12,400	12,000	11,500	11,100	11,100							
SB-166	Nickel-Chromium-Iron	Hot or Cold Worked—Annealed	80,000	30,000	7,500	7,300	6,900	6,800	6,800	6,800	6,800	6,800	6,500	6,300	6,000	3,900	2,000
		Hot Rolled or Forged— Hot Finished	85,000	35,000	8,800	8,700	8,500	8,200	8,000	7,900	7,900	7,900	7,700	7,400	7,300	7,200	5,500

Note 3. See Paragraphs UNF-12 and UNF-23.
Note 5. Safe operating temperature arbitrarily set at 500°F. maximum because of lack of data.

Thirty-five Years Ago

Comment on the *JOURNAL* of April 1920

Thirty-five years ago this month the Institute was in something of a ferment over the perennial questions of the salaries of engineers, particularly in the Civil service, recognition of the profession through some sort of legislative control and the advisability or otherwise of adopting some of the tactics of the labour unions. Headquarters didn't move fast enough to suit some of the branches, so we find their reports in the *Journal* of April, 1920, often given over to resolutions, some of them rather pointed.

Branches Study Employment Conditions

The Vancouver Branch was "unalterably opposed to . . . amendments to the Civil Service Act . . . tending to eliminate competitive examinations . . . and to introduce the old evil system of patronage." The Victoria Branch resolved to support daylight saving and a federal purchasing commission. Toronto was all stirred up over the issue of unions or no unions, the unions receiving a good deal of support. A certain amount of calm was restored by the adoption of a resolution asking headquarters "forthwith to request all branches to appoint committees . . . to . . . investigate and report upon . . . an organization designed to bring into operation (an) . . . effort toward the improvement of the economic status of engineers. . . ."It also supported a move by the Winnipeg Branch to get the Institute to bring pressure upon the Civil Service Commission to "have the minimum salaries of (government) engineering staffs made commensurate with those received . . . in private corporations."

Life in the other branches was relatively peaceful and perhaps not less fruitful. The Halifax Branch's committee was still studying projects for a Halifax-Dartmouth bridge. The Peterborough Branch had investigated the foundations of one of the piers of the new Hunter Street bridge and set at rest rumours that they were unsatisfactory. This work was done at the city's request. To the writer it seems questionable if the branch's action was in accordance with the best engineering ethics. Had the branch suspected something wrong and made an investigation of its own volition, it could only have been praised, but, in effect, for it to act as consultant at the city's request looks a little as though it were duped by the city in an attempt by the latter to get expert service without paying for it.

Only one council meeting was reported in this *Journal*. The resolution of the Toronto Branch, already referred to, was received and secured prompt action, council appointing a committee of John Murphy, E. R. Gray, F. B. Brown and A. R. Decary, M.E.I.C., "to consider the whole question of the remuneration of all engineers." The American Society of Chemical Engineers was to meet in Montreal in July, 1920, so council offered "the headquarters of the Institute for the meeting . . . assuring (co-operation) in every way." In view of the size of headquarters, one wonders where council proposed to put these guests, who would certainly be more numerous than the "crowds" of its own members who had burst headquarters to the seams in the past.

Most of the papers in this *Journal* were carryovers from the annual meeting. W. A. McLean, M.E.I.C., Deputy Minister of Highways of Ontario, discussed the road system of his own province. Of the 55,000 miles of road in Ontario, 42,000 were "graded and in use" and 22,000 miles of the latter had some kind of surfacing, ranging from gravel to concrete and high-type bituminous paving. Mr. McLean's budget for 1920-25 was set at $12 annually, a small amount compared to today's figures.

Engineering Education

There are some subjects on which an indefinite amount may be written and no definite conclusions arrived at. Engineering education is such a subject. In this *Journal*, Frank D. Adams, M.E.I.C., then acting principal of McGill University, wrote on The Problems of Engineering Education. The complaints in this paper were the familiar ones of the day and just as familiar now—inadequite preparation of students in our public and private schools, little or no selection of those wishing to enter engineering, lack of ability on the part of the individual student to organize his work efficiently, a curriculum too crowded for the best results, not enough aid for the good, but needy, student. None of these problems has been solved to everybody's satisfaction; nevertheless, it is the writer's feeling that a good deal of progress has been made. Incidentally, Dr. Adams, who was a geologist, was then also dean of McGill's engineering school, so he was discussing that which he knew at first hand.

The behaviour of concrete when exposed to the alkaline soils of the West had long been attracting attention, so Concrete Mixtures in Alkaline Soils, by C. J. Mackenzie, A.M.E.I.C., was timely. Dr. Mackenzie, now one of our honourary members and noted for his long association with the National Research Council, was then professor of civil engineering at the University of Saskatchewan. His paper, a short one, dealt with the manner in which a series of field tests on concretes of various mixes was being conducted; it was too early to report any results. Every concrete engineer knows of Fuller's ideal aggregate grading curve, but what is "Fuller's Ideal Crow"? Not any relation to "Old Crow", we presume.

Another paper on concrete in this *Journal* was Duff A. Abrams' Effect of Vibration, Jigging and Pressure on Fresh Concrete. Mr. Abrams will be remembered as the originator of the water-cement ratio for proportioning concrete, perhaps on the whole the greatest advance yet made in the effort to produce concrete of predictable quality. The conclusions reached were that any of these treatments did concrete no good after it was really in place and might even harm it, but that they were useful as methods of placing. Maybe there is a hint here for some contractors. By looking out the window, the writer can watch the

pouring of concrete in a sizable building foundation; the vibrators are going all day long whether concrete is being placed or not.

Canada was just beginning to realize that it had a stake in civil aviation, so had set up the Air Board, with Col. O. M. Biggar, K.C., as its vice-chairman. Explaining what the board was and how it functioned, Col. Biggar wrote that it had "exclusive jurisdiction over the atmosphere". It could form a military air force, direct and control civil aviation and construct and operate such facilities as it thought necessary. Government was even then considering setting up an air force along lines suggested by the board. Plans were also being made to start civil flying for various government departments, using mostly equipment presented to Canada by the British Air Ministry, including "eighteen airships . . . of different types." Aircraft were not very reliable in 1920 and Col. Biggar was quite right when he wrote, "The development of flying at the moment depends almost wholly upon the engineer. . . . We must develop an engine to show a (high) factor of safety. . . . We must develop a machine not subject to . . . high deterioration in flying." Well, the engineers did it, as everybody knows. The board had already promulgated flying regulations and had announced that it would *not* build any civil airports, a decision afterwards reversed.

Arthur Surveyer, M.E.I.C., now Dr. Arthur Surveyer, HON. M.E.I.C., contributed a note on The Work of the Ecole Polytechnique, in which he emphasized the need to teach the student to think: "Habits of the right kind should be imposed upon (the student) at the very beginning of his college career . . .", as true today as it ever was.

St. Lawrence Seaway

The St. Lawrence Seaway comes in for mention in this *Journal*, both Canada and the United States having asked the International Joint Commission "to go into the matter and report both as to the costs of navigational improvement and power development." The editor correctly foresaw both the sources of opposition to the seaway and the objections to it which would be raised, but spoke a little optimistically of the "last hearings". For a while we would have been justified in thinking that the "last hearings" would never be reached.

"(Telegram) PROFESSIONAL ENGINEERS' BILL OF BRITISH COLUMBIA PASSED THIRD READING . . .", speaks for itself.

In a letter to the editor, C. A. Mullen, A.M.E.I.C., argued that the Institute was trade union; "I see no difference in principle between our organization and that of the bricklayers, though there are . . . differences in tactics . . . they are all the same . . . thing . . . I think we can learn much from . . . the bricklayers. . . . We should . . . hold out the hand of common interest . . . to those whose labour happens to contain more of the physical . . . than ours."

On this contentious note we will come back to 1955.

Elections and Tranfers

At the meeting of Council held at Headquarters, on Friday, March 25th, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

S. Abolash, *Montreal*
M. J. Andrassy, *Montreal*
W. G. Beer, *Brockville*
D. J. P. Coleman, *Riverbend, Que.*
R. W. Crudge, *Toronto*
J. Dzafarov, *Chicoutimi*
C. V. Flemming, *London*
E. R. Gayfer, *Penticton*
D. C. G. Hill, *Hamilton*
A. W. Huffey, *Ear Falls, Ont.*
R. F. Johnston, *Montreal*
Z. A. Kular, *Montreal*
V. F. Murzo, *Bersimis*
D. J. Norman, *Montreal*
W. R. Schriever, *Ottawa*
H. Sorenson, *Montreal*
D. G. Treilhard, *Flin Flon*

Juniors:

B. G. Butler, *Senneterre, Que.*
W. P. Harris, *Montreal*
R. J. Nesbitt, *Quebec*
G. A. Pfefferkorn, *Montreal*
E. H. Schremp, *Montreal*

Transferred from the class of Junior to that of Member:

D. R. Bakewell, *Vancouver*
R. H. Blackmore, *Sherbrooke*
D. Blair, *Toronto*
G. Crevier, *Kingston*
R. A. Carter, *Kapuskasing*
C. G. Fritz, *Fort Garry, Man.*
J. J. Heffernan, *London*
W. E. Lyle, *Edmonton*
K. M. Mitchell, *Toronto*
M. A. Murphy, *Shawinigan Falls*
A. E. O'Reilly, *St. John's*
N. P. Persoage, *Ottawa*
R. G. Price, *Calgary*
J. S. Prifogle, *Richmond, Ind.*
T. M. Thomson, *Vancouver*
G. R. Woolfrey, *Montreal*

Transferred from the class of Student to that of Junior:

R. G. White, *Kingston*

The following Students were admitted:

Nova Scotia Technical College

K. H. W. Barrett — D. D. Todd
H. W. Doane — R. L. Vatcher

Queen's University

J. W. Hickey — R. B. Seed
S. F. E. May — S. A. Stinson
M. N. Patterson

Royal Military College

J. D. Brodie — J. W. Plummer
R. W. Cockfield — H. D. Silver
R. G. Gallinger

University of Toronto

M. Holenski — P. M. Price
D. A. McWhirter

University of New Brunswick

H. V. Craig — G. A. Keith
J. L. Demers — W. D. Lyon
F. B. Ervine — F. H. Ryder
D. F. Hallett

McGill University

G. Girard — D. J. Spurrell

Memorial University of Nfld.

T. R. Janes

Laval University

C. J. A. Francoeur

University of Manitoba

N. D. Brewer
D. C. Azar, B.Sc. (Civil) N.S.T.C., 1954
C. J. Cadorette, Student in CPEQ 1953.

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members:

T. C. Good — A. W. S. Stuckey
R. J. Hilliker — G. E. Zoellner

Juniors:

J. T. Hees — W. J. Meagher
J. Steudel

Junior to Member:

W. M. E. Boytzun

SASKATCHEWAN

Members:

S. R. Blackwell — P. Scott
I. S. Evans — J. Wallcraft

Juniors:

M. Goy — P. van Vliet

Students:

M. A. Barber — W. Petruk
J. E. Campbell — I. F. Rogers
J. A. Naylor — W. R. Tarasuk
A. D. Nordstrum — J. D. Yunker

Junior to Member:

R. H. Banks — W. J. Riddell
D. J. Kelly — D. H. Simpson
J. S. Kermeen — E. R. Smith

NEW BRUNSWICK

Member:

J. A. Slemin

QUEBEC

Members:

L. L. Graciani — J. Laks

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

News of the Members

H. E. Seely has been appointed manager of contract sales of Robertson-Irwin Ltd., of Hamilton. Mr. Seely, who is a graduate in civil engineering of the University of New Brunswick, will assume responsibility for sales across Canada of the Robertson building products. Previous to his new appointment his responsibilities with the company included field promotion, sales engineering and sales administration.

Victor V. Spencer has joined Honeycomb Construction Services Ltd., Toronto, in the capacity of project engineer.

A University of Toronto graduate of 1951, Mr. Spencer was previously employed by P.S.C. Applied Research Ltd., Toronto.

Dodington, Henderson & Chisvin, Toronto consulting engineers, have moved to new offices at 93 Yorkville Avenue. The principals are E. L. Dodington, V. L. Henderson, and J. Chisvin.

A. O. Williams, vice-president of North American Cyanamid Ltd., of Niagara Falls, Ont., has retired from active service with the company after 43 years.

A native of Georgia and a graduate of Georgia Institute of Technology, Mr. Williams joined the American Cyanamid Company in 1912. Since that time he has served the company in many capacities, rising to the position of works manager of the Niagara Falls plant in 1944 and then to the vice-presidency and a director of the company the following year. In 1918 he was loaned to the Air Nitrates Corporation and took part in the designing and operation of U.S. nitrate plants. Later he was in charge of an experimental phosphoric acid plant in Florida for two years.

M. A. Lyons, now residing in Toronto, has recently transferred his membership from Manitoba to Ontario.

Mr. Lyons, whose son is also a member of this Association, is a graduate of the Massachusetts Institute of Technology and in 1912 was appointed chief engineer of the Manitoba Department of Highways. Between 1936 and 1940 he was Assistant Deputy Minister of Public Works and Highway Commissioner for Manitoba and from 1940 to 1946 was Deputy Minister of Public Works.

In 1948 Mr. Lyons entered into private consulting practice and has taken an active part in town planning activities. From 1924 to 1941 he was comptroller of Town Planning for the Province of Manitoba and from 1949 to 1954 was chairman of the St. James Town Planning Commission.

E. G. Fraser, of Toronto, has been appointed manager of marketing and product research of Canada Wire & Cable Co. Ltd., Leaside, Toronto.

Mr. Fraser graduated in electrical engineering from the University of Toronto in 1935 and two years later joined the company's electrical engineering department. He remained at the head office until 1948, with the exception of the years 1940 to 1945, during which he served overseas with Royal Canadian Signals. In 1948 he was transferred to Montreal as eastern district engineer, vacating that opportunity to asume his new responsibilities.

The appointment of **R. B. Steele** as general superintendent of the Canadian National Telegraphs, eastern region, has been announced. A graduate of the Texas A. & M. College, he undertook post-graduate studies at Columbia University and has been associated with communication's work for the past 33 years.

From 1922 to 1929 he was associated with the Bell Telephone Laboratories in New York, where he assisted in the development of carrier telegraph system and telephoto transmission. In 1929 he joined Canadian National Telegraphs as transmission engineer. In 1939 he was appointed chief engineer, which position he held at the time of his recent promotion. During the last war he was loaned to the Federal Government as chief engineer of Defence Communications Limited.

J. H. S. Ford, Toronto, has been made chief engineer of Canadian National Telegraphs, succeeding **R. B. Steele.**

Mr. Ford joined Canadian National Telegraphs following his graduation from the University of Toronto in 1928. In 1943 he was appointed transmission engineer and nine years later became general transmission and plant extension engineer.

Walter G. McBurney, the technical director and former manager of the Niagara plant of North American Cyanamid Ltd., has gone to South Africa where a Cyanamid subsidiary will soon begin production of calcium cyanamide. The new plant, which is located at Witbank, some 150 miles east of Johannesburg, is expected to begin operating in March.

Mr. McBurney, who has been with Cyanamid since 1924, will assist in the initial operations of the new plant.

W. A. Moeser, of the Massey-Harris-Ferguson Company is being transferred from Marquette lez Lille, France, to Australia, where he will be associated with the company's plant at Melbourne.

Mr. Moeser graduated in mechanical engineering from the University of Toronto in 1943 and after service with the Royal Canadian Navy during the last war, joined the Massey-Harris organization in Toronto.

Arthur E. Field, Toronto, has been appointed sales manager of the following affiliated companies: Associated Quarries & Construction Ltd., Stone Division; The Hagersville Quarries Ltd.; and the Kirkfield Crushed Stone Ltd.

Mr. Field graduated in civil engineering in 1948 from the University of Toronto and worked with the Canadian Pacific Railway Company for five years after graduation before joining the above company.

J. L. Richards has formed the consulting firm of J. L. Richards & Associates, with offices at 157 Maclaren St., Ottawa 4. The new organization will engage in civil, electrical and mechanical engineering.

Mr. Richards was formerly associated with the Pennock Engineering Company of Ottawa and is a graduate of Queen's University in both electrical and mechanical engineering.

Dr. Harry R. Shawk has moved from Vancouver, B.C., to the Far East, where he is engaged in an advisory capacity in chemical engineering in Formosa. He recently entered the consulting field in Vancouver after leaving the Caribou Engineering Co. Ltd., with

which he had been engaged in chemical engineering related to the Royalite Products petroleum refinery at Kamloops, B.C.

William E. Laundry has moved from Ottawa to Toronto and is with the engineering division of The De Havilland Aircraft of Canada Ltd. While in Ottawa Mr. Laundry was with the division of mechanical engineering of National Research Council.

J. E. M. MacAllister has terminated his employment with the Steel Co. of Canada Ltd., Hamilton, and has moved to St. Catharines and is manager of The Crawford Fittings Co. (Canada) Ltd., Stamford, Ont.

S. F. Szajder has joined the St. Lawrence Seaway Authority in Montreal as a structural engineer.

Mr. Szajder, who is an engineering graduate of the University of Warsaw, was formerly a design engineer with Proctor, Redfern and Laughlin, of Toronto.

Peter D. Petroff, who has been in the employ of Drake-Merritt at Goose Airport in Labrador, has been apopinted department engineer of the mechanical and electrical departments.

S. S. Vozoris, consulting structural engineer, is now located at 4195 Dundas Street West, Toronto 18.

Murray E. Watts, of Toronto, has been appointed to the position of managing director of LeMoyne Exploration Ltd.

Mr. Watts, who is a graduate in mining engineering from Queen's University, will supervise LeMoyne's field exploration and property investigation program. LeMoyne Exploration is privately sponsored by Little Long Lac Gold Mines, Powell Ronyn Gold Mines, Perrin Gold Mines, Oklend Gold Mines and association companies.

Manitoba

Committees to be Formed

The council of the Association of Professional Engineers of Manitoba at their last meeting decided to circulate a questionnaire to the membership which would deal with the setting up of committees to study the following: Admission to the Association, Social Functions, Scholarships, Engineers in Training, Community Planning, Public Relations, and many others. It was felt that many of the members at large would be anxious to serve on these committees and thereby have a direct hand in the operation of their association. It was also felt that by having the members engaged in these activities it would increase their interest and be beneficial to the Association as a whole.

Engineers in the News

Professor Jack Hoogstraten, president of the Association of Professional Engineers of Manitoba, has been named to represent that body at the Dominion Council of Engineers to be held in St. John's, Newfoundland on May 18, 19 and 20, 1955.

Gordon Christie has recently been promoted to the position of sales manager of the Alpha Manufacturing Co. of Winnipeg. Mr. Christie was formerly chief engineer of that company.

Wilfred Frederiksen has been promoted to chief engineer of the Alpha Manufacturing Co. He was formerly a design engineer.

George H. Curry, formerly employed by Karl Rybka and Associates, consulting engineers in Toronto, has joined the firm of Smith, Carter, Katelnikoff, Architects, Winnipeg, as a mechanical design engineer.

Dave Reid, a graduate of the University of Manitoba, has returned to this province to head the newly formed Prairie Division of the Canadian Comstock Company with head office in Winnipeg. Mr. Reid has been with the same company in Eastern Canada since graduation.

Alberta

The annual convention of the Association of Professional Engineers of Alberta took place at the Macdonald Hotel, Edmonton, on March 12.

"The Alberta Professional Engineers" for February announced details of the program, noting that 100 members had taken part in the preparations. The chairman of the convention committee, E. K. Cumming, encouraging all members to attend, gave some very good illustrations of benefits that can be derived. He said:

"It doesn't matter who you are—draughtsman or president, salesman or consultant, student or professor, employee or employer; every professional engineer stands to gain something by attending this convention.

"Perhaps you will have the opportunity of getting a new idea or approach from a fellow engineer. It may be that you will find a different job that offers you a better chance for advancement. You might learn about a new machine that you can use in your Contracting Department. Someone may tell you about a new book that will answer some of your problems. Everyone can learn more about Association activities, and even if you don't realize any of these benefits you can be assured of a mighty fine time."

The retiring president is L. A. "Chic" Thorssen, who has guided Association affairs through one of the greatest years of progress to date. T. D. Stanley will be president for the year 1955.

Two of North America's leading engineers, it was announced, would take part in the program. Sydney L. Stolte, of St. Paul, Minn., was the annual dinner speaker, his subject being "A Stateside View of Engineering". Mr. Stolte is a past president of the National Society of Professional Engineers, president of the Minnesota Society of Architects, past-president of the Minnesota Society of Professional Engineers, vice-president of the Minnesota Good Roads Association.

Col. L. F. Grant, past president of the E.I.C., and present field secretary of the Institute was the speaker at the president's luncheon. His subject was "Do We Need Snobbery in Canadian University Education". Col. Grant is chairman of the Engineers' Council for Professional Development.

The program promised reports from the several active committees of the Association: the committee on education, which has been organizing local committees throughout the province to study education at all levels; the committee on public relations; the engineering alumni association; the committee studying revision of the by-laws; and the membership committee, which will have a forum discussion on the subject "Why be a Member".

British Columbia

Engineers-in-the-News

Garth Griffiths, of Victoria, has been appointed to the newly-created post of assistant to the general manager and chief engineer of the B.C. Power Commission.

J. Norman Olsen, also of the B.C. Power Commission, and until recently manager of the Comox Valley and Campbell River power districts, has taken over the position of distribution superintendent which was left vacant by Mr. Griffiths.

F. G. Pearce, formerly assistant superintendent of Vancouver Engineering Works Ltd., has been appointed sales manager of Vancouver Machinery Depot, an associate company.

J. M. Bean has accepted a position with H. F. Clarke Ltd. He has been with the Vancouver Iron Works since his graduation in 1950.

John H. Read, of John H. Read and Associates, consulting engineers, announces that he and his partners, **A. M. Read,** and **Peter Jones,** have formed a new partnership to include **Per Christoffersen,** under the new firm name of Read, Read, Jones, Christoffersen.

Col. N. C. Sherman, O.B.E., president of N. C. Sherman Ltd., consulting engineers, and Ironoce Products Ltd., has been appointed Honorary Colonel of Eighth Technical Regiment, Royal Canadian Electrical and Mechanical Engineers (Militia).

Four University of B.C. engineers were named winners of Athlone Fellowships which will bring them, and thirty-four other Canadians, two years of study in United Kingdom universities and industrial laboratories. They were **Robert Affleck,** of Victoria, who will graduate in Chemical Engineering this spring; **Walter Dietiker,** of Calgary,

in this year's electrical engineering graduating class; **David Guthrie,** of Trail, who graduated last year and will receive his master's degree in May; and **Ed Wright,** of Vancouver, who is graduating in Civil Engineering.

R. N. Fraser and **H. N. Halton,** were also awarded Athlone Scholarships. They were recipients of the special "B" awards for graduates in industry. Mr. Fraser, who graduated in electrical engineering from U.B.C. in 1953, is now with the Canadian Westinghouse Co. in Hamilton. Mr. Halton, mechanical engineering graduate of the class of '51, is with the Aluminum Co. at Arvida, Que.

H. R. Shawk, consulting chemical engineer of Vancouver, B.C., has accepted a two year assignment as consultant to the Chinese Nationalist Government in Formosa on behalf of the J. W. White Engineering Corporation of New York. Mr. Shawk will act as engineering consultant for the Foreign Operations Administration in Formosa on all projects connected with chemical manufacture, including an anhydrous ammonia plant and other projected enterprises for the production of fertilizer.

C. T. Humphrey, at present with P. R. Sandwell & Co., is leaving there at the end of the month to join H. A. Simons Ltd.

R. K. Coates is now employed by the Trans Canada Highway Division of the Department of Public Works at Banff, Alta. Mr. Coates holds his B.C.L.S. licence and was formerly with A. L. Purdy, B.C.L.S. at Nelson, B.C.

P. B. Saxvik has accepted a position with the International Pacific Salmon Fisheries Commission at New Westminster. He had previously been with Read, Read, Jones and Christoffersen.

J. A. Stickney has left for Edmonton to take up a position with Northern Construction Co. and J. W. Stewart Ltd. He had been with the Selby Drilling Co

C. N. Moore, of the Consolidated Mining & Smelting Co., has been transferred from Prince Rupert, B.C. to Port Arthur, Ont.

V. Rantela has left for Edmonton where he takes up a new job with Northern Construction Co. and J. W. Stewart Ltd.

Arthur Masuk, a 1954 civil graduate from Saskatchewan, and formerly with the Department of Public Works at Moose Jaw, has accepted a position with Northern Construction and J. W. Stewart Co.

M. Glotman, who is with the Canadian Pacific Railway Co. Ltd. and has been at Penticton for the past two years, has been transferred to Montreal in the bridge design department.

W. L. Johnson is now with H. A. Simons Ltd. He had been with G. S. Eldridge on the Puntledge power project.

A. C. N. de Voogd has accepted a position with the Consolidated Mining & Smelting Co. Ltd. He graduated in 1954 in geological engineering and has been working with the American Smelting & Refining Co. in Vancouver.

E. D. Thorne, who had been engaged in work on the Fraser River Model at the University of B.C., has accepted a position on the staff of the B.C. Engineering Co. Ltd.

R. A. Jemson was recently promoted to the position of Steam Plant Superintendent for Crown Zellerbach Canada Ltd., Ocean Falls, B.C. He joined the staff of Crown Zellerbach following his graduation from U.B.C. in 1950. Mr. Jemson served as assistant steam plant superintendent for about one year prior to his recent promotion.

A. C. Smith, a 1954 civil graduate of Gonzaga University, Spokane, is now employed by Western Consulting Ltd. He had been with H. Gardiner & Co.

Len Cox has accepted a position with Dennis Critoph & Associates. He had previously been working on the Fraser River and Vancouver Harbour Model at U.B.C.

F. C. Leroux, who had previously been with A. L. Swanson & Co., is now employed by H. A. Simons Ltd.

D. H. Tait is now employed with the National Geophysical Co. Ltd. at Dawson Creek. He was formerly with Burnett, McGugan and Hunter, of New Westminster.

J. W. H. Priest is now employed with H. A. Simons Ltd. in the instrument department.

P. A. Apostoli has accepted a position with the Standard Oil Co. He was formerly with Cariboo Engineering.

Soil Mechanics in Australia

The Journal is pleased to publish an invitation from the New Zealand Institution of Engineers for Canadian engineers to participate in the Australian and New Zealand conference on Soil Mechanics and Foundation Engineering, which is to be held in January, 1956.

Through the Conference of Commonwealth Engineering Institutions, members of one organization are welcome to participate in the activities of another, and this invitation is but another manifestation of the usefulness of such an agreement.

It will be noticed that the New Zealand Institution suggests that persons who are interested communicate with their secretary in Wellington, New Zealand. It would be helpful if any person writing there would send copies to the Institute headquarters so that some contact can be maintained with this conference and the Canadian participation in it.

Herewith is the invitation:

The second meeting of the Australian and New Zealand Conference on Soil Mechanics and Foundation Engineering is to be held in New Zealand (at Christchurch) from 23rd to 27th January, 1956. The meeting will be held under the joint auspices of the University of New Zealand and the New Zealand Institution of Engineers.

The organizers of the meeting would welcome any widening of the scope and interest of the proceedings and of the technical papers to be presented for discussion. I am asked, therefore, to extend a general invitation to engineers in other countries to participate in the meeting. It is not expected that many engineers from overseas will be able to visit New Zealand to attend the meeting in person, although they would indeed be welcome, and such an event would be a delight to the organizers. Apart from this possibility, however, avenues for participation are:

(a) The submission of papers for discussion at the meeting;

(b) Written discussion on papers to be presented at the meeting.

In regard to (a), papers are invited covering a wide field, and it is expected that it will be possible to classify those accepted under one or other of the following headings:

(i) Properties of Soils

(ii) Determination of Characteristics of Soils

(iii) Application to Engineering Problems

It would be appreciated if any who contemplate submitting papers would notify their intention and the subject chosen, at the earliest possible date, to the Secretary, N.Z. Institution of Engineers, P.O. Box 5036, Wellington, N.Z.

In regard to (b), it is hoped that advance copies of papers will be available several weeks before the meeting, and if any who wish to participate by way of written discussion will kindly notify the above, advance copies of papers will be mailed to them. Where only papers under a particular heading are of interest it would be helpful if this could be indicated.

Nakash

Richard Edgar Heartz, M.E.I.C.

President

of

The Engineering Institute of Canada

1955

Exactly 38 years of membership will stand behind him when Richard E. Heartz, of Montreal, steps into the presidency of The Engineering Institute of Canada in May.

Joining the Institute as a Student in 1917, when he graduated from McGill University, he became an Associate Member in 1926 and a Member in 1933. He was chairman of the Montreal Branch in 1941, a member of the Council from 1942 to 1944, treasurer in 1948, and vice-president and chairman of the Finance Committee in 1949 and 1950.

He is a member of the board of governors of Sir George Williams College in Montreal; the board of regents of Mount Allison University at Sackville, N.B., where he received an honorary doctorate of laws in 1952; and the board of governors of the Royal Edward Laurentian Hospital, Montreal.

Mr. Heartz was born at Marshfield, P.E.I., and received his early schooling in that province. Later he attended Mount Allison and McGill Universities. Immediately upon receiving his engineering degree at McGill, he enlisted in the Royal Flying Corps and was commissioned as a pilot a few months later.

Now the president and a director of The Shawinigan Engineering Company Limited, and a member of the management committee of the parent Shawinigan Water and Power Company, Mr. Heartz has been with Shawinigan for 35 years.

In 1920 he began his long association with the Company; his first assignment was on the construction of The Shawinigan Water and Power Company's No. 2A development at Shawinigan Falls, Que.

In the following years he acted as resident engineer on construction of such power developments as La Gabelle on the St. Maurice, St. Narcisse on the Batiscan, and Paugan Falls on the Gatineau. He was later transferred to the Company's head office in Montreal, and in 1935 was made assistant chief engineer. He was made vice-president and chief engineer in 1947, and president in 1952.

In 1941 and 1942 he was loaned by the Shawinigan Company as general manager of Wartime Merchant Shipping Limited, assisting in directing and co-ordinating the work of 14 shipyards and their associated suppliers in carrying out the Canadian cargo vessel program. Throughout the war that organization built more than 4,000,000 tons of shipping, and employed at its peak 75,000 men.

He long has been active in the American Society of Civil Engineers and the American Society of Mechanical Engineers. He is a member of the Corporation of Professional Engineers of Quebec.

He has four daughters, one of whom is a graduate in mechanical engineering of Queen's University.

Newly Elected Officers of the Institute

At the Annual Meeting, the president three vice-presidents and thirty-two councillors will take office. They will serve with others whose terms of office continue. The complete list of the Council will appear in the next issue of the *Journal*.

R. M. Hardy, M.E.I.C., who will serve for two years as the vice-president of the Institute representing the Western Provinces, is dean of engineering of the University of Alberta.

Dean Hardy is well known as well for his association with the work of several professional societies in Canada. He was president of the Association of Professional Engineers of Alberta in

R. M. Hardy, M.E.I.C.

1949, and president of the Dominion Council of Professional Engineers in 1953. He is an associate member of the American Society of Civil Engineers.

Dean Hardy was born in Winnipeg, where he received his early education and his professional training, graduating from the University of Manitoba in 1929 with a B.Sc. degree in civil engineering. He received the degree of M.Sc. from McGill University in 1930, after further study. The same year he joined the staff of the University of Alberta as a lecturer in the department of civil engineering. He was later appointed assistant professor, associate professor, and in 1946 succeeded R. S. L. Wilson, M.E.I.C., as dean of the faculty of applied science.

Dean Hardy spent a number of summers at the University of Michigan, studying structural engineering, and during the session 1939-40 he went to Harvard University where he studied soil mechanics, a field in which he has become recognized as an authority. He has done consulting work for the past twenty-five years for industrial concerns in eastern and western Canada, some of his most important assignments being with the Aluminum Company of Canada. He has also given extensive advice on structural and foundation problems in Alberta. In 1947 Dean Hardy received, jointly with E. D'Appolonia, the Keefer Medal of the Institute for their paper "Permanently Frozen Ground and Foundation Design". Dean Hardy also contributed a paper to the 1954 annual meeting, jointly with Charles F. Ripley, M.E.I.C., the subject being "Foundation Investigations for the Kitimat Smelter". He has headed the Canadian Good Roads Association's highway research institute; he is on the advisory council of the Canadian Welding Bureau.

Dean Hardy was appointed late in 1954 to the board of directors of Foundation of Canada Engineering Corporation Limited. He is president of R. M. Hardy Associates Ltd., and vice-president of Materials Testing Laboratories Ltd., of Edmonton and Calgary.

M. A. Montgomery, M.E.I.C., who will be a vice-president of the Institute representing the Province of Ontario, is sales manager of Canadian Blower & Forge Company Ltd. in Kitchener.

In 1937 he joined the sales staff of the company in the Montreal district but was moved to Kitchener as assistant sales manager for engineering products, following a period of war service as an engineer officer in the construction directorate of the Royal Canadian Navy from 1942 to 1945. In 1951 he was appointed sales manager and in 1952 was appointed to the board of directors of the Company.

Born in Prince Albert, Sask., Mr. Montgomery studied mechanical engineering at the University of Saskatchewan, graduating with a B.Sc. degree in

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M. A. Montgomery, M.E.I.C.

1934. He attended Western University in 1953 for a business administration course. From 1935 to 1937 he was employed as sales engineer with Sarco Canada Ltd., of Toronto.

Mr. Montgomery is a member of the Kitchener Chamber of Commerce, the Association of Professional Engineers of Ontario, and the Gyro Club.

Actively associated with the Engineering Institute, he joined as a Junior in 1938, transferring to a Member in 1949. He was elected the first chairman of the Kitchener branch on its inauguration in 1950, and represented the branch on the Council in 1952 and 1953.

R. L. Dunsmore, M.E.I.C., president of Champlain Oil Products Limited in Montreal, has been elected a vice-president of the Institute for the Province of Quebec.

Born at Seaforth, Ont., Mr. Dunsmore received his early education in St. Thomas, Ont., after which he obtained his B.Sc. degree in civil engineering from Queen's University in 1915.

During the first World War Mr. Dunsmore served as a major with the Royal Canadian Engineers. He was awarded the Military Cross for gallantry.

In 1919 he joined the Imperial Oil Limited as an assistant engineer, and for many years he was engaged in engineering and petroleum refinery operations in many parts of Canada and in Peru, South America.

During the second World War he served as director of fuel oil for the Royal Canadian Navy with the rank of commander. He was also appointed assistant director of plans.

Mr. Dunsmore became president of Champlain Oil Products Limited in 1949.

Associated with the Institute since 1924, Mr. Dunsmore is a past vice-president and has also served as chairman of both the Halifax and the Montreal branches of the Institute. He was elected an Associate Member in 1924, transferring to Member in 1939.

Grant R. Jack, M.E.I.C., has been elected to represent the Newfoundland Branch on the council of the Institute. He is chairman of the Board of Commissioners of Public Utilities of Newfoundland.

Mr. Jack has been connected with the Institute since 1918 when he was elected an Associate Member. He became a Member in 1940. In 1941 he was on the executive of the Toronto Branch.

Mr. Jack went to Newfoundland in 1944 as city engineer of St. John's. Previously he had been for many years commissioner of works for the Township of East York, Ontario. He had worked earlier with the firm of Frank Barbour and Associates, Limited, and with the city of Toronto as a resident engineer.

H. B. Carter, M.E.I.C., will represent the Corner Brook Branch on the Council

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R. L. Dunsmore, M.E.I.C.

of the Institute. He is electrical engineer with Bowater's Newfoundland Pulp and Paper Mills Ltd.

He joined the company in 1946 as an electrical draftsman in the engineering department, and was promoted to his present position in 1954.

Born in St. John's, Newfoundland, Mr. Carter received his early education there and in England. He attended Memorial University College in St. John's. He graduated in electrical engineering from McGill University in 1945, having previously received a diploma in engineering from Dalhousie University, Halifax.

Mr. Carter is a councillor of the Association of Professional Engineers of Newfoundland, and is also an associate member of the American Institute of Electrical Engineers. He joined the Institute as a Member in 1950.

E. K. MacNutt, M.E.I.C., of Charlottetown, has been elected councillor for the Prince Edward Island Branch of the Institute. He is district marine agent for the Charlottetown Agency of the Marine Branch of the Department of Transport.

He first joined the Aids to Navigation Branch of the Marine Department (later the Department of Transport), in 1935 in Charlottetown where he held the position of superintendent of lights. In 1947 he was appointed district engineer and in 1950 took his present position as district marine agent.

His previous experience included work as assistant and resident engineer on several construction jobs in the province of Quebec from 1924-1934.

Originally from Malpeque, P.E.I., Mr. MacNutt took civil engineering at McGill University, graduating in 1924. He joined the Engineering Institute as a Member in 1951.

G. F. Bennett, M.E.I.C., managing director of Foulis & Bennett Electric Limited in Halifax, N.S., will represent the Halifax Branch on the council of the Institute.

Mr. Bennett was born in Ottawa and received his early education at public and high schools of that city. He entered McGill University in 1927 and obtained his B.Sc. degree in electrical engineering in 1931. During the summer months of his course he was employed as rodman for the Canadian National Railways on a railway construction survey in northern Saskatchewan, and as a levelman for topographical surveys.

After his graduation Mr. Bennett entered the graduate training course provided by the Canadian Westinghouse Company, and upon completion of this training in 1934, became engaged in engineering, apparatus and merchandise sales in the Company's Halifax office.

In 1941 Mr. Bennett entered into partnership in the firm of Foulis & Bennett Electric Limited in Halifax.

Associated with the Institute since 1929, when he joined as a Student, Mr. Bennett was elected chairman of the Halifax Branch in 1953-54. He had transferred to Junior in 1926 and to Member in 1941. He is also an active member of the Association of Professional Engineers of Nova Scotia, being at present a member of the council.

L. E. Burrill, M.E.I.C., works manager of Sifto Salt Limited, a subsidiary of Dominion Tar and Chemical Company Ltd., in Amherst, has been elected to serve on the Council of the Institute for the Amherst Branch.

Associated with the Dominion Tar and Chemical Company since 1945, Mr. Burrill was previously employed as chemist of Goodrich Refining Co. Ltd. at Port Credit, Ont. from 1934 until 1940, when he joined Defence Industries Ltd. as supervisor and assistant supervisor of the production departments of the cordite plants at Nobel, Ont. and at Winnipeg. He became assistant superintendent of the creosoting plant of Dominion Tar and Chemical Co. Ltd. in Calgary in 1945, and was appointed works manager of the company's salt plant at Waterways, Alta., in 1948. He became superintendent of the salt plant in Sarnia in 1950, and transferring to his present position in Amherst in 1952.

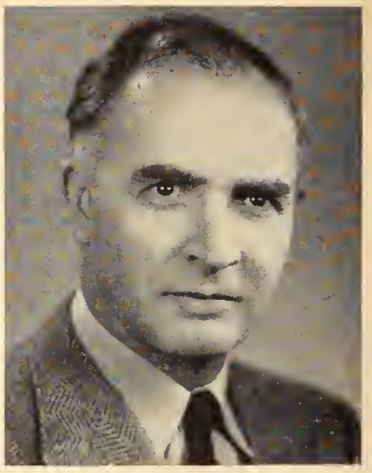
A native of Burgessville, Ont., he attended the University of Toronto, graduating with a B.A.Sc. degree in chemical engineering in 1933. He joined the Institute in 1953 as a member.

A. G. Watt, M.E.I.C., general manager of Consolidated Steel Corporation Ltd., structural steel engineers and fabricators, Saint John, N.B. has been elected to serve on the Council of the Institute for the Saint John Branch.

Born in Glasgow, Mr. Watt came to Canada in 1927 and entered Canadian Vickers Ltd. in Montreal as structural draughtsman and checker. Two years later he joined the Saint John Drydock and Shipbuilding Company Ltd., in Saint John where he served as chief draughtsman for eleven years. The following two years he was employed as personnel manager.

In 1942 Mr. Watt became personnel manager of Foundation Maritime Ltd. in Pictou, N.S.; and he was industrial relations and personnel director of Ferguson Industries of Pictou, N.S. from 1943 to 1945, when he returned to Saint John Drydock and Shipbuilding Company Ltd., as chief draughtsman of the structural steel division, becoming assistant chief engineer in 1950.

An active member of the Saint John Branch, Mr. Watt was general chairman of the Maritime Professional Meeting in 1952, and was elected chairman of the branch in 1953.



L. E. Burrill, M.E.I.C.

He became a Member of the Institute in 1946.

P. C. Levesque, M.E.I.C., has been elected a councillor of the Institute representing the Fredericton Branch. He is superintendent of district operation at Fredericton for the New Brunswick Electric Power Commission.

Mr. Levesque joined the Commission in 1946 and was for two years district engineer in charge of distribution at Grand Falls. In his present position, to which he was appointed in 1948, he is in charge of distribution lines, construction and operation and maintenance of transmission lines.

He was born in Alberta in 1921. He studied accounting at St. Joseph University in 1939, after which he undertook electrical engineering studies at the University of New Brunswick, graduating in 1944. Following this he served for two years in the Royal Canadian Navy as lieutenant.

He has been associated with the Institute since 1943 when he joined as a Student, transferring to Member in 1946. He was first appointed the councillor of the Fredericton Branch during last year.

L. P. Dancose, M.E.I.C., of Mont Joli, Que., has been re-elected to a second term as councillor of the Institute representing the Lower St. Lawrence Branch.

Mr. Dancose was born at St. Evariste, Frontenac County, Quebec. He received his B.A. degree from Laval University, and his B.A.Sc. degree in civil engineering from Ecole Polytechnique, Montreal, in 1942.

E. K. MacNutt, M.E.I.C.

A. G. Watt, M.E.I.C.

P. C. Levesque, M.E.I.C.

Bruce L. Davis, M.E.I.C.

E. T. Buchanan, M.E.I.C.

G. J. Cote, M.E.I.C.

After graduation he was employed for five years in the engineering department, Levis Division, of the Canadian National Railways. He was then promoted to assistant division engineer at Quebec, for the Laurentian Division. At the beginning of 1948 he joined the Canada and Gulf Terminal Railway Company as engineer and assistant superintendent and, at the end of the same year, was promoted to superintendent.

Mr. Dancose joined the Institute as a Student in 1942. He has been active in the Lower St. Lawrence Branch since its inauguration in 1952, and was appointed its first councillor.

Bruce L. Davis, M.E.I.C., general superintendent of the reduction division of the Aluminium Company of Canada at Arvida, has been elected to the Council of the Institute by the Saguenay Branch.

Mr. Davis joined the Aluminum Company at Arvida following his graduation in mining engineering from the University of Toronto in 1941. He has served the company in various capacities, including that of project engineer for the design and bringing into operation of the first post-war electrolytical caustic-chlorine plant at Arvida, using the horizontal stationary mecury cell. He presented a paper on this process to the Montreal Branch of the E.I.C. in 1950. Another, a paper written jointly with Dr. W. C. Gardiner, was published in "Chemistry" in 1949. The reduction division, of which he is superintendent, comprises the aluminum, magnesium, caustic-chlorine and carbon plants.

In 1951 Mr. Davis served as chairman of the Saguenay Branch. Previously he had been chairman of the junior section of the branch which he helped to develop. He joined the E.I.C. in 1941 as a Student, transferring to Junior in 1944 and becoming a Member in 1949. He is a member, also, of the Electrochemical Society.

Edward T. Buchanan, M.E.I.C., chief engineer of the Consolidated Paper Corporation in Grand'Mère, Que., will be on the Council of the Institute representing the St. Maurice Valley Branch.

Mr. Buchanan has been associated with the pulp and paper industry since 1935 when he started with the Corporation in accounting work. He was assistant chief engineer after 1946 and was appointed chief engineer in January 1953.

An electrical engineering graduate of McGill University, class of 1928, Mr. Buchanan was granted the I. H. Weldon Medal of the Technical Section of the Canadian Pulp and Paper Association in 1948.

Mr. Buchanan is assistant provincial commissioner of the Boy Scouts Association, and is past chairman of the St. Maurice Valley Branch of the Institute and former regional representative of the Corporation of Professional Engineers for the St. Maurice Valley.

G. J. Cote, M.E.I.C., will represent the Eastern Townships Branch on the Council of the Institute for a second term. He is senior partner of the firm Cote, Lemieux, Carignan and Bourque, Sherbrooke, Que.

Lieut.-Col. Cote was born at Sherbrooke. He obtained his education at the St. Jean Baptiste Academy, at St. Louis College, and at Ecole Polytechnique, Montreal. He received the degree of B.A.Sc. in civil engineering in 1936. He is a member of the Corporation of Professional Engineers of the Province of Quebec, and has been a Member of the Institute since 1946.

He had done survey work before graduation, and afterwards joined the firm Crepeau & Cote, of which he was the junior partner until 1940. For the firm he supervised municipal projects and bridge constructions.

He was in the Royal Canadian Engineers during the years 1940 to 1945, as a major, being in the French-German Campaign. He served after his discharge as officer commanding the Fusiliers de Sherbrooke, until June, 1952.

On his return he was appointed the senior associate member of the firm of Crepeau & Cote. Later the firm Cote, Lemieux, Carignan & Bourque was formed.

W. H. Gauvin, M.E.I.C.

William Henry Gauvin, M.E.I.C., has been elected to the Council of the Institute, representing the Montreal Branch. He is associate professor in the chemical engineering department at McGill University.

Professor Gauvin received his early education in France and Belgium, having been born in Paris. He studied chemical engineering at McGill University and obtained his B. Chem. degree in 1941, his M. Eng. degree in 1942, and his Ph. D. in physical chemistry in 1944.

Prior to attending McGill, he was a chemist with National Essential Oils Ltd., and later became assistant plant manager. From 1941 until 1943, he was demonstrator in chemical engineering at McGill University, and in 1942 acted as consultant to the American Electroplaters' Society.

Upon graduation in 1944 he joined Frank W. Horner Ltd. as plant superintendent, but returned to McGill University in 1946 as associate professor in chemical engineering. He also acts as consultant for the Pulp and Paper Research Institute of Canada, and consultant for the University of Ottawa.

Professor Gauvin has published 12 papers on the subject of electrochemistry and chemical engineering, and the Pulp and Paper Research Institute is about to publish 13 technical reports on fundamental research projects.

Professor Gauvin became a Member of the Institute in 1951 and is also a member of the Chemical Institute of Canada, the Electrochemical Society, Canadian Pulp and Paper Association and the American Electroplaters' Society.

C. G. Kingsmill, M.E.I.C., will serve on the Council of the Institute representing the Montreal Branch.

Director and assistant to the president of Angus Robertson Limited, general contractors, in Montreal, Mr. Kingsmill joined the company in 1952. From January to March, 1953, he was loaned by the company to Defence Construction (1951) Ltd., as chief engineer.

Mr. Kingsmill was connected with the construction of hydro-electric developments at Ile Maligne and Beauharnois, Que., and paper mills at Dolbeau, Que., Liverpool, N.S., and Baie Comeau, Que. When Quebec-Hydro was formed, he was with the Beauharnois Light, Heat

C. G. Kingsmill, M.E.I.C.

and Power Company and remained with them until 1952. He was then chief engineer of the power development division of the Quebec-Hydro.

A native of Toronto, Mr. Kingsmill attended the Royal Naval College of Canada and graduated in mechanical engineering from the University of Toronto in 1924.

He became a Junior of the Institute in 1927, a full Member in 1940, and was a member of the executive committee of the Montreal Branch from 1953 to 1955.

R. E. Hayes, M.E.I.C., manager of the engineering department of The General Supply Company of Canada Limited, has been elected to the Council of the Institute.

Mr. Hayes is a native of Ottawa. After attending Lisgar Collegiate in Ottawa, he entered McGill University graduating with a B.Sc. degree in engineering in 1924.

Following graduation, Mr. Hayes was employed by Peacock Brothers Limited of Montreal and joined the staff of the engineering department of The General Supply Company of Canada Limited in May, 1925.

He has been responsible for the installation of water purification equipment and automatic pumping stations in many Canadian municipalities including Ottawa, Montreal, Belleville and Sackville, N.B. With the advent of commercial aviation in Canada, he was responsible for the development of

R. E. Hayes, M.E.I.C.

automatic standby power plants to provide emergency power for the many aids to navigation which are now required for the safe operation of aircraft in and out of airports. During the war, he was responsible for the development of power plants for the operation of many secret devices such as radar, telecommunications and naval equipment.

Joining the Institute as a Junior in 1928, he became an Associate Member in 1936 and a Member in 1940. In 1954 Mr. Hayes was elected chairman of the Ottawa branch and for two years previously had served on the management committee. He is a member of the Association of Professional Engineers of Ontario and of the Corporation of Professional Engineers of Quebec.

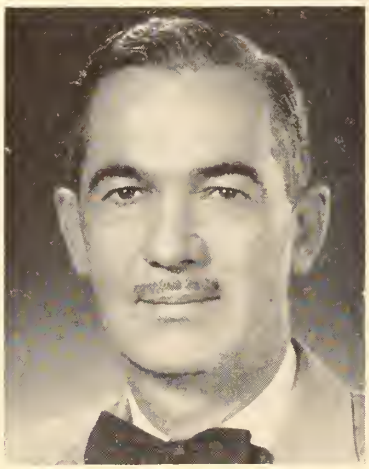
H. B. Brewer, M.E.I.C., has been elected to represent the Brockville Branch on the Council of the Institute for 1955.

Assistant manager of the Maitland Works of Dupont Company of Canada Limited since July 1, 1954, when the Company was formed, he was formerly an employee of Canadian Industries Ltd. Mr. Brewer had served with C.I.L. for the past 24 years. He has been engaged in explosives, agricultural chemical and nylon manufacturing activities along works engineering, construction and administration lines.

A native of Fredericton, N.B., Mr. Brewer studied electrical engineering at the University of New Brunswick, graduating with a B.Sc. degree in 1928.

He was employed by Aluminum Company of Canada Ltd. in 1928, with Hydrographic Surveys in 1929, and joined Canadian Industries Ltd. in 1930.

Mr. Brewer served as councillor of the Brockville Branch when it was inaugurated in 1954.



H. B. Brewer, M.E.I.C.

H. G. Conn, M.E.I.C., has been elected a councillor of the Institute representing the Kingston Branch. He is head of the department of mechanical engineering at Queen's University, which appointment he has held since 1946. He is a private consultant in heating and ventilating.

Professor Conn was earlier a plant engineer with Procter and Gamble Company Ltd., in Hamilton. During the recent war he served for six years in Canada, England and Europe as a lieutenant colonel in the R.C.E.M.E.

Professor Conn is a member of the Institute of Mechanical Engineers of England and serves as a member on the Institution's Canadian Advisory Committee. He also serves as a member on the examining board of the Association of Professional Engineers of Ontario, and is a member of the American Society of Mechanical Engineers. He has been an active member of the Engineering Institute since 1931. He is currently a representative on the A.S.M.E. Educational Committe.

In 1931 he received his B.Sc. degree in mechanical engineering from Queen's University and in 1946 graduated with a M.S. degree from the University of Michigan.

Sydney Sillitoe, M.E.I.C., has been re-elected to the Council of the Institute for his second term, to represent the Belleville Branch.

A native of Edmonton, Mr. Sillitoe received his early education there and undertook electrical engineering studies at the University of Alberta, graduating with a B.Sc. degree in 1931. He took two more years in communication and structural design and received his M.Sc. degree in 1933. He then attended McGill University for research work for one year, the result being the publication of a paper in the Canadian Journal of Research on the subject "Reflections from the Ionosphere".

Sydney Sillitoe, M.E.I.C.

Mr. Sillitoe is production superintendent of the Belleville plant of Northern Electric Company Ltd. Joining the company in 1934 in Montreal as a junior engineer, he was appointed technical engineer in charge of production engineering in 1943, and broadcast equipment design engineer in 1946. In 1947 he became an equipment engineer

H. G. Conn, M.E.I.C.

at the Belleville plant, and in 1950 was named assistant superintendent of general assembly. He received his appointment as production superintendent in 1951.

He was assigned to the Department of Munitions and Supply on a technical mission to England in 1941.

Mr. Sillitoe is a member of the Association of Professional Engineers of Ontario and an associate member of the Institute of Radio Engineers. He is a charter member of the Montreal section of I.R.E., serving as its secretary in 1937-38, and its chairman in 1938-39. He has been associated with the work of the Canadian Radio Technical Planning Board, and of the Radio Manufacturers Association of Canada. He has also served on the rehabilitation advisory committee of the school of electronics of Ryerson Institute. When the Belleville Branch of the Institute was formed in 1950 Mr. Sillitoe was elected secretary and was in 1952 the first elected councillor.

Mr. Sillitoe has presented technical papers to branches of the Engineering Institute, the Canadian Electrical Association and the Canadian Institute of Mining and Metallurgy. Papers on mine

Mackenzie MeMurray, M.E.I.C.

radio signalling equipment have been published in the Canadian Mining and Metallurgical Bulletin, November, 1949, and the Canadian Mining Journal, September 1949.

Mackenzie MeMurray, M.E.I.C., has been elected councillor of the Institute representing the Toronto Branch. He is divisional welding engineer with Dominion Bridge Company Limited.

Mr. McMurray received his B.A.Sc. degree in metallurgical engineering from the University of Toronto in 1939, and spent some time as a demonstrator in mining engineering at that university before joining Dominion Bridge Company Limited in 1940 as metallurgist and chief inspector in the munitions division. He occupied that position until 1945 when plant operations were brought to a close. He then became engaged in design work both in Toronto and at the boiler division of the Company's head office in Lachine, Que.

In 1948 Mr. McMurray was appointed a sales engineer in the boiler division of the company, and a year later, a welding engineer of the Ontario division.

He has been a member of the Institute since 1948, and has since cooperated in many of the Toronto Branch projects. He is the immediate past chairman of the branch.

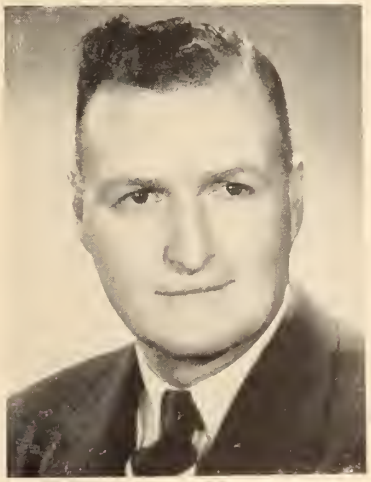
D. D. C. McGeachy, M.E.I.C., president and general manager of Canada Vulcanizer and Equipment Company Ltd. in London, Ont., has been elected a councillor of the Institute representing the London Branch.

Mr. McGeachy was affiliated with this company as vice-president and general manager in 1948 and was appointed president in 1949. From 1946 until 1949 he was employed by William Kennedy and Son at Owen Sound, Ont., and previously was engaged in torpedo inspection work for the British Admiralty Delegation at Falls River, Mass., and in New York; he terminated his service with the R.C.N.V.R. in 1946 with the rank of lieutenant. He is a mechanical engineering graduate of Queen's University, class of 1940.

Mr. McGeachy served as chairman of the London Branch of the Institute in 1952. He has been an active participant in the work of the Institute since joining it as a Student in 1938.

W. R. Mitchell, M.E.I.C., has been elected a councillor of the Institute to represent the Border Cities Branch. Mr Mitchell is with Canadian Bridge Company Limited in Walkerville, Ont.

Born in Winnipeg, Mr. Mitchell graduated in 1934 from the University of Manitoba and for three years worked with the Manitoba Bridge and Iron Works at Winnipeg as production clerk, shop inspector and sales engineer. From 1937 until 1939 he was an estimator with London Structural Steel Company Limited in Ontario and for a short time was a structural steel designer with Defence Industries Limited at Montreal.



W. R. Mitchell, M.E.I.C.

He joined Canadian Bridge Company Limited as a draftsman in 1940, and is now contracting engineer for the Company.

Mr. Mitchell has been actively associated with the work of the Institute, serving as chairman of the Border Cities Branch in 1952. He joined the Institute in 1934 as a Student, transferring to Member in 1942.

G. K. Hunter, JR.E.I.C., who is construction engineer for the Port Hope Division of the Department of Highways of Ontario, has been elected to the Council of the Institute for 1955 to represent the Port Hope Branch.

Mr. Hunter was born in Toronto and received his early education there. During the war he served as a navigator

D. D. C. McGeachy, M.E.I.C.

with the R.C.A.F., and following discharge took a civil engineering course at the University of Toronto, graduating in 1950. During his university course he was employed during the summers by the Department of Highways as instrumentman, laboratory assistant, and as engineer's assistant. He then joined the permanent staff of the Department upon graduation.

Mr. Hunter became a Student member of the Institute in 1950 and transferred to Junior in 1952.

G. L. Hood, M.E.I.C., has been elected to the Council of the Institute to represent the Nipissing and Upper Ottawa Branch.

He has been with the Hydro-Electric Power Commission of Ontario since 1938 and was appointed in 1949 supervising meter engineer, North Eastern Region, at North Bay.

Joining the H.E.P.C. as assistant meter and relay engineer at North Bay, he was later stationed at Port Arthur and at Timmins, Ont.

Born at Minnedosa, Man., he was educated at Oxbow, Sask., and graduated in electrical engineering from the University of Manitoba in 1932. In 1934, he started work on electrical maintenance with the Howey Gold Mine. During 1937-1938 he was a demonstrator at the University of Toronto. For a short time thereafter he was employed as a draughtsman with the Toronto Harbour Commission.

In 1952 Mr. Hood served as chairman of the North Bay Temiskaming Branch of the Institute.

G. L. Hood, M.E.I.C.

R. H. Moore, M.E.I.C.

Mr. Hood was closely associated with the activities leading to the formation of the Branch in 1952. He was chairman during its first year of operation.

R. H. Moore, M.E.I.C., chief mechanical and electrical engineer with Falconbridge Nickel Mines Ltd., has been elected to the Council of the Institute representing the Sudbury Branch.

Born in Winnipeg and receiving his early education there, Mr. Moore studied at the University of Manitoba graduating with a B.Sc. degree in civil engineering in 1933 and in electrical engineering in 1935.

Following employment with the Hudson Bay Mining and Smelting Company Ltd. in Flin Flon, Man. and the Babcock-Wilcox and Goldie McCulloch Company Ltd., in Galt, Ont., Mr. Moore joined his present company as a design engineer in 1946. In his present position he is responsible for the mechanical and electrical engineering supervision of the company properties in the Sudbury district.

G. S. Halter, M.E.I.C.

Joining as a Student member of the Institute in 1930 and becoming a full Member in 1941, Mr. Moore served as chairman of the Institute's Sudbury branch in 1951.

G. S. Halter, M.E.I.C., an electrical design engineer with C. D. Howe Company Ltd., in Port Arthur, Ont., has been elected councillor of the Institute representing the Lakehead Branch.

A native of Fort William, Mr. Halter received his general education at the Central Public School and the Fort William Collegiate and entered the University of Manitoba in 1942 where he graduated in electrical engineering in 1946.

During the summers from 1942 until 1944, Mr. Halter was employed with the Canadian Car and Foundry Company in Fort William as inspector of aircraft parts, draftsman, investigator and shop contact man for the engineering department. In the summer of 1945 he served with the Fort William Hydro as meter technician. He joined C. D. Howe Company in 1946.

Mr. Halter was secretary-treasurer of the Lakehead Branch for three years, a member of the directorate for one year, vice-chairman for one year. As chairman in 1953-54 he was, at 28, the youngest man ever to hold that position for the Lakehead Branch. He joined the Institute in 1945, as a Student, transferring to Junior in 1948 and to Member in 1951.

C. V. Antenbring, M.E.I.C., elected to the Council of the Institute to represent the Winnipeg Branch, is president and manager of Cowin & Co. Ltd., reinforced concrete engineers, of Winnipeg.

A native of Winnipeg, Mr. Antenbring received his early education there and later attended the University of Manitoba. He graduated in 1926 with a B.Sc. degree in civil engineering.

Mr. Antenbring joined Cowin & Co. Ltd., in 1927 as a designer of reinforced concrete, following some months in Chicago, Ill. with Keller & DeLeew, municipal engineers.

He became a Student member of the Institute in 1924, transferred to Associate Member in 1937 and to Member in 1940. He served as chairman of the Winnipeg Branch in 1949. He is a member

C. V. Antenbring, M.E.I.C.

and past president of the Association of Professional Engineers of Manitoba.

J. G. Schaeffer, M.E.I.C., of Regina, has been elected to serve on the Council of the Institute, representing the Saskatchewan Branch.

Director of the division of sanitation of the Health Department of Saskatchewan since 1947, Mr. Schaeffer joined the Department as an engineer in 1937.

He is a civil engineering graduate of Queen's University, class of 1923. He did summer work as a rodman and inspector in the city engineer's department at Regina in 1921. In 1922 he worked as an instrument man with the Department of Highways of Saskatchewan.

Following graduation, he joined the

J. G. Schaeffer, M.E.I.C.

City of Regina as a sewage engineer and superintendent of sewage disposal works. In 1928 he went to Saskatoon to work with Underwood & McLellan, consulting engineers, returning in 1937 to Regina as engineer with the Provincial Health Department.

Mr. Schaeffer was chairman of the Saskatchewan Branch of the Institute for 1952. He has been active in the interests of the Institute in the West, having joined as a Student in 1922. He transferred to Associate Member in 1927, to Member in 1940.

E. K. Cumming, M.E.I.C., has been elected a councillor of the Institute, representing the Edmonton Branch. He is president of Cumming Galbraith Limited in Edmonton, a sales and engineering service company. He is also director of several other Alberta companies.

Born in Cayley, Alta., Mr. Cumming received his early education there and in Nanton. He began his engineering course at the University of Alberta and completed his two final years at McGill University, graduating with a B.Eng. degree in mechanical engineering in 1944.

He then served as an engineer lieutenant with the Royal Canadian Naval Volunteer Reserve in the European area, after which he was appointed instructor in mechanical engineering at the University of Alberta, and at the same time supervisor of building construction at the university.

E. K. Cumming, M.E.I.C.

H. P. Hamilton, M.E.I.C.

He formed the Cumming Galbraith company in 1948 to handle the supply of heating, ventilating and air conditioning equipment for the C. A. Dunham Company, the Canadian Sirocco Company and Powers Regulator Company of Canada Limited.

Mr. Cumming is a member of the Association of Professional Engineers of Alberta, and is chairman of the public Relations Committee. He has helped to advance the work of the Institute in Alberta, being elected secretary-treasurer of the Edmonton branch in 1948. He was the Edmonton Branch chairman in 1954.

H. P. Hamilton, M.E.I.C., design engineer with the Consolidated Mining and Smelting Company Ltd. in Trail, B.C., has been elected councillor of the Institute to represent the Kootenay Branch.

Originally from Regina, Mr. Hamilton studied electrical engineering at the University of Toronto, graduating in 1934. In 1935 he went to Swift Current, Sask., as a surveyor's helper and draftsman with the Water Development Committee. From 1936 until 1940, he was employed with the Churchill River Power Co. Ltd., at Island Falls, Sask. There he worked as a draftsman on design and detail for water storage facilities at Reindeer Lake. He worked later on design and detail for an additional unit in the same plant.

He joined the design department of the Hudson Bay Mining and Smelting Company Ltd. at Flin Flon, Man., in 1940, assisting in the layout of electrical equipment. In 1946 he took his present position with Consolidated Mining and Smelting Company.

Mr. Hamilton is a member of the Association of Professional Engineers of British Columbia. He was a charter member of the Kootenay Branch of the Engineering Institute when it was formed in 1946. He was chairman of the Branch in 1951. He has been a member of the Institute since 1945, having joined as a Junior in 1938.

M. L. Wade, M.E.I.C., has been elected to a second term as councillor of the Institute, representing the Central British Columbia Branch.

He is a consulting engineer at Kamloops, practising in the electrical and hydraulic field serving the interior of British Columbia and parts of Western Alberta.

H. T. Libby, M.E.I.C.

A Canadian, though born in San Francisco, Cal., and receiving his early education in British Columbia, Mr. Wade graduated in 1912 in electrical engineering from McGill University. There he made a special study of hydraulics.

He was employed in construction and municipal engineering in British Columbia for the next two years, after which he was associated with the Canadian Westinghouse Company as an erecting engineer in Montreal and Hamilton and as sales engineer in Winnipeg. He practised engineering in Regina for two years and from 1921 to 1923 was associated with Canadian General Electric Company at Vancouver as a service engineer.

In 1923 he joined the East Kootenay Power Company as superintendent of generating stations, and was promoted to general superintendent the following year. In 1930 he was engaged by the West Kootenay Power and Light Company to carry out damsite investigation and superintend surveys in connection with the Adams River Canyon. This led to the establishment of Mr. Wade's present consulting practice.

Mr. Wade helped inaugurate the Central British Columbia branch in 1949, was its first chairman, and has been active with the branch ever since. He joined the Institute as a Junior in 1914, transferring to Associate Member in 1917, and to Member in 1936.

He is also a member of the Association of Professional Engineers of British Columbia and of the American Waterworks Association, Canadian Section.

H. T. Libby, M.E.I.C., has been elected to represent the Vancouver Branch on the Council of the Institute.

Mr. Libby is superintendent of gas distribution with the B.C. Electric Gas Division in Vancouver. He has held various positions in this company, with which he has been associated since 1923.

He is the author of several technical articles mostly concerning gas distribution, one of which was printed in Canada, the United States and Great Britain.

Born in Kent, England, he came to Vancouver at an early age.

Mr. Libby became a member of the Association of Professional Engineers of British Columbia in 1946 by examination as a mechanical engineer. He is a member of the British Columbia Engineering Society, the National Association of Corrosion Engineers, the American Gas Association and the Vancouver Board of Trade.

In 1947 he joined the Engineering Institute as a Member, was elected to the executive of the Vancouver Branch in 1951 and was appointed chairman of the publicity committee in the same year. In 1952 he served as vice-chairman of the Branch and chairman of the program committee, and in 1953 was elected chairman of the Branch.

W. A. Bowman, M.E.I.C., designing and structural engineer with the British Columbia Department of Public Works in Victoria, has been elected to represent the Vancouver Island Branch on the Council of the Institute.

Born at Port Arthur, Ont., Mr. Bowman received his general education at the Hudson Public School and the Port Arthur Collegiate Institute, after which he attended the University of Manitoba graduating with his B.Sc. degree in 1942.

During the summer months of his university course, he served as rodman and chainman with the Ontario Department of Highways and with the Canadian National Railways, and was also a construction inspector with C. D. Howe Co. Ltd. in Port Arthur.

After service with the Royal Canadian Engineers during the war, he joined the C. D. Howe Company in Port Arthur in 1946 as a structural designer.

M. L. Wade, M.E.I.C.

W. A. Bowman, M.E.I.C.

The following year he was transferred by the company to Vancouver, B.C. as a resident engineer.

In 1949 he joined the Brish Columbia Department of Public Works in Victoria as an engineer in training, and the next year was appointed to his present position.

Mr. Bowman served as secretary-treasurer of the Vancouver Island Branch in 1951 and was elected chairman for 1954-1955. He is also a member of the Association of Professional Engineers of British Columbia.

Lt. Col. M. C. Sutherland-Brown, M.E.I.C., who is senior highway engineer on the Alaska Highway for the Department of National Defence in Whitehorse, has been elected to serve on the Council of the Institute, representing the Yukon branch.

Lt. Col. Sutherland-Brown was born in London, England, but received his general education at University School in Victoria, B.C. He undertook engineering training at the Royal Military College and Queen's University, graduating from the latter with a B.Sc. degree in civil engineering in 1939.

During 1938 and 1939 he was employed on general construction as works officer

M. C. Sutherland-Brown, M.E.I.C.

with the Royal Canadian Engineers, and as assistant district engineer officer in Calgary, Alta.

From 1939 until 1945 he served in various military engineering units overseas, during which time he rose from the rank of lieutenant to that of lieutenant-colonel.

For two years after the war, Lt.-Col. Sutherland-Brown was district engineer officer on general construction in Vancouver, B.C. He was posted to Army Headquarters in 1947 as assistant director of works and accommodation.

Prior to his appointment to the Northwest Highway System in 1952, he attended military courses in England and Germany.

Lt. Col. Sutherland-Brown was chairman of the Yukon Branch for 1954. He joined the Institute in 1937 as a Student, transferring to Junior in 1946 and to Member in 1947. He is also a member of the Association of Professional Engineers for Ontario.

Personals

News of the Personal Activities of Members of the Institute

Brigadier Jean-Paul Carriere, M.E.I.C., has been appointed to the position of chief engineer of the harbour and rivers engineering branch of the Department of Public Works of Canada, succeeding Lt.-Col. A. A. Anderson who has retired.

Brigadier Carriere has had wide experience both in government and private practice as a professional engineer. He was born in Hull, Quebec, and was educated at College Notre-Dame and Ecole Polytechnique in Hull, and at LaSalle Academy and the University of Ottawa.

J.-P. Carriere, M.E.I.C.

He served as an engineer in various capacities with the federal Department of Public Works from 1929 to 1940, when he enlisted and proceeded overseas as an officer in the Corps of Royal Canadian Engineers.

While overseas he served in important pre-invasion functions of the Canadian Army and he was returned to Canada in 1942 to attend the war staff course. Later he became a member of the directing staff of the same course. Brigadier Carriere returned overseas in 1943 and during the invasion of Europe he was in charge of construction of defence airfields for army support. His final appointment in the field was that of deputy chief engineer, First Canadian Army, with special responsibility for the construction of bridges across the Rhine and its tributaries for the final push into Germany.

For his war services he received the award of Officer of the Order of the Crown of Belgium, and the French Government conferred upon him the honours of Chevalier de la Legion d'Honneur and the Croix de Guerre avec Palme.

In 1945, after his discharge from the active army with the rank of brigadier, he returned to his position in the engineering branch of the Department of Public Works in Ottawa, where he remained until early in 1946, when he resigned from the federal civil service to become city manager and chief engineer of the City of Hull.

During the following three years he was also a member of the National Capital Planning Committee. From 1949 to 1951 he was chief engineer for the Dufresne Engineering Co. Ltd., of Montreal, and from 1951 until June, 1954, he was chief engineer for the firm of Collet Freres Ltee., of Montreal.

In June last year Bridagier Carriere rejoined the federal civil service with his appointment to the newly established position of director of development engineering, Department of Public Works. In this position he has had responsibility for the federal government's activities in the construction program of the Trans-Canada highway, the design of the Pembroke-Alumette Island Interprovincial Bridge, and other development engineering projects.

Nelson Mann, M.E.I.C., assistant deputy minister of the Nova Scotia Department of Trade and Industry has been named executive manager of the Atlantic Provinces Economic Council.

The Economic Council accepted its incorporation in January, and laid the

Nelson Mann, M.E.I.C.

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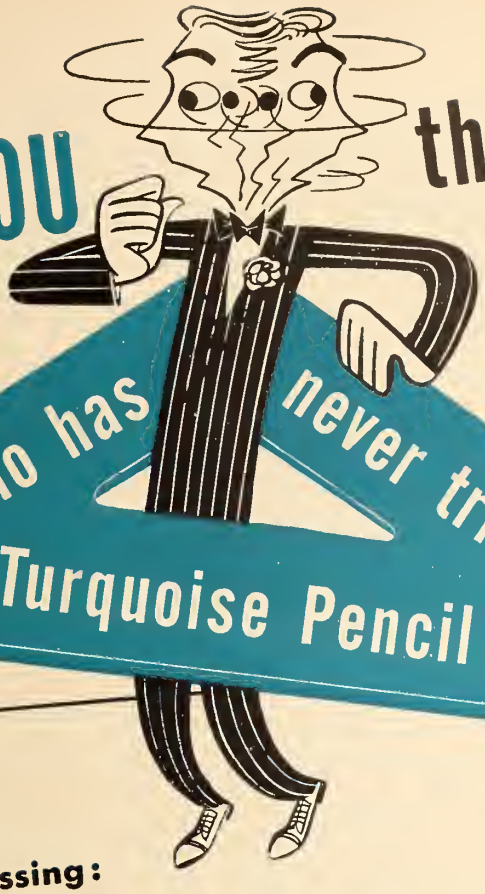

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groundwork for its role in economic development of the four provinces. It will survey and study the difficulties and advantages of business and recommend methods to ensure the economic future. It will oppose, or support, legislation affecting trade, commerce, manufacturing and industrial development and aim at stimulating discussion and bringing about united action. The appointment of Mr. Mann was one of the Council's first actions.

He is a native of Sydney, where he attended public and high school. He received his engineering certificate from Acadia University. Two years later he graduated in mechanical engineering from the Nova Scotia Technical College.

Following graduation he worked as a laboratory technician and assistant meter engineer with the Imperial Oil Ltd. refinery at Imperoyal and as plant superintendent with the Eagle Pencil Co. He spent the war years with the Canadian Industries Ltd., in several capacities.

Mr. Mann was responsible for the improved design of both 9-mm. and .303 ammunition during World War II and also prepared manuals on pencil manufacture and small arms ammunition manufacture, the first of their kind in both fields.

He joined the consulting firm of J. D. Woods and Gordon Ltd., in Toronto, after the war and later did consulting engineering work with a number of firms in the Toronto area on production control plans and organizational set-up principally in the metal and textile fields. He returned to Nova Scotia to accept his appointment with the Nova Scotia government in 1950.

Headquarters of the Council are in Moncton, where Mr. Mann will have his office.

J. Douglas Kline, M.E.I.C., was appointed assistant manager of the Halifax Public Service Commission, effective January 1, 1955. Mr. Kline will also retain his post of chief engineer.

Mr. Kline at that time resigned from the offices he held for nine years in the Association of Professional Engineers of Nova Scotia, those of secretary-treasurer and registrar.

J. Douglas Kline, M.E.I.C.

He was born in Halifax, and received his education there. He graduated from St. Mary's University in 1938 with a bachelor of science degree, and from Nova Scotia Technical College in 1940 with a degree in civil engineering. After graduating he started with Defence Industries Limited in Montreal as a draughtsman remaining with the company until 1944 when he was design supervisor at the Pickering Works.

Mr. Kline went to the Halifax Public Utilities Commission in 1944 as design engineer. In 1946 he was appointed chief engineer.

Mr. Kline was secretary of the Halifax Branch of the Institute in 1946-48. He retains his offices in several other associations, serving as secretary-treasurer of the Maritime Branch of the Canadian Section of the American Water Works Association; member and provincial government representative on the Halifax County Vocational Education Board; and chairman of the Provincial Disaster Services Committee for the Nova Scotia Division of the Canadian Red Cross. He is also a member of the Executive Alumni Association, St. Mary's University, and a member of the Halifax Board of Trade.

He has been active in Boy Scout Association activities, Home and School Association and civil defence.

R. E. Tweeddale, M.E.I.C., has been appointed assistant chief engineer of the New Brunswick Electric Power Commission in Fredericton. He was formerly in charge of the commission's development division.

A 1935 graduate of the University of New Brunswick in electrical engineering, Mr. Tweeddale was afterwards employed as district highway engineer with the New Brunswick government. He joined the Royal Canadian Air Force in 1940 and served overseas as radar officer until his discharge as a flight lieutenant at the end of the war.

R. E. Tweeddale, M.E.I.C.

He then joined the engineering department of the New Brunswick Electric Power Commission and was subsequently named manager of operations. In 1950 he was placed in charge of the commission's development division.

Mr. Tweeddale is chairman of the Fredericton Branch of the Institute.

Professor E. A. Allcut, M.E.I.C., will be the chairman of a newly formed Canadian Standards Association committee. It is proposed that the committee formulate a standard on atmospheric pollution control, and it has been further suggested that the report and model ordinance prepared by the E.I.C. Committee on Air Pollution Control in Canada be used as a basis for such a specification.

Prof. Allcut, head of the department of mechanical engineering, University of Toronto, is chairman of the E.I.C. Committee, chairman of the Air Pollution Board of Toronto, and a member of the Committee on Air Pollution Control of the American Society of Mechanical Engineers.

E. W. B. Donohue, M.E.I.C., is associated with the St. Lawrence River Joint Board of Engineers in Cornwall, Ont. For several years previously he was in private construction practice in Montreal, which he set up following a period of association as engineer and

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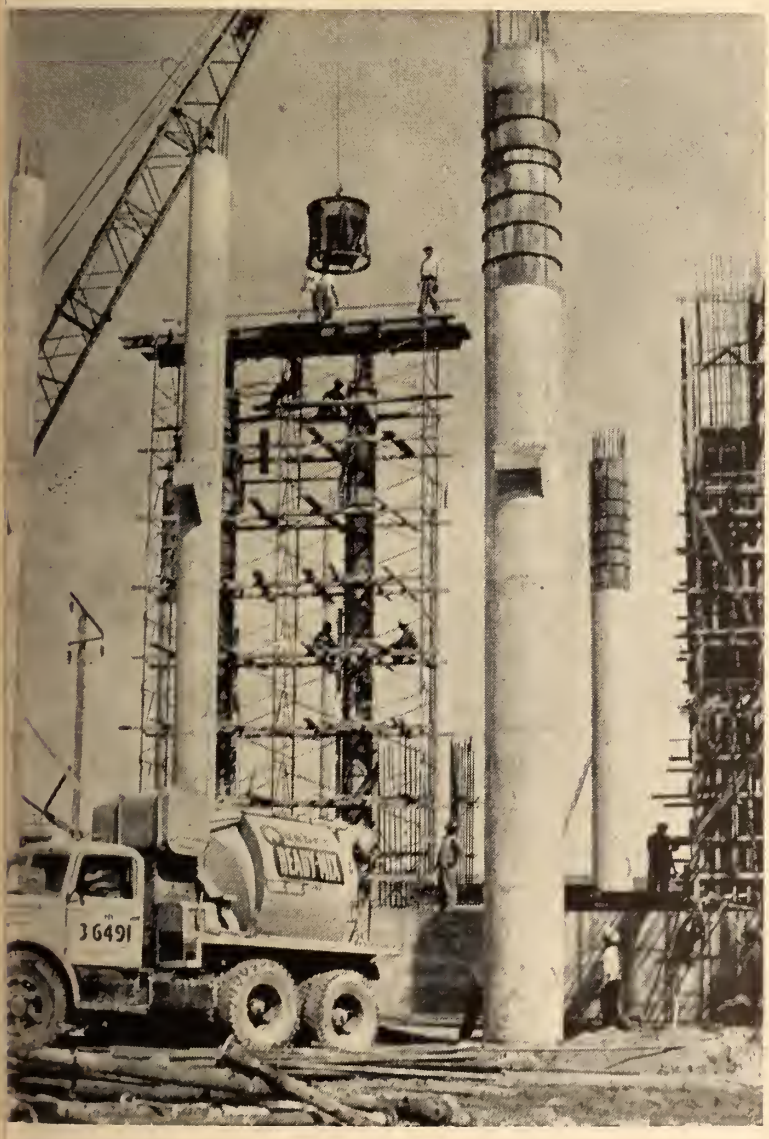

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security officer with Defence Industries Limited and Canadian Industries Limited, in Montreal.

A 1924 civil engineering graduate of McGill University, Mr. Donohue spent some of his earlier years in the employ of Domill Construction Company at Dalhousie, N.B.

Major Malcolm Turner, M.E.I.C., has been transferred to the First Field Regiment at Vedder Crossing, B.C.

Major Turner attended the Royal Military College in Kingston until 1939 when he went overseas to serve with the R.C.E. He returned to Canada at the end of the War in 1945, and entered Queen's University to study civil engineering, graduating in 1947.

Following graduation, Major Turner was posted to the office of the command engineer in Halifax, and in 1949 was transferred to Canadian Army H.Q. for the New Brunswick area in Fredericton as area engineer. In 1952 he was sent to command a field squadron, R.C.E., in Chilliwack, B.C.

Prior to his recent assignment, Major Turner spent one year in the United Kingdom at the R.C.E. Staff College in Camberley.

Peter D. Dalton, M.E.I.C., president of Dalton Engineering and Construction Co. Ltd. in Toronto, has been elected president of the Ontario General Contractors Association at the Association's recent annual meeting.

Mr. Dalton formed the P. D. Dalton Company in 1943 which later became a limited company operating as Dalton Engineering and Construction Co. Ltd., of which he has been president since 1946.

A 1928 graduate of McGill University with a B.Sc. degree, Mr. Dalton was for a time construction manager with Geo. A. Fuller Company of Canada Ltd., in Toronto.

M. G. Taylor, M.E.I.C., has been appointed manager of the Nova Scotia Power Commission in Halifax.

During the past 17 years he has been general manager of the three Venezuelan properties which are subsidiaries of International Power Company Ltd., and more recently has been acting as sponsor of the two electrical properties in the Republic of El Salvador, also subsidiaries of the International Power Company.

Mr. Taylor received his B.Sc. degree in electrical engineering from the Nova Scotia Technical College in 1927 and his M.Sc. degree from the Massachusetts Institute of Technology in 1931.

J. Hargreaves, M.E.I.C., Hon. Professor of Astronomy at the University of Alberta since 1953, has recently left for Colombo with the Ottawa Astronomical Research Expedition on a four-month tour.

An R.P.E. of Ontario, Professor Hargreaves was in 1948 a mechanical engineer in private practice and astronomical research in Ottawa.

Raymond S. Williams, M.E.I.C., has been appointed Winnipeg district sales manager for Canadian Johns-Manville Company, Ltd.

Mr. Williams joined the sales organi-

Raymond S. Williams, M.E.I.C.

zation of Canadian Johns-Manville in Winnipeg in 1947. Previous to that he had extensive sales and engineering experience in Western Canada for Canadian National Railways and the Western Utility Company. In 1943, during World War II, he was assigned to the Canadian Army to assist in the design and construction of the diesel armoured train.

Mr. Williams is a member of the Association of Professional Engineers, the Canadian Electrical Association, the Institute of Power Engineers, and the National Association of Corrosion Engineers.

R. T. Houlihan, M.E.I.C., former manager of the apparatus division's Niagara branch of Canadian Westinghouse Co. Ltd., has been appointed branch manager at London, Ont.

R. T. Houlihan, M.E.I.C.

Mr. Houlihan entered the Westinghouse Graduate Training Course upon graduation in 1941 from the University of Alberta. After service as a lieutenant in the Royal Canadian Navy, he joined the staff of the Westinghouse western district as apparatus salesman in Winnipeg, and in 1950 was appointed manager of the apparatus division of the western district. The following year he was named district sales manager of the company in Vancouver.

D. J. McChesney, M.E.I.C., has been appointed manager of plant engineering for the Ford Motor Company of Canada Ltd., in Oakville, Ont. Previous to this appointment, he was mechanical engineer in charge of the mechanical design section of plant engineering at the Windsor plant of the company.

Mr. McChesney is a 1943 mechanical engineering graduate of the University of Toronto.

H. S. Windeler, M.E.I.C., former chief engineer of Anglo-Newfoundland Development Company Limited in Grand Falls, Nfld., has been promoted to the position of assistant to J. E. Manuel, assistant to the president in Quebec City.

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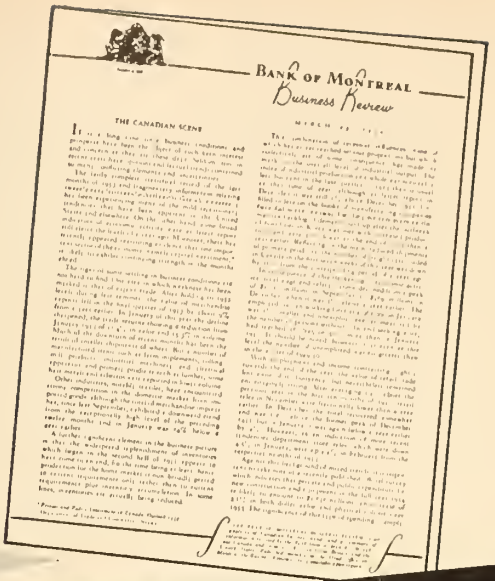

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Mr. Windeler is a 1914 McGill University engineering graduate.

R. E. MacAfee, M.E.I.C., who was this year named a Life Member of the Engineering Institute, has recently retired from Babcock-Wilcox & Goldie-McCulloch Limited in Montreal, where he has been for many years manager of the eastern district.

Mr. MacAfee graduated in electrical engineering from McGill University in 1910. During World War I he served with the Canadian Engineers as a major. He was awarded the Military Cross for distinguished service.

E. E. Copping, M.E.I.C., has been appointed assistant superintendent of the generating division of the Shawinigan Water and Power Company in Shawinigan Falls, Que.

Mr. Copping has been on the permanent staff of the company since graduating from McGill University in electrical engineering in 1941, and has held the positions of relay engineer at the Rapide Blanc power house, supervisor of operations there, supervisor of electrical maintenance at the Shawinigan Falls power house; and superintendent of the substation division of the Three Rivers district.

He is a councillor of the Engineering Institute representing the St. Maurice Valley Branch.

Jack Morris, M.E.I.C., who has been elected chairman of the Cornwall Branch of the Institute, is manager of engineering headquarters, Courtaulds (Canada) Limited.

Mr. Morris joined Courtaulds (Canada) Limited in 1945 as manager of the

Jack Morris, M.E.I.C.

engineering division. He is a native of England, a graduate of St. Lawrence College and Lincoln Technical College following which he served as an engineering trainee with Ruston & Hornsby of Lincoln. Later he went to Scotland for this company as an engineering technical assistant. In 1932 Mr. Morris was appointed to a similar position for Rustons and R. A. Lister on the staff of Wm. Stairs Son & Morrow Ltd., of Halifax. At the outbreak of World War II he was called to active service with the Princess Louise Fusiliers (MG) serving as general staff officer and later as assistant to the director of chemical warfare, N.D.H.Q., with the rank of lieutenant colonel.

Mr. Morris is a member of the American Society of Mechanical Engineers.

E. P. Stephenson, M.E.I.C., has been appointed system signal engineer for Canadian National Railways.

A native of Hazel Hill, N.S., Mr. Stephenson attended the Nova Scotia Technical College and Dalhousie University, graduating with a B.Sc. degree in electrical engineering.

He enlisted with the Royal Canadian Electrical and Mechanical Engineers during the last war and held the rank of major upon demobilization in 1945. Two years later he joined Canadian National Railways as assistant signal engineer in Toronto, and in 1949 was promoted to signal engineer there.

K. B. Parkinson, M.E.I.C., has been appointed assistant chief engineer of Dibblee Construction Company Limited in Ottawa.

Mr. Parkinson received his B.Comm. degree and his B.Sc. degree in civil engineering in 1951 from Queen's University and since that time has been engaged as superintendent of the Dibblee Construction Company.

G. A. Gray, M.E.I.C., has been named branch manager of C. A. Dunham Co. Ltd. in Ottawa. He was previously acting branch manager.

Prior to joining the company he was associated with Ontario Equipment and Supply Limited.

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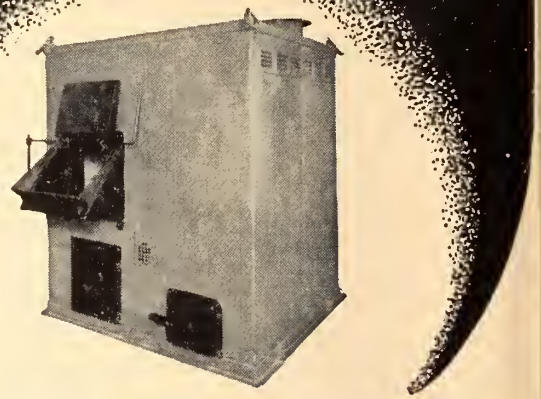

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He is a 1949 mechanical engineering graduate of Queen's University.

J. F. Brett, M.E.I.C., who has retired from the Department of Public Works of the City of Montreal, has announced that he will carry on consulting work at his Melrose Avenue office in Montreal.

James T. J. Raleigh, M.E.I.C., has been named petroleum engineer in the mines branch of the Manitoba Department of Mines and Natural Resources.

A native of Manitoba, Mr. Raleigh graduated from Kelvin High School. Winnipeg, and received his B.Sc. degree in civil engineering from the University of Manitoba in 1952.

Since his graduation he has been employed in the producing division of Imperial Oil Limited.

He is a member of the Association of Professional Engineers of Saskatchewan.

Andrew George Ballantyne, M.E.I.C., of the B.C. Power Commission in Victoria, has been elected chairman of the Vancouver Island Branch of the Engineering Institute of Canada.

A. G. Ballantyne, M.E.I.C.

Mr. Ballantyne was born in Redcliff, Alta., and received his general education there and in Calgary. He obtained his B.Sc. degree in civil engineering from the University of Alberta in 1943.

During the summers of his university course he worked as surveyor on irrigation schemes in southern Alberta, airports in northern British Columbia, Fort St. John and Fort Nelson.

Upon graduation he joined the Department of Transport and was engaged in airport surveys until 1944 when he became associated with P.F.R.A., in Calgary as design engineer on St. Mary's Dam and appurtenant works and other irrigation works on the Prairies.

In 1946 he joined the industrial works of Consolidated Mining and Smelting Company Ltd. in Trail as design engineer, and three years later entered the B.C. Power Commission in Victoria where he is employed on the design of hydro-electric plants and is in charge of all civil engineering design under the chief engineer.

Mr. Ballantyne is a member of the Association of Professional Engineers of British Columbia.

Professor Jack Hoogstraten, M.E.I.C., professor of the civil engineering department of the University of Manitoba, has been elected president of the Association of Professional Engineers of Manitoba at the Association's annual meeting. He succeeds G. B. Williams, M.E.I.C.

Professor Hoogstraten graduated from the University of Manitoba in 1929 with a B.Sc. degree. He has been associated with the University's civil engineering department for many years.

Wing Commander W. Trischuk, R.C.A.F., M.E.I.C., has recently been promoted to his present rank and is serving as construction engineering officer in the technical branch of the R.C.A.F. at St. Hubert, Que. He is at present filling the position of staff officer construction engineering, Air Defence Command Headquarters.

Before assuming his present position in June, 1954, he was stationed in Edmonton where he reported to Air Force Headquarters on new major construction of buildings, services and installations on RCAF Stations in Western Canada.

Wing Commander Trischuk is a civil engineering graduate of the University of Saskatchewan, class of 1933.

W. K. Sharpe, M.E.I.C., has been promoted to the position of supervising engineer, Atlantic region, of the Public Health Engineering Division of the Department of National Health and Welfare. He was previously sanitary engineer in Truro, N.S.

Mr. Sharpe joined the Department in 1945 upon graduation in civil engineering from the University of Toronto, and served for a time as director of the sanitary engineering division in Charlottetown.

A. H. Thompson, M.E.I.C., has been appointd assistant chief mechanical engineer with the Foundation Engineering Company at the Toronto office.

Mr. Thompson graduated with a B.Eng. degree from the Nova Scotia Technical College in 1942 and that same year joined the Foundation Company at Pictou, N.S. in the shipbuilding division. He was consecutively draughtsman, hull superintendent and mechanical engineer until 1944 when he was transferred to the Montreal office to work on design and field supervision of varnish, lacquer and paint plants.

In 1953 he was appointed supervisor mechanical design, which position he held until his recent appointment.

Capt. Jack Adams, M.E.I.C., has returned from the Royal Military College of Science, Shrivenham, England, where he has spent two years. He is now staff captain in the vehicle section of the directorate of electrical and mechanical engineering, Army headquarters, Ottawa.

Capt. Adams graduated in mechanical engineering from the University of Saskatchewan in 1944 and was attached to the R.C.E.M.E. at Halifax as a lieutenant in 1946. He subsequently became a captain in 1950 and for a time was stationed at Army headquarters in Ottawa.

In 1951 he was project engineer at the Canadian Joint Air Training Centre at Rivers, Man., and in 1952 attended the R.C.E.M.E. school at Barriefield, Ont. He then spent one year at Montreal prior to his departure for England.

J. E. Dyck, M.E.I.C., has been transferred as superintendent of engineering by the Aluminum Company of Canada from Arvida to Montreal.

He graduated from the University of Saskatchewan with a B.Sc. degree in mechanical engineering in 1930 and remained at the university as an instructor for the next two years. In 1934 he went to Harris, Sask., as principal of the high school and teacher of mathematics and sciences.

He then became associated with the International Nickel Company at Copper Cliff, Ont., and in 1941 went to Montreal as senior draughtsman and designer on reinforced concrete, heating, ventilation and plumbing for the Alum-

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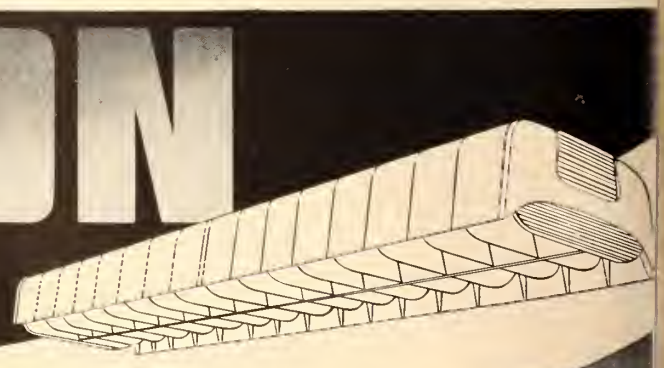

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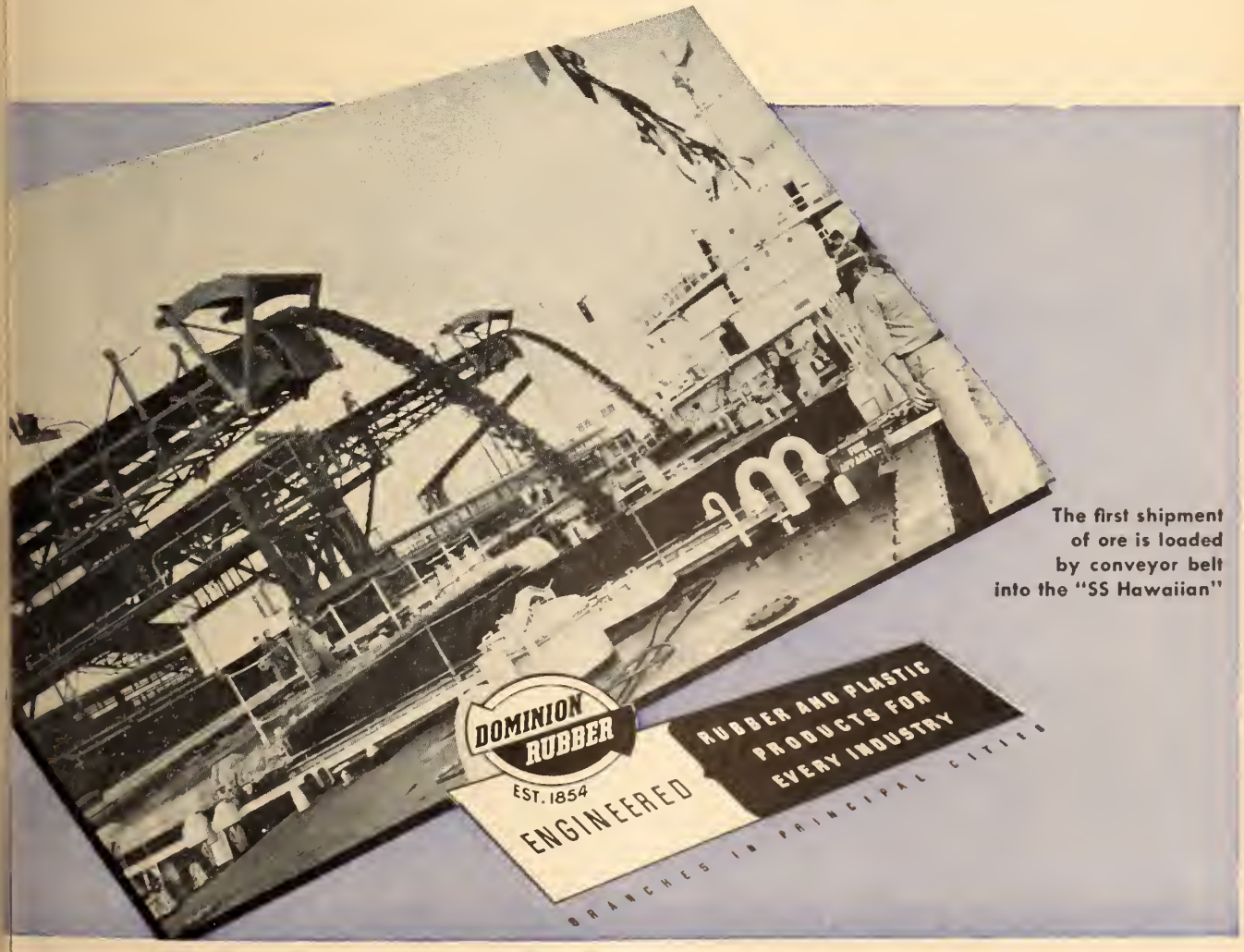

The first shipment of ore is loaded by conveyor belt into the "SS Hawaiian"

inum Company of Canada Ltd. In 1944 he was transferred to Arvida, where he was statistician for the industrial engineering department.

Mr. Dyck was secretary-treasurer of the Saguenay Branch of the Institute in 1946.

H. M. Sherwood, M.E.I.C., is works manager of Canadian Industries (1954) Limited "Terylene" plant at Millhaven, Ont.

He first joined the company in 1939 as production engineer at Brownsburg, Que., subsequently becoming works manager of the ammunition division there.

Mr. Sherwood is a 1933 chemical engineering graduate of the University of Alberta.

J. R. Michie, M.E.I.C., has been appointed branch manager of the Canadian Ice Machine Company in Montreal.

Associated with the company since 1940, Mr. Michie was at one time contract engineer in the Halifax branch, later becoming assistant manager of the Maritime division. In 1949 he was named branch manager in Ottawa, which position he held until 1951 when he was transferred to the Vancouver branch as divisional manager.

Mr. Michie is a 1940 mechanical engineering graduate of the University of Toronto and served with the R.C.N.V.R. during the war.

D. W. Laird, M.E.I.C., has been appointed contract completions officer at the head office of Defence Construction (1951) Ltd. in Ottawa. Previous to this appointment he was branch manager in Winnipeg where he was responsible for the defence construction program in Manitoba, Saskatchewan and northwest Ontario. Before joining Defence Construction (1951) Ltd., Mr. Laird was associated for three years as regional construction engineer with Central Mortgage and Housing Corporation in Winnipeg.

A 1942 civil engineering graduate of the University of Manitoba, Mr. Laird joined the staff of C. D. Howe Company Ltd., at Port Arthur, and in 1943 became a lieutenant with the Royal Canadian Engineers, returning to the company at the close of the war.

Harold P. Boone, M.E.I.C., has accepted the position of industrial instrument sales and service correspondent with the Minneapolis-Honeywell Regulator Company. He was formerly on the teaching staff of the Collegiate Institute and Vocational School in St. Catharines, Ont.

Mr. Boone, a member of the Association of Professional Engineers of Ontario, is a 1937 electrical engineering graduate of the University of New Brunswick.

R. G. Radley, M.E.I.C., is on the staff of McDougall & Friedman Associates in Montreal.

Mr. Radley received his diploma in electrical engineering from Coventry Technical College in 1952, and has since been associated with Wiggs, Walford, Frost & Lindsay, consulting engineers in Montreal, and with the office of the Directorate of Installations for the North East Air Command in St. John's, Nfld.

Bernard J. D. Harlow, M.E.I.C., has joined the staff of Foundation Company of Canada Ltd. in Smooth Rock Falls, Ont.

Mr. Harlow, a 1943 graduate in civil engineering of Leeds University, was previously general superintendent of H. G. Johnston Co. Ltd., contracting engineers in Montreal.

L. J. Poirier, M.E.I.C., is associated as sales representative with A. C. Leslie and Co. Ltd. in Montreal.

Before accepting this position he was sales representative with Truscon Steel Company of Canada Ltd. in Montreal.

Mr. Poirier received his B.Eng. degree in civil engineering from the Nova Scotia Technical College in 1944.

D. P. Thompson, M.E.I.C., who was previously on the staff of the Manitoba Hydro-Electric Board, is now associated with Forsberg and Co. Ltd., mining contractors in Winnipeg.

Mr. Thompson, a 1940 civil engineering graduate of the University of Saskatchewan, is a member of the Association of Professional Engineers of Manitoba.

A. G. Underhill, M.E.I.C., formerly hydraulic engineer with the Alberta Department of Water Resources, is now employed by Precast Concrete Limited in Calgary.

Mr. Underhill is a 1949 graduate in civil engineering of the University of Alberta and is a member of the Association of Professional Engineers of Alberta.

Theodore C. York, M.E.I.C., is associated as design engineer with Gannett,

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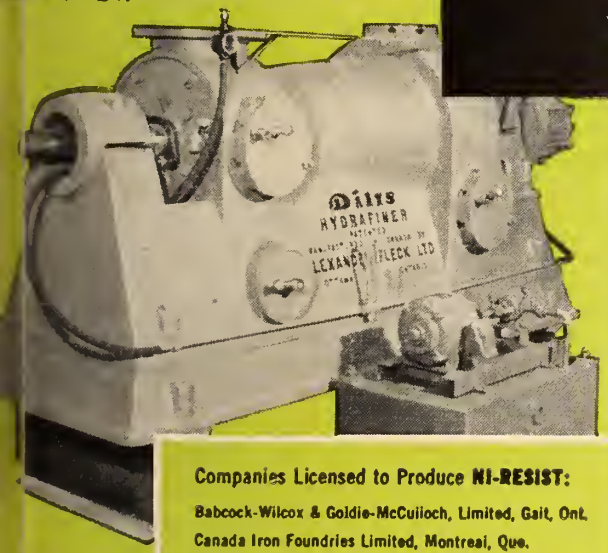

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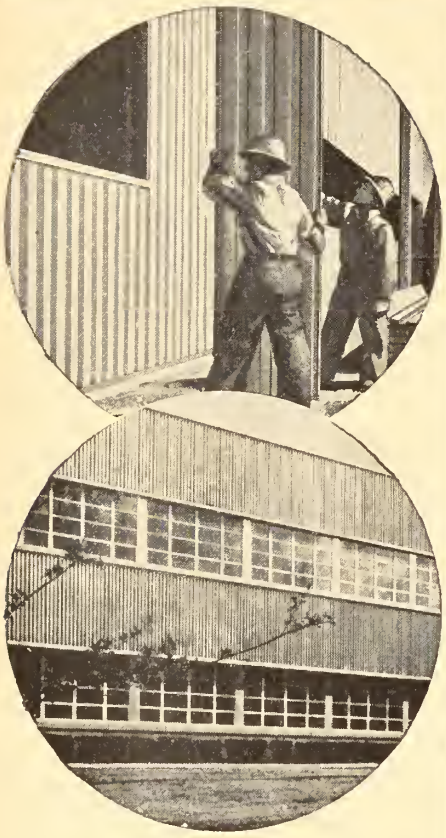

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Fleming, Corddry and Carpenter in Harrisburg, Penn. Prior to accepting this position he was a partner in Associated Technical Services in Montreal.

Mr. York is a member of the Association of Professional Engineers of British Columbia.

Raymond Lanctot, M.E.I.C., is president of Lanctot Automobiles Inc. in Cowansville, Que.

A 1924 graduate of McGill University, Mr. Lanctot was formerly chief plant engineer with Canadian Car and Foundry Co. Ltd. in Montreal.

W. F. Stratychuk, M.E.I.C., a 1949 agricultural engineering graduate of the University of Saskatchewan, has recently become resident engineer with the St. Lawrence Seaway Authority in St. Catharines, Ont.

Prior to this appointment, Mr. Stratychuk was associated with the Dominion Department of Agriculture, P.F.R.A., in Swift Current, Sask.

J. H. R. Dansereau, M.E.I.C., is president and general manager of DASCO Limited in Montreal.

Employed since 1947 as a sales engineer in the boiler division of Dominion Bridge Company in Lachine, Que., Mr. Dansereau served overseas during the war as a navigator instructor with the RCAF.

He received his B.Sc. degree from L'Ecole Polytechnique in 1942.

R. K. Williams, M.E.I.C., recently a salesman in the industrial and commercial department of Chambers and Meredith Ltd., Realtors in Toronto, has formed his own business in real estate and property management and is managing agent for Queen-Yonge Investments Ltd., in Toronto.

Mr. Williams was also associated with Harvey Spry and Associates in 1951, and was engineering consultant to Associated Business Consultants Ltd. from 1949 to 1951.

In 1946 he was appointed industrial engineer to the Industrial Development Bank, and for a while previous to this was manager of personnel for Victory Aircraft Ltd. of Toronto.

H. E. Seely, M.E.I.C., has been appointed manager of contract sales for Robertson-Irwin Limited in Hamilton. He will assume responsibility for sales across Canada of the Robertson building products.

H. E. Seely, M.E.I.C.

A 1947 civil engineering graduate of the University of New Brunswick, Mr. Seely has gained wide experience with the company in field promotion, sales engineering and sales administration. He joined the company's Montreal office in 1949 as sales engineer and was transferred to Hamilton in 1950 where he was promoted to product manager in 1953.

Following graduation, Mr. Seely had been associated with H. H. Robertson Company Ltd. in Montreal.

H. J. Butterill, M.E.I.C., has been appointed assistant manager, cobalt operations, for the Deloro Smelting and Refining Company in Deloro, Ont.

Mr. Butterill has been, since 1950, chief metallurgist and chief inspector at the Arvida works of the Aluminum Company of Canada Ltd.

A 1940 graduate of the University of Toronto with a B.Sc. degree, he joined the Royal Canadian Electrical and Mechanical Engineers after graduation. He served in various ranks in the Ordnance Corps and R.C.E.M.E., being promoted to major on joining the Armament Design Department of the Ministry of Supply, England.

In 1945 he went to The International Nickel Company in Toronto, Ont., as a member of the Development and Research Division where he remained until 1948. He then joined the Defence Research Board as chief engineer of the Canadian Armament Design and Experimental Establishment at Quebec.

P. M. Rebin, M.E.I.C., is resident engineer on the staff of Abitibi Power and Paper Company Ltd., in Sturgeon Falls, Ont. He was formerly at the company's Port Arthur Thunder Bay division, as assistant engineer.

A 1939 mechanical engineering graduate of the University of Saskatchewan, Mr. Rebin was for a time employed with Vulcan Iron Works in Winnipeg and with Waterous Limited in Brantford, Ont.

Ewart M. Haacke, M.E.I.C., has been elected chairman of the Montreal section of the Illuminating Engineering Society for 1955. For the past 18 months he has been chairman of the lighting section of the Canadian Electrical Association. He is also a member of the Corporation of Professional Engineers of Quebec, and the Association of Professional Engineers of Ontario, and the American Institute of Electrical Engineers.

A 1942 electrical engineering graduate of Queen's University, Mr. Haacke was for six years editor of "Electrical News & Engineering" with MacLean Publications Ltd. in Toronto, and he joined J A. Wilson Lighting and Display Ltd in 1951 as manager of the Montreal branch.

C. E. Beynon, M.E.I.C., is a member of the firm McGregor, Anderson and Beynon of Toronto. Previous to entering into the new partnership, he was assistant superintendent of engineering design and plant design with Atomic Energy of Canada Limited at Chalk River, Ont.

Mr. Beynon is a mechanical engineering graduate of Toronto University, class of 1937.

A. A. Goldes, M.E.I.C., formerly head of the structural engineering department of Messrs. Shore & Moffat, architects, of

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Toronto, is now on the staff of Messrs. Hooper & Yolles, consulting engineers, in Toronto.

Mr. Goldes, who is a 1941 engineering graduate of Witwatersrand University, was previously design engineer with Dominion Bridge Co. Ltd. in Winnipeg.

Roy L. Snitch, M.E.I.C., is assistant plant metallurgist with International Nickel Company of Canada Limited in Copper Cliff, Ont.

A 1938 graduate in metallurgical engineering of the University of Toronto, Mr. Snitch was previously process engineer and assistant superintendent with the company in Coniston, Ont.

R. A. Reid, M.E.I.C., has been transferred as assistant works manager by Dominion Bridge Co. Ltd., from Lachine, Que., to Winnipeg.

Mr. Reid graduated in mechanical engineering from McGill University in 1942, and joined Dominion Bridge Co. in Lachine as cost accountant in 1949. In 1953, he was made chief inspector and later became plant production engineer, prior to his present appointment.

Gordon M. Rose, M.E.I.C., has joined the staff of W. V. Zinn and Associates, consulting engineers, in Toronto, as chief reinforced concrete engineer.

E. M. Rensaa, M.E.I.C., and **Dr. A. O. Minsos,** who were partners in the Edmonton firm of Main, Rensaa and Minsos, which was dissolved at the end of 1954, are continuing as architects and consulting engineers in Edmonton under the firm name of Rensaa and Minsos.

Mr. T. C. Main, who together with Mr. Rensaa and Dr. Minsos, was a partner in the subsidiary firm, Canadian-British Engineering Consultants, has taken over that company.

F. Lionel Peckover, M.E.I.C., has been appointed senior assistant engineer (soils) in charge of the soils mechanics section of the engineering branch of the St. Lawrence Seaway Authority in Montreal.

Mr. Peckover has been employed on engineering work for the St. Lawrence Seaway since September, 1953. Previous to this, he was with the division of building research, National Research Council, in Ottawa.

He received his B.A.Sc. degree in civil engineering from the University of Toronto in 1944, and his M.S. degree in civil engineering from Harvard University in 1947.

F. R. Denham, M.E.I.C., formerly with Ford Motor Company of Canada Ltd., has joined Lucas-Rotax Ltd. as a development engineer.

Mr. Denham, who received his B.Sc. degree in mechanical engineering from the University of Durham in 1950, and his Ph.D. from the same university in 1953, was previously defence scientific service officer with the Canadian Armament Research and Development Establishment at Valcartier, Que.

E. Klug-Andersen, M.E.I.C., formerly resident engineer with Foundation Company of Canada Ltd., in Hamilton, and at one time in Sault Ste. Marie, is now on the staff of Lazarides, Lount and Partners in Toronto.

Mr. Klug-Andersen received his M.Sc. degree in civil and structural engineering from the Technical University of Denmark in 1947.

W. M. Steeves, M.E.I.C., has been appointed assistant engineer for the City

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of Moncton. He was previously associated with Capitol Engineering Corp. Dillsburg, Penna. as Jr. highway design engineer.

Upon his graduation in civil engineering from the University of New Brunswick in 1948, Mr. Steeves was associated with the St. John office of the Public Works of Canada, and was for three years town manager of Woodstock. He joined the Dillsburg firm in 1952.

John S. Stevens, M.E.I.C., formerly resident engineer with the Nova Scotia Department of Highways and Public Works in Halifax, has been appointed assistant manager of Municipal Ready-Mix Limited at Sydney River, N.S.

Mr. Stevens is a 1947 civil engineering graduate of the Nova Scotia Technical College.

Colin G. Campbell, M.E.I.C., is design engineer with the Powell River Pulp & Paper Company in Powell River, B.C.

A 1948 University of British Columbia mechanical engineering graduate, he was formerly associated with Campbell & Campbell, architects and engineers in Calgary.

Captain D. K. Teasdale, M.E.I.C., was elected chairman of the Royal Canadian Electrical and Mechanical Engineers Corps Association, Maritime Chapter, at the annual meeting held at the Cambridge Military Library in Halifax on January 11. Captain D. K. Teasdale, M.E.I.C., was elected chairman, **Lt. Col. S. T. Montgomery,** M.E.I.C., vice-chairman, and **H. G. Bowes,** M.E.I.C., secretary-treasurer.

A new film, "A R.C.E.M.E. Workshop in the Field," made by the National Film Board of the R.C.E.M.E. Brigade Workshop in Germany in 1953, was shown at the meeting, after which **Lt. Col. C. G. Kirby,** M.E.I.C., Command Electrical and Mechanical Engineers at Eastern Command spoke briefly on the need to insure preparedness by maintaining industrial potential at a very high level.

Clifford R. Haryett, M.E.I.C., formerly process engineer with Aluminum Company of Canada Limited at Arvida, Que., has been appointed plant manager of the caustic chlorine plant of Western Chemicals Limited in Two Hills, Alta.

Mr. Haryett graduated in chemical engineering in 1949 from the University of Saskatchewan.

G. T. Alexander, JR.E.I.C., has been transferred by Calgary Power Limited from Cochrane, Alta., to Wabamun, Alta.

Mr. Alexander is a 1948 civil engineering graduate of the University of New Brunswick.

H. W. Beckett, JR.E.I.C., is construction engineer with Consolidated Mining and Smelting Company Ltd., in Calgary. He joined the company in 1949 as an engineer in training in Trail.

Mr. Beckett graduated in civil engineering from the University of Saskatchewan in 1948.

G. P. Schwarzkopf, JR.E.I.C., has joined Howard Smith Paper Mills Ltd., in Cornwall, Ont.

A 1948 graduate in mechanical engineering of the University of Toronto, Mr. Schwarzkopf was previously associated with Brantford Refrigerator Limited in Brantford, Ont.

Arthur J. Shama, JR.E.I.C., is construction supervisor with Canadian Petrofina Limited in Toronto. He was formerly with Geodetic Survey in Ottawa.

Mr. Shama graduated in civil engineering from McGill University in 1948.

L. D. Almack, JR.E.I.C., formerly chief inspector with John Inglis Company Ltd. of Toronto, is now on the staff of

R.C.E.M.E. Corps Association, Maritime chapter officers, from left to right: Lt.-Col. C. G. Kirby, M.E.I.C., Comd. EME(EC); Capt. D. K. Teasdale, M.E.I.C., chairman; Capt. H. G. Bowes, M.E.I.C., secretary-treasurer; and Lt.-Col. S. T. Montgomery, M.E.I.C., vice-chairman.

English Electric Company Ltd. in Liverpool, England.

Mr. Almack received his B.Sc. degree from the University of Toronto in 1949.

M. G. Bolstad, Jr.E.I.C., who has been associated with Canadian Refractories Limited in Marelan, Que., for two and a half years, has returned to Gypsum Lime and Alabastine, Canada, Ltd. in Caledonia, Ont., as plant engineer.

Mr. Bolstad graduated from the University of Saskatchewan in ceramic engineering in 1949 and joined the Gypsum Lime and Alabastine, Canada, Ltd. in 1950.

R. Boudreau, Jr.E.I.C., who is a sales engineer with Canadian General Electric Company Ltd., has been transferred from Montreal to Ottawa.

He graduated in electrical engineering from Laval University in 1949.

J. H. Goar, Jr.E.I.C., formerly sales engineer for Canadian Westinghouse Co. Ltd. in Windsor, Ont., has been named manager of the apparatus division's Niagara branch with headquarters in

J. H. Goar, Jr.E.I.C.

Hamilton. He succeeds R. T. Houlihan, M.E.I.C., who has been appointed branch manager at London, Ont.

Mr. Goar joined the company's training course after receiving his B.Sc. degree from the University of Manitoba in 1948. During the war he served with the R.C.A.F. as a flying officer.

C. K. Johnson, Jr.E.I.C., has joined the electric light and power department of the City of Calgary. Previously he was associated with the Hydro-Electric Power Corporation of Ontario.

Mr. Johnson graduated in electrical engineering from the University of Manitoba in 1949.

G. Mantha, Jr.E.I.C., has been appointed sales engineer with Armeo Drainage and Metal Products of Canada Limited in Montreal.

A 1949 graduate in civil engineering of McGill University, Mr. Mantha was formerly sales engineer with National Carbon Limited.

Wm. E. Blakely, Jr.E.I.C., a 1950 graduate in engineering physics of the University of Alberta, is associated with Triad Oils Limited in Calgary. He was previously employed as party chief to the National Geophysical Company of Calgary.

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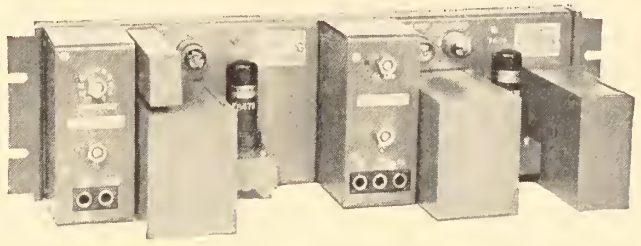

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Fault-free teletype circuits are obtained, even where the telephone circuit on which they are superimposed suffers from noise or abrupt level variatians which may be so great as to render on-aff keyed signals unintelligible. Frequency-shift signals do not suffer deterioration fram non-linear transmissian, such as is caused by overloading in vaice-frequency, carrier or radio equipment. Under mast circumstances a signal-to-noise ratio per channel as law as 20 db is satisfactory, and under same canditions even lower ratias result in fault-free operation. This equipment meets the requirements of current MIL specifications wherever applicable.

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R. T. Gibson, JR.E.I.C., is senior stress engineer on the staff of Avro Aircraft Limited (formerly the aircraft division A. V. Roe Canada Limited).

During the next year and a half Mr. Gibson will be located in Winnipeg where he will be responsible for the engineering aspects of a sub-contract being carried out by MacDonald Bros. Aircraft Limited for Avro Aircraft Limited.

Mr. Gibson graduated in civil engineering from the University of New Brunswick in 1946.

Niels Ole Andersen, JR.E.I.C., is resident engineer with Defence Construction (1951) Limited in London, Ont.

A 1947 graduate of the Royal Technical University of Copenhagen in civil engineering, he was formerly supervisor of military construction with Central Mortgage and Housing Corporation at Clinton, Ont.

Ernest J. Rossi, JR.E.I.C., formerly associated with J. P. Porter Company Limited in Montreal, is now dredging engineer with the St. Lawrence Seaway Authority.

Mr. Rossi is a civil engineering graduate of McGill University, class of 1947.

P. N. Brown, JR.E.I.C., structural engineer with Canadian Bridge Co. Ltd., has recently been transferred from Kingston to Walkerville, Ont. He graduated in civil engineering from the University of Toronto in 1950.

Mr. Brown is secretary-treasurer of the Border Cities branch of the E.I.C.

Jack D. Cape, JR.E.I.C., has recently been appointed sales engineer in the belting and hose industrial division of the B. F. Goodrich Co. Ltd. in Kitchener, Ont. He joined the company as tire technician in 1953.

Mr. Cape graduated in mechanical engineering from the University of Toronto in 1950.

E. L. Mercer, JR.E.I.C., has joined Morrison, Hershfield, Millman and Huggins of Toronto. He was formerly associated with Laminated Structures Limited in Montreal and with Timber Structures of Canada Limited in Peterborough, Ont.

Mr. Mercer is a 1950 civil engineering graduate of the University of Toronto.

M. Stoyanoff, JR.E.I.C., has accepted the appointment as bridge designer with the Ontario Department of Highways. He was formerly associated with Central Mortgage and Housing Corporation in Camp Borden, Ont.

Mr. Stoyanoff received his B.Sc. degree in civil engineering from the University of Toronto in 1950.

John A. Pollock, JR.E.I.C., a 1950 mechanical engineering graduate of Queen's University, is on the staff of the Mathews Conveyor Company at Port Hope, Ont.

He was previously employed as mechanical maintenance supervisor by the Aluminum Company of Canada at Arvida.

Richard Welwood, JR.E.I.C., is plant engineer at the Hespeler plant of Gypsum, Lime and Alabastine, Canada, Limited.

Graduating in mining engineering from Queen's University in 1950, Mr. Welwood joined the Gypsum Lime and Alabastine Company as mine captain of the underground mine at Caledonia, having previously been associated with Britannia Mining and Smelting Company Limited in British Columbia.

A. G. Hyde, JR.E.I.C., has been appointed general manager of Geocon Limited.

A native of Regina, Mr. Hyde spent four years with the R.C.A.F. during the War. He graduated from McGill University in mechanical engineering in 1949. That same year he joined Gunite and Waterproofing Limited as engineer. In 1950 he was named district manager of the company in Toronto. In January 1954 he was appointed manager of the gunite and waterproofing division of Geacon Limited, a post which he held until his recent appointment.

Reginald K. Brown, JR.E.I.C., has been appointed city engineer by the City of Stratford. He joined the department in 1952 as an assistant and became acting city engineer in August, 1954.

Mr. Brown graduated in 1951 from the University of Toronto with a B.A.Sc. degree in mechanical engineering.

S. McClements, JR.E.I.C., has taken a position as methods engineer with Scott-Atwater Co. Ltd., in Minneapolis. He is studying concurrently for a master's degree in industrial engineering and plant management at the University of Minnesota.

He was previously employed as processing engineer for a two-year period with Canadian Car and Foundry Co. Ltd. in Fort William.

Mr. McClements graduated in mechanical engineering from McGill University in 1951.

Murray F. Pittuck, JR.E.I.C., has been promoted by Shawinigan Engineering Company Limited to the position of superintendent of transmission line construction. He joined the company in 1951 and the following year became assistant superintendent of transmission line construction, and for a period of two months was engaged as inspector on the Kemano-Kitimat transmission line for the Aluminum Company of Canada Limited.

Mr. Pittuck is a 1951 civil engineering graduate of McGill University.

L. Rispler, JR.E.I.C., is employed as sales engineer in the commercial division of Minneapolis-Honeywell Regulator Co. Ltd., in Montreal.

Mr. Rispler graduated in chemical engineering from the University of Alberta in 1951.

R. F. Wheelan, JR.E.I.C., has recently been transferred from Fort Churchill, Man. to La Tuque, Que. by the Foundation Company of Canada Limited, which he joined in 1951.

Mr. Wheelan graduated in civil engineering in 1951 from Queen's University.

Tai Yue-Shing, JR.E.I.C., a 1951 electrical engineering graduate of McGill University, has joined the staff of the H.O. Electrical Department, B.M.P. Company Limited in Seria, State of Brunei, British Borneo.

Mr. Yue-Shing was previously employed as electrical designer with Wiggs, Walford, Frost and Lindsay in Montreal.

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P. A. Defend, JR.E.I.C., formerly employed with Hinde and Dauch Paper Company of Canada in Toronto, has joined Gypsum Lime and Alabastine (Canada) Limited as plant engineer in Caledonia, Ont.

Mr. Defend is a 1952 graduate in mechanical engineering from McGill University.

Norman Harding, JR.E.I.C., is employed as design engineer in the systems department of Computing Devices of Canada Limited in Ottawa. He was previously test set design engineer with Northern Electric Co. Ltd. in Montreal.

Mr. Harding graduated in electrical engineering from the University of B.C. in 1952.

W. A. Johnson, JR.E.I.C., formerly employed with the California Standard Company in Virden, Man., has recently accepted an appointment of hydraulic engineer with the St. Lawrence Seaway Authority in Cornwall, Ont.

Mr. Johnson graduated in civil engineering from the University of Manitoba in 1952.

J. A. Kane, JR.E.I.C., a 1952 graduate in electrical engineering of McGill University, is resident sales engineer for Moloney Electric Company of Canada Limited in Quebec City.

J. P. Mosher, JR.E.I.C., has joined the staff of Canadian International Paper Company in Three Rivers, Que., as design engineer.

He was formerly a technical assistant employed at the head office of Shell Oil Company of Canada Limited in Toronto.

Mr. Mosher is a McGill University graduate in mechanical engineering, class of 1952.

D. H. P. Smith, JR.E.I.C., is project engineer in the central engineering department of Electric Reduction Company of Canada Limited, in Toronto. He was formerly in the company's Buckingham, Que. office.

Mr. Smith graduated in 1952 from the University of B.C. with a B.A.Sc. degree in mechanical engineering.

D. D. Barkwell, JR.E.I.C., has taken a position as senior reservoir engineer with the Saskatchewan Department of Mineral Resources, petroleum and natural gas branch, in Regina.

Mr. Barkwell graduated in mechanical engineering from the University of Saskatchewan in 1953.

T. M. Berger, JR.E.I.C., who graduated in electrical engineering from the University of B.C. in 1953, is now employed with the British Columbia Power Commission as assistant to the distribution superintendent in Victoria, B.C.

E. L. Bryenton, JR.E.I.C., who joined the Bell Telephone Company as plant engineer in 1953, has been transferred from Ottawa to the special contract department in Montreal.

Mr. Bryenton graduated in civil engineering from the University of New Brunswick in 1953.

F/O. P. Bussieres, R.C.A.F., JR.E.I.C., has recently been transferred by the R.C.A.F. to the central experimental and proving establishment in Rockcliffe, Ont. He was previously located at the R.C.A.F. station in Aylmer, Ont.

F/O Bussières is a mechanical engineering graduate of McGill University, class of 1953.

T. Stuart Campbell, JR.E.I.C., has been transferred by Consolidated Mining and Smelting Company Limited from Pine Point, N.W.T. to Thailand in Asia where he expects to remain for three years.

Mr. Campbell is a 1953 graduate in mining engineering of the University of B.C.

L. S. Dillon, JR.E.I.C., a 1953 engineering graduate of the University of Saskatchewan is located at the R.C.A.F. station in Centralia, Ont., as assistant to the construction engineering officer.

Earl W. Fee, JR.E.I.C., who was awarded an Athlone Fellowship in 1953, is at present studying atomic power plant design at the Atomic Energy Research Establishment in Harwell, England. His first year under the Fellowship was spent with English Electric Co. Ltd., in Rugby.

Mr. Fee received his B.A.Sc. degree in 1953 from the University of Toronto.

P. Greenwood, JR.E.I.C., is field engineer with the Petroleum and Natural Gas Conservation Board and has recently been transferred from Redwater to Devon, Alta.

Mr. Greenwood received a B.Sc. degree in chemical engineering in 1953 from the University of Alberta.

A. E. Insley, JR.E.I.C., is employed by M. M. Dillon Company in London, Ont., as construction inspector. He was for-

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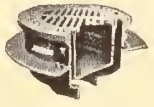

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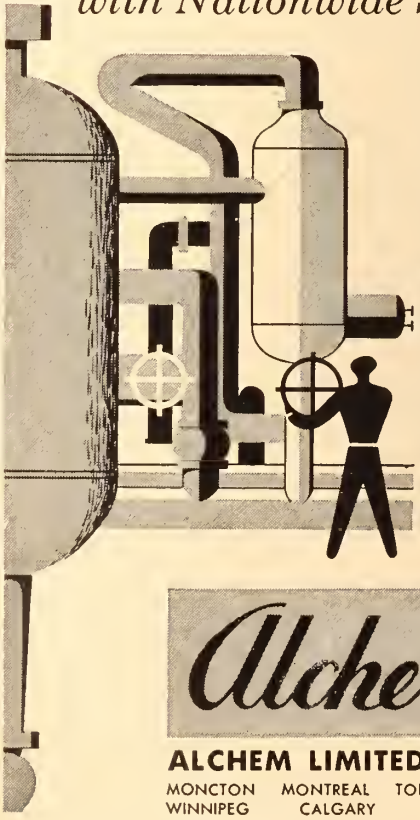

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merly associated with Pearson, Phillips and Barrat in Vancouver.

Mr. Insley graduated in civil engineering from the University of B.C. in 1953.

John S. Pringle, Jr.E.I.C., has joined the staff of the Canadian International Paper Company in Temiskaming, Quebec. He was formerly located at the company's Three Rivers branch.

Mr. Pringle graduated in mechanical engineering from McGill University in 1953.

F. W. Slingerland, Jr.E.I.C., is employed with the Defence Research Board as a scientific officer, grade III, in the operations research section in Ottawa.

Mr. Slingerland graduated in mechanical engineering from Queen's University in 1953.

K. D. H. Willcocks, Jr.E.I.C., has accepted the position of field maintenance engineer with Northern Electric Company in Belleville, Ont. He was previously with the Ford Motor Company at Windsor.

Sydney Narvey, S.E.I.C., has been named chief engineer by Engineering Industries Company Ltd. in Toronto. He was previously employed in the refrigeration and air conditioning division of John Inglis Company Limited in Vancouver.

Mr. Narvey received his B.Sc. degree in mechanical engineering from North Carolina State College in 1953.

Joseph E. Gruspier, S.E.I.C., is employed as an engineer Grade I in the materials testing division of the Ontario Department of Highways. He received his B.Sc. degree from the University of Toronto in 1954.

E. A. Seaman, S.E.I.C., who graduated in electrical engineering from McGill University in 1954, is now working on the staff of the Defence Research Northern Laboratory in Fort Churchill, Man.

He joined the Defence Research Board in Ottawa as technical officer last year.

Z. E. Wasarab, S.E.I.C., who graduated in mechanical engineering from the University of Saskatchewan in 1954, has joined Northern Electric Company Limited in Montreal.

John Russell Beatty, S.E.I.C., has been named staff chemical engineer by Prince Albert Refineries. A specialist in fuel oil production, Mr. Beatty is a chemical engineering graduate of the University of Toronto, and the University of Michigan.

Prior to this appointment Mr. Beatty was a laboratory technician and technical assistant with Canadian Industries Limited in Kingston.

F. K. Burgar, S.E.I.C., is project engineer for Sir Lindsay Parkinson (Canada) Ltd., Hon. George Dunbar Bridge Project in Ottawa. Previously he was associated with the Watson Construction Company in Marmora, and Defence Construction Ltd. in Barriefield, Ont.

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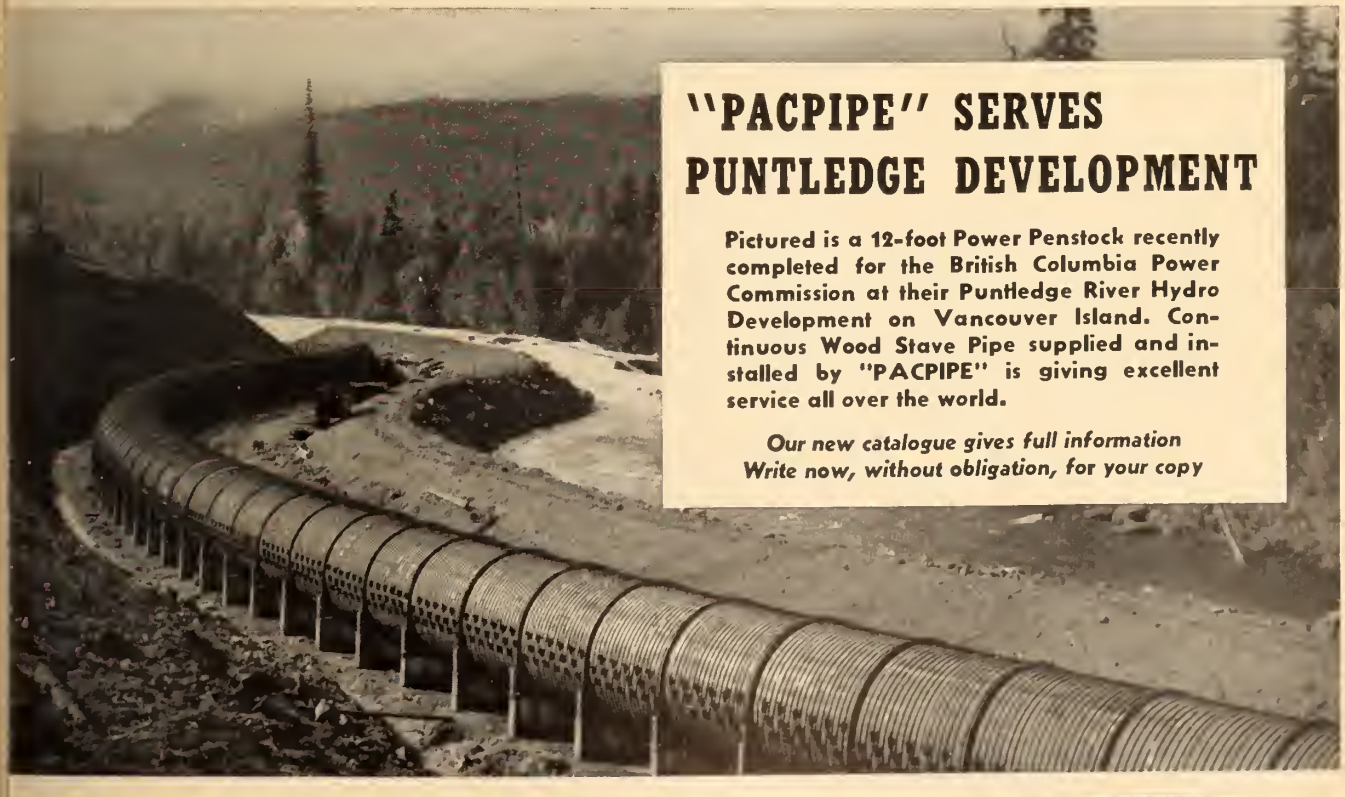
J. A. Walsworth, S.E.I.C., who has so far completed a year and a half of Canadian Westinghouse Company's two year graduate training course, has been transferred to the company's Niagara branch as sales engineer.



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Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded h re.

William Harmon Slinn, M.E.I.C., outside plant engineer with the Bell Telephone Company of Canada in Toronto, and connected with the company's engineering department for 30 years, passed away on November 18, 1954.

Mr. Slinn was born in Regina on September 23, 1891, and moved as a small boy to Ottawa where he was educated at the public school and Collegiate Institute. In 1916 he graduated with a B.Sc. degree in civil engineering from Queen's University.

During the summer months of his university training he was employed in various capacities with Canadian National Railways and with the Morrisburg and Ottawa Electric Railway. He joined the Canadian Army in 1914 and from January, 1916 until September, 1918, became assistant to the C.R.C.E. M.D. No. 3 and was placed in charge of maintenance and construction of military buildings. In addition, he was camp engineer at Barriefield.

During 1919 Mr. Slinn served as a lecturer in civil engineering at Queen's University, after which he was appointed assistant city engineer in Kingston, Ont. In February, 1920, he joined the Cape Construction Company in Sherbrooke, Que., as assistant engineer on construction, and five years later entered the Bell Telephone Company of Canada Ltd. in Montreal as engineer of special studies. He was subsequently transferred to Toronto as division plant engineer. At the time of his death Mr. Slinn occupied the position of outside plant engineer.

Mr. Slinn was a member of the Association of Professional Engineers of Ontario and of the Telephone Pioneers of America.

He joined the Engineering Institute as a Student in 1916, transferring to Junior in 1918, to Associate Member in 1920, and to Member in 1940.

George Leslie Dickson, M.E.I.C., retired electrical and signal engineer for the Atlantic region of Canadian National Railways, and a former vice-president of the Engineering Institute, passed away on February 27, 1955, in the Moncton Hospital.

Mr. Dickson was born in Truro, N.S., on December 24, 1878. He received his M.A. degree from Acadia University in 1900, and afterwards undertook engineering study at McGill University, leaving during his final year to become chief electrician with the Pictou County Electric Company with which he was employed for six years.

In 1910 he was appointed engineer with the Nova Scotia Steel and Coal Company at the Wabana, Nfld., iron mines, and six years later became general manager of the Chambers Electric Light and Power Company in Truro, N.S.

Geo. L. Dickson, M.E.I.C.

He joined Canadian National Railways at Moncton as foreman in the signal and electrical department, and the following year was named general power plant inspector. In 1920 he was granted leave of absence to act on the Grand Trunk Railway Arbitration Board, and three years later he was named electrical and signal engineer for the Atlantic region. He retired in December, 1943.

Mr. Dickson was famed for his intimate knowledge of the history of Nova Scotia. He was an outstanding athlete both in and out of college, playing rugby, soccer, lacrosse, baseball and hockey. He was also an enthusiastic curler.

He was a past president and councillor of the Association of Professional Engineers of New Brunswick.

He also served as a vice-president of the Engineering Institute which he joined as an Associate Member in 1923, transferring to Member in 1940. Mr. Dickson attained Life Membership in the Institute in January, 1954.

Edouard Lavoie, M.E.I.C., a pioneer in the industrial development of Chicoutimi and its surrounding area, passed away on March 18, 1954.

Born on October 3, 1883, at Baie St. Paul, Que., Mr. Lavoie obtained his elementary schooling there, afterwards attending College de Levis. He received his B.A. degree from Laval University, and his B.Sc. degree in civil engineering from Queen's University in 1907.

Upon graduation he was employed until 1911 on location and construction work with the Transcontinental Railways and with the Baie des Ha Ha Railway. He then joined the Chicoutimi Pulp Company as general superintendent. Under his direction the Chute Garneau pulp mill hydro facilities were expanded, and the Val Jalbert mill was completely renovated.

In 1929 Mr. Lavoie opened the first consulting engineering offices in Chicoutimi in partnership with Mr. Lorenso Delisle under the firm name of Lavoie and Delisle. Mr. Laquerre joined the firm as a third associate in 1946 and from that date the company was known as Lavoie, Delisle and Laquerre.

In 1939 Mr. Lavoie served as town engineer at Chicoutimi. He was associated with Mr. Swan of England on the construction of the port in Chicoutimi. In addition, he was responsible for the construction of the hospital, the orphanage, churches, schools, water and sewer systems.

Mr. Lavoie was a member of the American Water Works Association, and was a member of the Saguenay School Commission from 1927 until 1942, serving as its chairman in 1931-32. He was also director and president of the Saguenay Spinning Society of which he was a founder and active member.

A Member of the Engineering Institute of Canada since 1923, Mr. Lavoie was a former chairman of the Saguenay Branch. He attained Life Membership in the Institute in January, 1954.

Raymond LeBel, M.E.I.C., a partner in the structural consulting engineering firm of Beaulieu and LeBel of Montreal, passed away on June 1, 1954.

Mr. LeBel was born in Montreal on December 18, 1912, and was educated at Ecole Champagnat and Ecole St. Viateur He graduated with a B.A.Sc. degree in civil engineering from Ecole Polytechnique in 1939. During the summer months of his engineering course he was employed by the Quebec Streams Commission as chainman, rodman, levelman and transitman.

Upon graduation he joined the Quebec Department of Public Works, and later the same year transferred to the Federal Department of Public Works and was employed on design, draughting and supervision of construction. In 1940 he joined J. M. Eugene Guay, Inc., consulting engineers, in Montreal as structural engineer in charge of design of concrete construction and of work in the field.

Mr. LeBel entered the Canadian Army in 1942 as a lieutenant in the

third division of the Royal Canadian Engineers, serving overseas as well as with the fifth Fortress Company in Newfoundland, and as instructor at Petawawa. Upon his discharge from the Army in 1946, he returned to his position with J. M. Eugene Guay, Inc.

In 1949 Mr. LeBel went into partnership with Gerard O. Beaulieu, M.E.I.C., under the firm name of Beaulieu and LeBel, structural consulting engineers, in Montreal.

Mr. LeBel was a member of the Corporation of Professional Engineers of Quebec.

He joined the Engineering Institute as a Student in 1938, transferring to Junior in 1940 and to Member in 1947.

Thomas Bell Jackson, M.E.I.C., personnel director of the Saskatchewan Power Corporation, passed away on January 12, 1955, in hospital in Regina.

Mr. Jackson was born in Newport, Monmouthshire, South Wales, on September 25, 1899. He came to Canada in 1903 and received his education in both Yorkton and Saskatoon, Sask., after which he undertook his engineering study through the International Correspondence School.

In 1918 he joined the staff of the city power plant in Saskatoon. When the Saskatchewan Power Commission's first major plant was completed in Saskatoon in 1930, he was named chief electrician. Promoted to the position of assistant superintendent of power in 1942, Mr. Jackson was transferred four years later to the Regina head office of the Saskatchewan Power Corporation. He was named plant electrical superintendent in 1948, and in 1949, after taking part in negotiations with the Union, was given the additional responsibilities of field personnel and safety director. Ill health forced him to give up this additional work but he continued as plant electrical superintendent. In November, 1954, he was appointed to the position of personnel director.

During the early years of his employment with the Power Commission he took an active part in forming the first union of all employees in the system. He also played a leading role in establishing the superannuation plan and was for many years the employees' representative on the Power Corporation Superannuation Board.

Mr. Jackson was a member of the Association of Professional Engineers of Saskatchewan.

He joined the Engineering Institute as an Associate Member in 1939, and transferred to Member in 1940.

George Herbert Loane, M.E.I.C., associate professor of electrical engineering at the University of New Brunswick, passed away on February 4, 1955, at the Victoria Public Hospital in Fredericton.

Professor Loane was born in Campbellton, N.B., on October 28, 1921. He was educated at the Campbellton Grammar and High Schools, and in 1943 received his B.Sc. degree in electrical engineering from the University of New Brunswick. He then joined the R.C.A.F. and served until the war ended in Winnipeg with the rank of pilot officer. Upon his discharge from the R.C.A.F., he joined the Bell Telephone Company of Canada as personnel counsellor in Montreal. In 1946 he became junior engineer on electrical layout and design with Robert Rankin and Company, consulting engineers, in Montreal and was engaged on the design of the staple fibre plant for Courtauld's (Canada) Limited in Cornwall, Ont. During the summer of that same year he served as instrumentman on highway surveys with the Department of Public Works of New Brunswick, and then joined Canadian National Telegraphs in Toronto as assistant outside plant engineer for Eastern lines, subsequently becoming assisting plant superintendent of Eastern lines and responsible for budgeting and technical planning for outside plant construction and the administration of plant personnel.

Professor Loane was among the first group chosen for Beaverbrook Overseas Scholarships, and attended King's College, University of London during 1947-48.

He joined the faculty of the University of New Brunswick in August, 1951, as an assistant professor of electrical engineering. In October, 1954, he received his M.Sc. degree at the first fall convocation of the University of New Brunswick Law School in Saint John. He was appointed to the post of associate professor of electrical engineering in September, 1954.

He was a member of the American Institute of Electrical Engineers and of the Association of Professional Engineers of New Brunswick.

Professor Loane joined the Engineering Institute as a Student in 1941, transferring to Junior in 1946 and to Member in 1951. He served as treasurer of the Fredericton Branch of the Institute in 1953-54.

Frank Eric Turner, M.E.I.C., assistant manager of the electrical engineering department of H.M.C. Dockyard in Halifax, passed away in November, 1954.

Mr. Turner was born in Leeds, England, on September 25, 1917, and was educated at Brudenell Boys' School, Woodhouse Technical School and Leeds College of Technology. He was the recipient of the junior and intermediate technical scholarships in 1931 and 1933, respectively. Mr. Turner received the National Certificate in electrical engineering in 1938, and the Higher National Certificate in 1940. In 1944 he completed successfully the examination for admittance as an associate member to the Institution of Electrical Engineers.

In 1934, Mr. Turner joined Dictaphone Company Limited in Leeds as junior assistant, and three years later became associated in the same capacity with the Yorkshire Electric Power Company in Branhope. He was promoted in 1939 to the position of assistant district engineer, responsible for the installation, maintenance and operation of the company's EHT and LT supply transmissions, distribution and substations in a large section of the Castleford district.

From 1941 until 1946 he was electrical engineering assistant to the director of the electrical engineering department of the H.M. Admiralty and was employed on the compilation and design of armament control and communication systems of newly constructed vessels.

Mr. Turner then joined the staff of the directorate of electrical engineering of the Department of National Defence (Naval Service) in Ottawa as a technical officer and was placed in charge of the armament control section. He was responsible to the electrical engineer in chief for the policy and fitting of armament control and internal communication systems and equipment in H.M.C. ships and establishments, and the supervision of assistants and a drawing office staff.

In 1947 he was appointed assistant manager of the electrical engineering department of H.M.C. Dockyard in Halifax.

Mr. Turner was an associate member of the Institution of Electrical Engineers, a member of the Association of Professional Civil Servants, a charter member of the Admiralty (Bath) Electronics Society, and a member of the Association of Scientific Works (Bath Branch).

He joined the Engineering Institute of Canada as a Member in 1951.

Walter Wilfred Rechenmacher, M.E.I.C., former construction superintendent with Olynyc Construction Company in Saskatoon, Sask., passed away on September 22, 1953, following injuries received in a construction accident three days earlier.

Mr. Rechenmacher was born at Scott, Sask., on August 23, 1920, and was educated at schools in Dodsland, Sask. After serving with the R.C.A.F. from 1940 until 1945, he entered the University of Saskatchewan, graduating with a B.Sc. degree in civil engineering in 1949.

He joined the firm of Underwood and McLellan Company Ltd., consulting engineers, in Saskatoon in the spring of 1949 and held the position of resident engineer for the next two years at Rosetown, Sask., where he was responsible for the supervision of the installation of water and sewer services in that town. He was then transferred to the R.C.A.F. station at Moose Jaw, Sask., where he was resident engineer in charge of the installation of all ground services in the extensive rebuilding program at that site. In May of 1953 he left Underwood and McLellan Company Ltd. to join Olynyc Construction Company as construction superintendent on work in the Saskatoon area.

Mr. Rechenmacher was a member of the Association of Professional Engineers of Saskatchewan. He joined the Engineering Institute as a Member in 1953.

Roy Basil Crowell, Jr.E.I.C., resident engineer with the Shawinigan Engineering Company at Varennes, Que., passed away at the Jeanne d'Arc Hospital in Montreal on August 26, 1954.

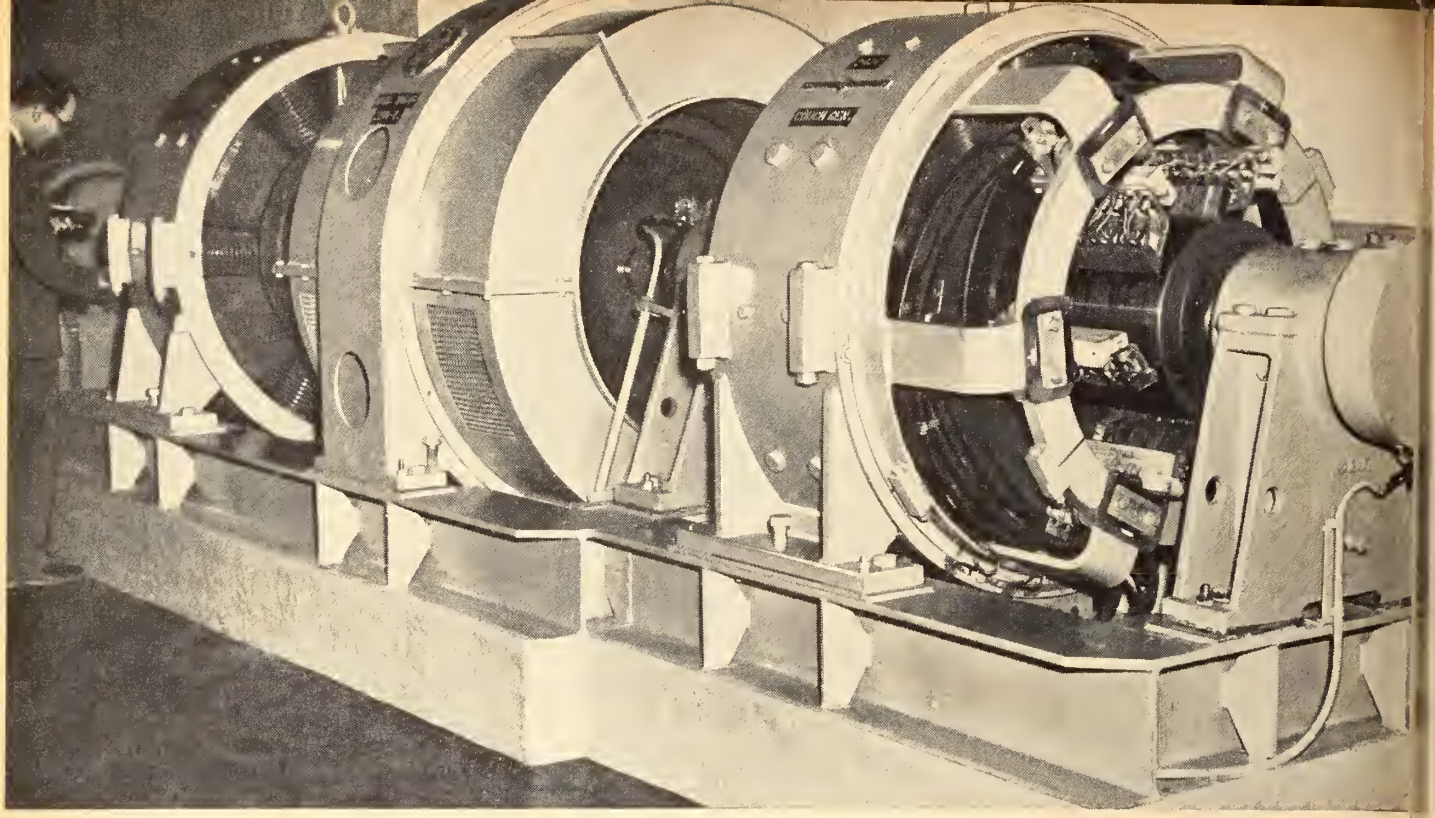
Mr. Crowell was born in Glace Bay, Nova Scotia on May 10, 1919, and was educated at the Glace Bay High School, Acadia University, and the Nova Scotia Technical College where he graduated with a B.Eng. degree in civil engineering in 1951.

He served overseas during World War II with the third division of the Artillery Survey.

During the summer months of his university course he was employed as noteman and instrumentman on topographical survey work with the Department of Mines and Resources.

Since graduation he has been associated with the Shawinigan Engineering Company.

He joined the Engineering Institute as a Student in 1950 and transferred to Junior Member in 1953.



Main power DC motor-generator set No. 1 for 202-inch, 1,500 FPM paper machine drive. This three-unit set comprises a 350 KW Dryer generator, 600 HP—750 RPM—2,300 volt—0.9 PF G-E Synchronous Motor, and 250 KW Couch generator mounted on a common base. Over-speed switch is mounted at the right end of the set.

G-E DRIVE UPS UNIT CAPACITY

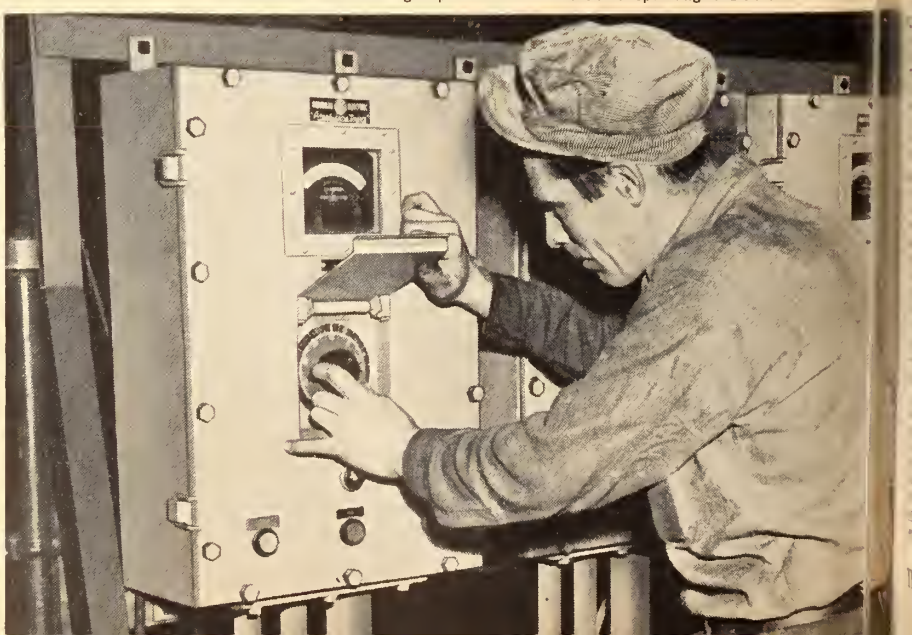
Modernization of No. 1 paper machine at the Ontario Paper Company, Thorold, with a G-E Sectional Drive has increased its output capacity 20%. Rated production speed has been increased from 1,250 feet of paper per minute, to 1,500 feet. This installation is a repeat order of similar equipment installed on this customer's No. 5 machine, in 1947.

This Company manufactures high quality newsprint for export. Their modernization program reflects the vision and foresight that is typical of the present trend to increased production and export by Canada's leading industry.

In addition to supplying the complete coordinated drive, C-G-E paper machine specialists supervised tune-up of the equipment on site. The entire changeover—including down-time and "break-in"—was accomplished with only 70 hours loss in production. Commenting on this feat, Mr. W. L. Eliason, Chief Electrical Engineer, stated "we feel that this performance was outstanding . . .".

Twin Limitamp starting unit for full magnetic primary reactor reduced voltage starting 600 HP—2300 volt synchronous motor and 450 HP—2300 volt induction motor. Short circuit capacity 100 RMS MVA on load side of contactor. Common bus compartment divides units.

Typical section operator's Control Cabinet mounted in front side alley of machine. Unit is completely waterproof. Load ammeter is mounted behind glass. Operator raises flap to adjust section speed on multi-turn helical-wound rheostat. Colour-coded control pushbuttons are mounted at bottom. Lights provide visual indication of operating condition.



Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS VACANT

CHEMICAL

CHEMICAL ENGINEER with some production experience required by large modern plant in Montreal for the study and development of production techniques associated with new products. Salary to be arranged. File No. 5129-V.

CHEMICAL ENGINEERS graduates from recognized Canadian Universities with 0-5 years experience. Required for process development studies, solution of technical assignments in production units, and on-the-job training in production supervisory capacities. Positions are in petrochemical plant located in Sarnia. Please reply in detail stating experience, education, etc. All replies will be kept in strict confidence. File No. 5137-V.

PETRO-CHEMICAL, CHEMICAL AND PETROLEUM ENGINEERS and constructors require engineers, designers and draftsmen with experience in the above fields, for their engineering design office in Southern Ontario. Please reply with brief details of experience, academic qualifications and salary. File No. 5140-V.

CHEMIST OR CHEMICAL ENGINEER, for general supervision of staff and operation of chemical plant integrated with Kraft Pulp mill, located in Northwestern Ontario. Must be graduate chemist or chemical engineer and be in excellent physical condition. Salary commensurate with experience and ability. Excellent employee benefits. Apply stating full particulars of experience, education, age, marital status, etc. File No. 5148-V.

PRINCIPAL PETROLEUM ENGINEER required by Sask. Department of Mineral Resources. Competition No. c/c 3510. Salary range $481-$566 per month. Applicants require university graduation in engineering plus extensive field and office experience in the oil and gas industry. To take charge of the development division of the petroleum and natural gas branch. File No. 5149-V.

RESEARCH ENGINEER, required by Sask. department of Mineral Resources. Salary range $326.-$397 per month. Requirements recent graduate in ceramics, chemical or geological engineering, to carry out lab and pilot scale experimental work, field exploration, and economic survey dealing with the non-metallic or industrial minerals of the Province. Good pension plan and conditions of employment. For further information and application forms contact P.S.C. Legislative Bldg., Regina. File No. 5154-V.

CHEMICAL ENGINEERS young, with a few years practical industrial background in chemical or allied fields together with sales experience, required as technical representatives. World wide concern offers processes and equipment to a broad industrial market. Salary is open, car provided. Location Ontario and Quebec. File No. 5156-V.

CHEMICAL ENGINEER with 3 to 5 years experience, preferably in chemical plant process engineering and/or operations, for process engineering work, plant located 25 miles from Montreal. File No. 5161-V.

A CHEMICAL ENGINEER required for development work in latex and solvent adhesives. Experience in this field an asset but not essential. The field is expanding and offers good opportunities. Location Montreal. Replies will be treated in confidence. File No. 5173-V.

A CHEMICAL ENGINEER will be required to assist our sales man. He should preferably have some experience in the latex field. He should have some imaginative ability in order to recognize and be able to apply new uses to our growing list of products, as related to the construction industry. A period of training will be offered to a recent graduate in chemical engineering, or to someone with 2 or 3 years industrial experience. Offices in Montreal. File No. 5173-V.

CIVIL

PROFESSOR CIVIL ENGINEERING, for appointment September 1st, 1955, to direct, supervise and give undergraduate and post graduate instruction in specified field in civil engineering. Salary range $5900 to $6600 with superannuation, hospital insurance and other benefits. Applicant should be university graduate, preferably with postgraduate training and should have had several years practical experience in responsible engineering work. Location Halifax, N.S. File No. 5110-V.

PROFESSIONAL ENGINEER, fully experienced in municipal engineering, required by a firm of consulting engineers. Applicant must be capable of taking full charge of the design of sewage treatment plants, sewerage systems, water supply and distribution, be fully competent to write specifications, and meet and discuss problems with municipal councils and engineers, and supervise the work of contractors. Work will be in Ontario from Toronto office. Full details as to experience, education, and references required in first letter. File No. 5116-V.

GRADUATE ENGINEER with extensive experience in general structural design including heavy concrete structures to direct the work of design and detailing group in the Montreal office of an established firm of utility consultants. Applicants must have a thorough knowledge of Canadian building materials and construction practices. File No. 5119-V.

THE CITY OF PRINCE ALBERT (pop. 19,000) requires an assistant engineer. Must hold an engineering degree preferably civil, from a recognized university. Position offers varied experience, future security, and an opportunity for advancement. Salary $325. to $375. per month, depending on qualifications. Reply stating age, experience, education and relevant information to File No. 5124-V.

WANTED AT ONCE salesman with experience in pipes for use in waterworks or sewerage systems. Experience in the installation of these pipes desirable but not essential. Please reply stating age, experience, educational qualifications and salary expected. Our employees are informed of this advertisement. File No. 5126-V.

CIVIL ENGINEER, preferably recent graduate, for bridge section of large transportation company with headquarters in Montreal. Duties include design of steel and reinforced concrete structures, preparation of reports and some travelling. File No. 5127-V.

CONSTRUCTION SUPERINTENDENT, excellent opportunity for top flight man with a proven record of successful jobs completed in the chemical or petro chemical field. Ability to organize and administer large projects including cost control, labour relations, stores, field supervision, together with a good technical and practical background. Applicant should have 10 years experience in construction field. Vacancy open with major petrochemical and petroleum engineers and constructors. Please reply with experience and salary expected to File No. 5139-V.

APPLICATIONS ARE INVITED for the position of engineer for the Town of Dryden, Ontario. Population 4200. Applicant should be qualified to lay out and supervise the construction of watermain and sewerage extensions, the construction of streets, drainage and the general requirements of a growing community. This is a permanent position to the qualified applicant with excellent opportunities, pension plan in effect after one year's service, also sick leave provisions. Starting salary $450 per month to be increased to $500 after six months probationary period. Applicants should state their educational background, age, marital status, previous employer and references and a recent photograph. File No. 5143-V.

CIVIL ENGINEER, Canadian graduate preferably—minimum 3 years recent design experience in R/C bridge and highway required. Previous experience in industrial building design considered useful. Work in Windsor, Ontario. File No. 5155-V.

CIVIL ENGINEER, young Canadian graduate, 2 years maximum for academic design engineering related to steel and concrete support of equipment, pipes, etc. Work in Sarnia. File No. 5155-V.

TWO GRADUATE CIVIL ENGINEERS for consulting firm engaged in large scale development projects. One to three years experience in design and supervision of roads, sewerage systems, water distribution systems, etc. required. Please reply giving full details of academic training and professional experience, references and salary requirements. File No. 5163-V.

THE PUBLIC UTILITIES COMMISSION of the City of Kingston requires a graduate engineer with water works engineering experience to plan, design and supervise projects in connection with a municipal water works system. Duties would include supervising the installation of new watermains and eventually supervising the operation of a modern filtration plan. Salary commensurate with qualifications. Position offers participation in commission's hospitalization and pension plans.

ORENDA ENGINES LIMITED

Toronto, Canada

require

ENGINEERS IN GAS TURBINE DEVELOPMENT

An expanding Canadian company has openings for engineers of university graduate or equivalent status, preferably with Gas Turbine experience in the following fields:

COMBUSTION SYSTEMS

Experience in gas dynamics problems desired and the ability to assume responsibility for organizing and executing detailed programs for the development of gas turbine combustors and related equipment.

VIBRATION ENGINEERS

Previous experience preferred in vibration problems on gas turbine blading and engine structures. The work will include direction of laboratory, test house and flight vibration tests in addition to analysis of test data.

Apply to:

Placement Supervisor,

ORENDA ENGINES LIMITED

Malton, Ontario.

Applicant should submit full details of education, experience, age and references. Replies will be kept confidential. File No. 5164-V.

MANAGER REQUIRED FOR Canadian subsidiary of British organization, manufacturing construction equipment. To take complete charge of the appointment of distributors and demonstrations, to service customers, and conduct the entire business. Preferably civil engineer and/or experience in construction work and particularly in regard to construction equipment and the sale thereof. File No. 5163-V.

CIVIL ENGINEER required by general contractor to administer a group of contracts distant from the firm's head office which is in Quebec. Applicant must have experience in all phases of general contractors' operations and be not less than about 30 years of age. The administrator would be domiciled in Quebec or the Maritime Provinces. Applicants must state salary expected. File No. 5176-V.

ELECTRICAL

GENERAL MANAGER required for the Saskatchewan Power Corporation operating a rapidly expanding province-wide electrical utility and an extensive gas utility. Headquarters Regina. Kindly state fully background and experience including previous training in and knowledge of electrical and gas utilities and industrial and public relations. State also salary expected and date available. File No. 5093-V.

ELECTRICAL ENGINEER, with four years general experience in substations and industrial layout of large motors, mining experience preferred. Write stating experience and qualifications to File No. 5095-V.

ELECTRICAL ENGINEERING DRAUGHTSMAN or electrical engineer, required for consulting engineer's office. Experience required in commercial and residential design, layout, etc. Permanent position. Please write advising experience to File No. 5096-V.

ELECTRICAL ENGINEER, graduate with at least 5 years experience protective relay work with electric operating utility company. Relay studies, system development studies and general technical electrical operating and design work. Permanent position long established consulting organization. Headquarters New York. Some travel Latin America. Knowledge of Spanish or Portuguese desirable, not essential. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5108-V.

ELECTRICAL DRAUGHTSMAN, required in Montreal by naval architects office. Age 25 to 35 with technical and all around experience. Applicant would have to be of good personality and reasonable executive ability to work in as assistant electrical engineer and eventually chief electrical engineer. File No. 5111-V.

PROFESSOR AND HEAD OF THE DEPARTMENT OF POWER ENGINEERING, required by The Institute of Science, Bangalore. This is one of the foremost institutions of India. As head of the department, to administer the power engineering department and coordinate the activities of the four sections of electrical engineering, mechanical engineering, civil and hydraulic engineering, and high voltage engineering. Qualifications; a degree in electrical engineering of a recognized University, practical training in well-known electrical manufacturing concerns or large power projects and/or power supply organizations. Duration of appointment, one year renewable. Salary between the equivalent of $8750 and $9500 per annum (national income tax reimbursed if levied), depending on qualifications and experience, plus family allowances. File No. 5115-V.

ELECTRICAL ENGINEER, graduate with at least 5 years experience protective relay work with electric operating utility company. Relay studies, system development studies and general technical electrical operating and design work. Permanent position long established consulting organization. Headquarters New York. Some travel Latin America. Knowledge of Spanish or Portuguese desirable, not essential. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5117-V.

GRADUATE ELECTRICAL ENGINEERS—one senior—two juniors—Senior at least 10 years experience—Junior 3 to 5 years experience in electrical design, operation and construction of steam, hydro plants and substations. Permanent position with long established consulting organization for public utility operating companies located Latin America. Headquarters New York. Some travel necessary in future. Knowledge of Spanish or Portuguese useful, not essential. Salary commensurate with qualifications. Good opportunity. Reply stating age, education, experience and personal particulars. File No. 5118-V.

A LARGE MANITOBA UTILITY requires a graduate electric engineer, to fill the position of Asst. to the transmission line engineer. Applicant should have at least three years experience in distribution practices, including layout of large distribution areas, estimating of costs of distribution changes and extensions, improvement of voltage conditions and expansion of existing systems, basic economic studies. Ability to write clear and concise reports, to supervise and deal with field staff is essential. Location Winnipeg. Applications treated confidentially. File No. 5121-V.

ELECTRICAL ENGINEER communication option from Canadian University required by manufacturer of television located in Ontario. Applicants should be 2 to 3 years out of university and have some experience in radar or allied equipment. Position open in Production Department. File No. 5122-V.

GRADUATE ELECTRICAL ENGINEER to assume responsibility for design and development of distribution and small power transformer with manufacturer established in Alberta. At least one year design and/or manufacturing experience desirable. Applicants to give personal data (including recent photo), education, experience, references and minimum initial salary expected. File No. 5131-V.

ELECTRICAL ENGINEER with at least two years of experience in industry. To handle under supervision, design of power distribution and control for plant extension and development work, supervision of draughting, test work, preparation of test reports and estimates. Required by smelting firm in the vicinity of Montreal. Experience in electric furnace smelting. File No. 5132-V.

MANAGER OF ENGINEERING required to direct our guided missile development and design program. The man for whom we are looking will have a background of at least ten years electronics experience. Specific experience in guided missiles would be a definite asset. His executive ability must be of a high order, and his supervisory experience be at engineering management level. This position will demand the best from a highly capable and mature engineering executive and in return offers an attractive salary, plus excellent opportunity for further professional and personal advancement. Reply in strictest confidence. File No. 5133-V.

A LARGE PROGRESSIVE AND WELL established electrical engineering company in N.E. England offers opportunities to engineer designers and draftsmen who have served a recognized engineering apprenticeship, possess technical qualifications to Higher National Certificate standard in electrical and/or mechanical engineering and have had practical experience on the drawing board preferably in connection with the design of electrical switchgear. Engagement would be for a minimum period of 2 years with the opportunity of continuance thereafter on a pensionable basis. Minimum salaries £585 per annum at age 25 and £663 at age 30. Passage paid and housing assistance in approved cases. A few opportunities also occur on much similar terms for contract engineers with qualifications and experience adequate to handle all phases of tender and contract work met with in world wide electrical power supply equipment industry, particularly in respect to control and switchgear. File No. 5144-V.

ARCHITECTURAL DESIGNERS
STRUCTURAL DESIGNERS
AND DRAFTSMEN

For long range industrial program in an established consulting office.

Must be experienced and capable of checking design drawings. Draftsmen experienced in structural steel detailing.

Send complete resume of experience.

Samborn, Steketee & Associates

1214 Cherry Street
Toledo 4, Ohio

ENGINEERS

Continuing progress and expansion of this Company's operations have created many interesting new career opportunities for

ELECTRONICS, ELECTRICAL, CIVIL, MECHANICAL

and other Engineers interested in

COSTING, SELECTING and DEVELOPING COMMUNICATIONS SYSTEMS

involving uses of the latest types of

Microwave Equipment • Network TV Transmission
Telephone Switching Systems • Carrier Systems
Cable Distribution Systems

In addition to employee security and benefit plans for which this Company is well-known, the Bell offers its Engineers opportunity to advance to higher executive positions in both engineering and administrative capacities.

Salary: commensurate with experience and ability.

All replies will be treated in strict confidence. To arrange an interview, write our Employment Manager at Montreal, (Mr. R. B. McGiverin, 620 Belmont Street), or at Toronto, (Mr. T. R. Traynor, 76 Adelaide St. West).

THE BELL TELEPHONE COMPANY OF CANADA

PROJECT MANAGER (electrical and electronic) to design electrical and electronic installations in aircraft and to supervise a small section of electrical and mechanical draughtsmen. Applicants should have a degree in electrical engineering or mechanical engineering with electrical subjects and a strong secondary and preferably 5 years experience in design of electrical and electronic installation in aircraft. Experience in supervision of draughtsmen desirable. Salary commensurate with experience and qualifications. Reply stating age, education, experience, personal particulars and salary expected. File No. 5147-V.

ELECTRICAL ENGINEER, Canadian graduate with 4 to 6 years expereince lighting and power distribution for industrial buildings. Work in Windsor or Sarnia. File No. 5155-V.

THE PUBLIC UTILITIES COMMISSION of the City of Kingston requires a graduate engineer with electrical distribution engineering experience to plan, design and supervise projects in connection with an electric utility. Position offers participation in commission's hospitalization and pension plans. Salary commensurate with qualifications. Applicant should submit full details of education, experience, age and references. Replies will be kept confidential. File No. 5164-V.

GRADUATE ELECTRICAL ENGINEER interested in a career in Latin America with a Canadian owned electric light and power utility located in La Paz, Bolivia. Age limit 30 years and should have 4 to 5 years experience in electrical distribution. Prospects of promotion are excellent due to the company's continued growth and expansion. File No. 5170-V.

TWO COMPETENT GRADUATE ELECTRICAL engineers, age 30 to 40 with minimum 8 years experience design operation and maintenance of distribution facilities, required by rapidly growing utility, desirable location South America. Portuguese or Spanish useful, not essential to start. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5171-V.

ELECTRICAL ENGINEERS required to fill two vacancies in the teaching staff of the electrical engineering department at the University of New Brunswick. Good academic standing and either an advanced degree or at least two years of technical experience preferred. Should have an interest in teaching and initiative and energy to be effective in the growth of a rapidly expanding department. Reply stating age, education, experience, personal particulars, references and minimum salary expected. File No. 5172-V.

ELECTRICAL ENGINEER required as sales engineer with a leading electronics firm. Good salary plus commission and excellent opportunity for future advancement. All applicants should state qualifications and salary expected. File No. 5177-V.

MECHANICAL

MECHANICAL ENGINEER required in Edmonton, who has graduated from a Canadian University and who has about 3-5 years experience in a chemical plant or refinery. He will deal mostly in equipment used in the manufacture of petro-chemicals and synthetic fibres. Duties will consist of general engineering which will include design, layout and estimating. File No. 5055-V.

MECHANICAL ENGINEER required for development and design of precision mechanisms of control equipment. Must be graduate engineer, above 30 years of age and considerable experience. Must have the ability to take over leadership of an experimental group and be prepared to make decisions. Salary commensurate with experience and qualifications. File No. 5103-V.

MECHANICAL ENGINEER required for development and product design of optical equipment. Applicant should be not less than 30 years old, with at least 5 years experience in the optical field. Plant location Eastern Townships. Salary commensurate with experience and qualifications. File No. 5103-V.

ASSISTANT PROFESSOR MECHANICAL ENGINEERING for appointment September 1, 1955, to give undergraduate instruction in the thermal power and allied subjects. Salary range $4100 to $5000 with superannuation, hospital insurance and other benefits. Applicant should be university graduate with some years practical experience in steam power work. Location Halifax, N.S. File No. 5110-V.

VACANCIES IN CORNWALL, Ontario for graduate mechanical engineers. Age 24 to 28. Duties will cover design, construction and maintenance of all types of rayon machinery. Applications should be made to File No. 5120-V.

MECHANICAL ENGINEERS, graduates from recognized Canadian Universities with 0-10 years experience in a chemical plant or refinery. Duties will consist of general engineering, including design layout and estimating. Please reply in detail stating experience, education, etc. All replies will be kept in strict confidence. File No. 5137-V.

MECHANICAL MAINTENANCE ENGINEER with 5 years experience in oil refineries required as assistant maintenance superintendent in Southern Ontario. Please reply giving details of experience and salary expected. File No. 5141-V.

APPLICATIONS ARE invited for the position of instructor in Engineering at Mount Allison University. Duties to begin about Sept. 15th. Candidates must be university graduates in engineering, preferably in mechanical engineering. Salary range $2500 to $3000. Please apply to File No. 5150-V.

GRADUATE MECHANICAL ENGINEER, for large industrial concern near Montreal to take charge of a research project involving the design and development of new pilot plant machinery. Only those having initiative and capable of doing independent research work need apply. State age, experience and salary expected. File No. 5151-V.

MECHANICAL ENGINEER. Canadian graduate, 3 to 8 years experience process piping and equipment in refinery or chemical plants. Field experience valuable. Work in Sarnia. File No. 5155-V.

MECHANICAL ENGINEER required immediately for manufacturing department of electrode manufacturing plant in Montreal. Applicant should be a graduate of Canadian University, bilingual, with approximately five years of general engineering experience. Must be willing to do practical work. Remuneration in line with qualifications. Generous pension plan and other employee benefits. File No. 5160-V.

MECHANICAL ENGINEER with 3 to 5 years experience, preferably in connection with construction projects of various kinds, for work on plant engineering projects. Plant located 25 miles from Montreal. File No. 5161-V.

MECHANICAL ENGINEER OR graduate of engineering physics required by leading manufacturer of heating, ventilating and air conditioning equipment for sales engineering work. Age 21 to 27 years. Prefer a graduate of 1953, 1954 or 1955 classes. Previous experience in this work is not necessary, however, please state age and experience when replying. File No. 5168-V.

FIRE RESEARCH

The National Research Council

Division of Building Research
Ottawa, Canada

requires

A Physicist, or Engineering Physicist, to assist with the Division's Fire Research program.

Qualifications:

Applicants must be graduates from a recognized university.

Salary:

Salary commensurate with qualificatians.

Further Particulars:

The program is intended to reduce the toll of life and the immense property loss which arise from fires in all kinds of buildings in Canada. A wide general scientific knowledge and originality and versatility in experimental work are more desirable than any advanced specialization; but an interest in measurement of thermal radiation and flame temperatures, in unsteady-state heat transfer and in statistics would be an advantage, and the capacity to write reports which are clear to the public is indispensable.

Applications with full details of education and experience should be sent to the employment officer, National Research Council, Sussex Drive, Ottawa 2, Canada.

MECHANICAL ENGINEER required by automotive manufacturing company in Montreal. Applicant should be between the ages of 30-40 and preferably bilingual with experience in internal combustion engines. Duties will include the study of quality problems and production planning. File No. 5178-V.

MISCELLANEOUS

THE NATIONAL RESEARCH COUNCIL, Ottawa, Canada, requires a university graduate to investigate problems in aircraft icing. Duties will include tests in flight as well as in icing tunnels and development work in co-operation with commercial aircraft firms. Experience in aeronautical engineering problems and aircraft performance is desirable. Initial salary in the range of $3750 to $5750 per annum depending on qualifications. File No. 5086-V.

CIVIL AND MECHANICAL ENGINEER required preferably with a few years of relevant experience and with good academic records for positions as research officers. To work on the dissemination of technical information to the construction industry and to study in the field new materials and techniques as used in construction. The ability to write clear reports to bridge the gap between research and industry is important. To undertake studies leading to the specification and assessment of materials and components for application in housing. Opportunities for study of the technical aspects of house construction will be provided. Salary will depend on training and experience. Applications with full details of education and experience should be sent to File No. 5091-V.

SCIENTISTS AND ENGINEERS with The Defence Research Board for challenging positions, with ample opportunity for advancement are available at several locations in Canada. Physicists, engineering physicists, electrical engineers, mechanical engineers, mathematicians, statisticians, chemists, biological and social scientists. There is also a requirement for trained scientists for work in operational research and scientific information. Qualifications: applications are invited from Canadian citizens or British subjects, graduates with a good academic record in science or engineering from a recognized university, preferably with post-graduate training. Proven scientific ability experience desirable. Salaries will be commensurate with qualifications and experience. Write outlining your qualifications to File No. 5092-V.

A LARGE MANUFACTURER in the Eastern Townships requires an engineer with maintenance background interested in industrial engineering, or visa versa. This is a newly created position to review and expand maintenance control procedures for a diversified maintenance work force—an expanding field with tremendous scope. Initiative and ability to present ideas effectively are essential qualifications. File No. 5094-V.

AIRCRAFT SALES MANAGER REQUIRED. Applicants must have a good aviation background and should not be more than 40 years of age. Preference will be given to those having an aeronautical engineering qualification. The position is a permanent one and available immediately. The successful candidate will be required to travel extensively in Canada, U.S.A. and the U.K. and will be resident in Montreal. Initial salary will depend on qualifications and experience, in addition, the company provides group pension and insurance plans and other benefits. Applications (six copies) giving full details of training, qualifications and experience and the names of three persons to whom reference may be made should be sent to File No. 5097-V.

SALES ENGINEER, experienced in concrete work. Territory province of Quebec. Bilingual preferred but not essential. Permanent position if satisfactory. Please reply giving details of experience, salary required, etc. Apply to File No. 5098-V.

ENGINEER REQUIRED with at least ten years experience in the diesel engine field preferably in application engineering. Age between 35 and 45 years. Must be Canadian graduate. The salary will be above the average for positions of this type and the development prospects are good. Location Montreal. File No. 5100-V.

MECHANICAL OR TEXTILE ENGINEER

AS

ASSISTANT SUPERINTENDENT

Progressive, modern, textile company in Gronby, Quebec, wishes to engoge o mechonicol or textile engineer as Assistant Superintendent.

A mon of 25 to 35 yeors of oge who is primorily interested in production and plont engineering is desired. Previous manufacturing experience, including stoff supervision, is essentiol.

All communicotions will be considered strictly confidentiol ond interviews will be orronged in Montreal with oppliconts hoving suitoble quolificotions.

Applications should include doy ond evening telephone numbers, home address ond detoils of quolificotions. Please reply to File No. 5179-V.

THREE RECENT GRADUATE engineers required at our plant in Ontario, with experience as follows: some experience in design of machinery and equipment; some electrical experience, or electrical engineer with mechanical experience; experienced in machinery and equipment design—new and maintenance—in charge of draughting room. File No. 5104-V.

OPPORTUNITIES FOR SENIOR ENGINEERS and technicians for permanent positions in rapidly expanding research organization located in Toronto. Senior engineers should be experienced in electro-mechanical, electronic, servo-controlled and computing instrumentation. Salarics open. Write detailing education, qualifications and experience. All inquiries will be treated in strictest confidence. File No. 5105-V.

APPLICATIONS INVITED WITH university graduation in Engineering and several years experience in field and office petroleum engineering work; to perform supervisory and professional duties related to draughting of sound conservation practices regulations; estimation of reserves; and general reservoir management. Location Western Canada. File No. 5109-V.

SENIOR GEOLOGIST, required by Saskatchewan Department of Mineral Resources. Applicants require University graduation in geology or petrology as well as several years professional geological experience and membership in C.I.M.M. and Association of Professional Engineers to take charge of geological survey parties for approximately six months each year and to prepare reports and other duties the remaining six months. File No. 5112-V.

A GRADUATE CHEMICAL OR MECHANICAL engineer for technical services work in marketing department of major Canadian oil company, Toronto office. Good technical background in petroleum fuels, lubricants and associated products essential, plus ability to make successful customer contacts and sales meeting presentations. Interesting prospects for advancement and liberal employee benefit plans. Give all information in first instance. All replies confidential. File No. 5125-V.

SALES ENGINEER with experience in combustion, oil burning equipment and lines related to boiler room equipment required by established engineering company located in Montreal. Write giving full details of experience and salary desired. File No. 5128-V.

A FIRM LOCATED IN Montreal requires the services of a graduate engineer who is experienced in the fields of water conditioning and purification, sewage and industrial waste treatment. A bacteriological background would be of advantage. File No. 5130-V.

SENIOR AND INTERMEDIATE ELECTRONIC engineers and physicists are required by a leading Canadian firm to carry out design and development work in the fields of radar, microwave communications, telephony and AM & TV broadcast equipment. All replies are confidential and will be acknowledged. File No. 5135-V.

TORONTO AFFILIATE OF world wide concern engaging in extensive and varied research has immediate requirement for experienced patent attorney or agent to organize a patent department. In addition to supervising Canadian prosecutions and making infringement and validity investigations, appointee will maintain liaison with overseas patent department and will work in close co-operation with personnel engaged in licensing activities. Applicants should submit complete resume of personal data. All replies will be treated confidentially. File No. 5136-V.

TWO ENGINEERS WANTED. Electrical or mechanical. Must be graduate of Canadian or U.S. University. Experience not necessary. State full particulars and preference for production or design. Independent company located mid-western Ontario city. Full benefits. File No. 5138-V.

SALES ENGINEER required by company located in Montreal engaged in water and liquid conditioning engineering. Duties include both sales estimating and service work. Dealings are generally in the pulp and paper industry, utilities and general manufacturing

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Hydraulic Engineers

Salary up to $7200 per annum

depending upon qualifications

For

St. Lawrence River Joint Board, Montreal — Competition 55-1252

and

Northern Affairs and National Resources, Ottawa — Competition 55-1250

For further information, write to

Civil Service Commission, Ottawa.

Quote Competition Number

CITY OF PORT ARTHUR

Applications will be received up to Monday, 30th May, 1955, for the position of

ASSISTANT CITY ENGINEER

Previous employment with a municipality desirable, but not essential.

Application forms will be forwarded on request. Complete statement as to experience and qualifications, in detail, must be submitted with the application form.

Consideration will be given to sharing expenses of interview and moving expenses of successful applicant.

Arthur H. Evans,
City Clerk.

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field. Stationed in Montreal to travel in the Province of Quebec and the Maritimes. Salary dependent on the experience of the individual, employment benefits with hospitalization, pension. File No. 5145-V.

MAJOR OIL SERVICE COMPANY operating in several locations in the Western Provinces requires several graduate engineers immediately. The positions offered involve field work, travelling and irregular hours. The salary schedule and employee benefits are excellent, the work has variety and several opportunities for advancement are available. The company is the leader in its field and well established on a world wide scale. No previous experience is necessary, however an interest in fundamental electricity is desirable. Applicants must be 20 to 39 years of age and should supply a transcript of university marks with their reply. Please give age, education, experience and other qualifications. Minimum salary is $375.00. Complete job and company description available upon request. File No 5146-V.

OPPORTUNITY FOR AN ENGINEER, if you have had ten or more years of experience in a pulp and paper mill, or in the sale of industrial equipment or some combination of the two, we have an opening in sales engineering that would be very interesting to you. We are a well established manufacturer of pulp and paper mill equipment. Living conditions in our centrally located city are considered very desirable. This is a senior position suitable for a serious and ambitious man who expects and warrants liberal remuneration. Our present staff have been advised of this advertisement. Your communication, outlining your background will be treated in confidence. File No. 5152-V.

LARGE ESTABLISHED paper company requires graduate mechanical, civil and electrical engineers with necessary experience to undertake investigations, preliminary designs and estimates for expansion of existing mills and new projects which may be contemplated. Good opportunity for qualified men with pulp and paper mill experience. Office located in Montreal. Replies should state age, qualifications, experience and salary expected. Interview will be arranged with prospective applicants. File No. 5153-V.

SALES ENGINEER, wanted with several years of sales experience preferably in petroleum chemical, steam power plant or pulp and paper industries. Required to handle all sales aspects relating to heat transfer equipment for major firm engaged in design of same. Would involve travel, principally in Eastern Canada. Location in Montreal. Salary and expenses. File No. 5157-V.

SENIOR PROJECT ENGINEER required by engineering-construction firm specializing in oil refineries and chemical plants. Applicants should have at least ten years experience in the design and installation of process equipment including pressure vessels, piping, pumps and compressors, buildings and structures. Plant operating or maintenance experience desirable. Location will be Montreal office. Please furnish personal data, detailed experience record and references. File No. 5158-V.

RECENT GRADUATE IN MECHANICAL OR chemical engineering required for Montreal East Refinery. One or two years' basic experience required with plant utilities such as steam, air and water. Knowledge of plant electrical systems useful but not essential. Position provides excellent opportunity for professional experience and promotion. Duties after suitable training period, will include such matters as performance studies on steam boiler plant, steam engine and turbines, pumps, air compressors, condensers and similar mechanical equipment, economic studies on efficient usage of plant utilities; preparation of estimates and layouts for extensions to plant utility systems. Salary dependent on experience and qualifications. Applications will be treated confidentially and should be addressed in writing with full particulars to File No. 5159-V.

YOUNG TECHNICALLY TRAINED men for industrial engineering subdivision, which includes tool engineering, production engineering, work standards, and plant layout and material handling. Location Ontario. File No. 5162-V.

INDUSTRIAL ENGINEER with work standards experience in foundry, machine assembly type of operation. Assignments will include development and installation of major programs as well as development of procedures and personnel. We are seeking a man with a degree in engineering or applied science, between 28 and 35 years of age. Location Ontario. File No. 5162-V.

PLANT MANAGER PREFERBALY 25 to 35, required by an Alberta firm specializing in precast concrete. Applicants must be university graduates in civil engineering or mechanical engineering, with a minimum of three years experience, preferably in manufacturing or in reinforced concrete. Will be required to supervise and direct all activities of a branch plant, reporting directly to the general manager. Salary open, with advancement dependent largely upon administrative ability. required by an Alberta firm specializing in cation, interests and recent photograph. File No. 5166-V.

JUNIOR ELECTRICAL ENGINEER

We require the services of a Junior Electrical engineer to act as an assistant to the distribution engineer. Please state education, experience, and salary expected.

Replies will be held strictly confidential. Apply Personnel Officer, Ottawa Hydro-Electric Commission, 56 Sparks Street, Ottawa, Ontario.

CHIEF CHEMIST REQUIRED

Graduate chemist, 3 to 5 years' industrial experience in inorganic chemical analysis. Should be thoroughly grounded in physical chemistry, including modern instrumentation techniques. Should have successful management experience and ability to reorganize and modernize existing laboratory. Must understand principles of modern analytical control methods necessary for a complex continuous production process. Location, South Eastern Ontario. Company housing provided at low rental if desired along with excellent sickness, accident and pension benefits. This is a challenging opportunity for a man with ability, ambition and the desire to assume a management function in a medium sized company. Salary open. File No. 5189-V.

ESTIMATOR

(Quality Surveyor)

Location—Ottawa

State qualifications, age, marital status, experience, salary expected.

Replies will be treated confidentially.

File No. 5187-V.

INDUSTRIAL ENGINEER, man with experience in job methods work and the installation of inactive systems for Montreal manufacturing company. Engineer with experience with management consultant firm would be considered. File No. 5167-V.

YOUNG SALES ENGINEER, preferably 1955 graduate required as sales engineer by manufacturer of complete line of heating and ventilating equipment and centrifugal pumps. Training period for experience in Canadian or U.S. offices. Head Office in Ontario. File No. 5169-V.

SALES ENGINEER required by well established and highly respected company in the field of scientific illumination. Duties after a specific training program, will involve the sale of prismatic lighting units and the discussion of lighting applications with architects, consulting engineers and electrical contractors, officials of industrial and commercial firms, municipal and hydro officers. Qualities of personality, diligence, and dependability along with a sincere desire for a permanent career in the lighting industry are of prime importance. File No. 5174-V.

DEPARTMENT OF NATIONAL DEFENCE, Ottawa, urgently requires inspecting officer. Under direction to be responsible for the direction of inspection of the manufacture and filling of artillery ammunition stores (shell); to lay down inspection requirements and proof conditions concerning the manufacture and filling of all shell stores; to set standards of workmanship and finish; to recommend acceptance or rejection of concessions or other departures from drawings and specifications. Graduation in engineering or applied science from a university of recognized standing, and/or qualifications that would permit membership in a Provincial Association or the Corporation of Professional Engineers. File No. 5175-V.

TECHNICAL WRITERS REQUIRED with a university degree in science or engineering. The ability to express technical information in clear concise English and to read wiring diagrams, schematics and mechanical drawings is essential. Positions offer varied experience, future security and an opportunity for advancement. Please reply stating age, experience, educational qualifications and salary expected. File No. 5177-V.

SITUATIONS WANTED

CHEMICAL ENGINEER, M.E.I.C., age 35, 10 years experience in research, development and production desires position as assistant sulphite superintendent or control superintendent in pulp or paper mills. File No. 660-W.

MECHANICAL-ELECTRICAL ENGINEER, P.Eng. Jr.E.I.C., Polytechnique 1948, fluently bilingual, married with two children. 2½ years engineer draughtsman, equipment installation and plant services layout; 4 years plant engineering, supervising chemical plant electrical and process instrumentatinn design, construction and maintenance, equipment preventive maintenance program, pressure vessel work, safety and fire protection. Experience includes industrial electronics, hydro-electric sub-stations distribution and relay protection. Desires responsible position in Montreal area. File No. 1097-W.

EXECUTIVE ENGINEER Mechanical graduate P.Eng. Ontario and Quebec. M.E.I.C., age 39, married, with wide and diversified Canadian experience in engineering design, construction, maintenance, industrial, manufacturing and business field. Accustomed in dealing with management and personnel (technical and

otherwise.) Capable administrator and organizer, aggressive, tactful. Would consider position offering responsibility, scope and future. Eastern Canada preferred. Available by arrangement. File No. 1793-W.

EXPERIENCED ENGINEER, M.E.I.C., would furnish structural designs and quantity estimates in steel concrete or wood, for architects or others requiring only occasional work of this type in Montreal. File No. 2672-W.

ELECTRICAL ENGINEER P.Eng. Ont. Jr.E.I.C., with post graduate business administration training, 7 years sales and manufacturing experience at responsible level. Presently in sales administration, functions including formulation of sales policies, supervision of sales, sales promotion, sales forecasting etc. Seeks responsible position in sales administration (industrial market). File No. 2975-W.

MECHANICAL ENGINEER, B.Sc., Queen's, P. Eng. Ontario, married 2 children, with 9 years experience; two years design and maintenance in modern newsprint mill, five ycars design of steam power generating plants with large consulting company, two years and currently utilities engineer with design engineering and construction company. Familiar with equipment and operation of 900 lb. 750F powcr plants; stoker, pulverized fuel, and gas firing, coal and ash handling, water pumping and treatment for steam and process use, large air compressors, instrumentation and control, code piping, chemical plant services, heating and ventilating. Recently completed start-up of 4½ million dollar project in Western Canada. Seeking responsible position with industry, government agency, or consulting group. File No. 2990-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng. (Ont.) B.Sc. (Quecns) 1941, age 38, 13 years experience in manufacturing methods, process engineering, production engineering of high precision components, plant layout and engineering. Desires position as plant engineer or mechanical superintendent; available immediately. File No. 3272-W.

MECHANICAL AND ELECTRICAL ENGINEER, Jr.E.I.C., graduated 1949 from Vienna University; married, 2 children; 3½ years in Canada, perfectly bilingual; experience covers: heating, air conditioning, drying and piping with consulting engineer and contractor; as junior engineer, field supervisor and project engineer; equipment, instrumentation, process and service piping for complex chemical plant, as draftsman and mechanical engineer; layout, detailed planning, supervising the erection of complete electrical system and equipment for large cement plant, as chief of electrical section; good organizational capabilities and experience in dealing with management, staff, suppliers and contractors; seeks responsible and challenging position in industry, plant or with consulting engineer; first class references. File No. 3945-W.

CIVIL ENGINEER Jr.E.I.C., (McGill) with 4 years experience on highway construction, surveys, soils and foundation engineering for bridges and heavy structures wishes employment with a small company undertaking construction of bridges, buildings and roads. File No. 3988-W.

ELECTRICAL ENGINEER, Jr.E.I.C., U. of Manitoba, 1950, 29 years of age, Test Course, 2½ years design of mercury arc rectifier controls, 5 months automotive plant engineering, 9 months supervisory capacity in hydro electric generation. Will consider any location. File No. 4021-W.

MECHANICAL ENGINEER, B.Sc., P.Eng., Ont., single, with 8 years experience; 5 years plant engineering, maintenance and design specializing in application of instrumentation, agitation and related chemical plant services and equipment; 2 years project engineer with large chemical company, design and installation stainless steel plant equipment; past year with refinery organization piping and pressure vessel design. Seek scope for initiative in project design, engineering sales or field work utilizing experience. Travel not objectionable, prefer Ontario, Montreal, or U.S.A. File No. 4248-W.

METALLURGICAL ENGINEER, Jr.E.I.C., P. Eng., B.Sc. (Chemistry), B.E. Nova Scotia Technical College 1952. Married, age 32. Experience includes one year as chemist in control laboratory of a non-ferrous smelter; one year as assistant welding engineer with a steel fabricator, and approximately one year with a research firm on ore preparation and reduction of ores. Desires technical position with firm located in Ontario or Quebec. File No. 4128-W.

CONSTRUCTION ENGINEER, P.Eng., Jr.E.I.C., McGill 1951, married, 26 years old. Two years structural design experience in structures for industrial plants and warehouses. Extensive construction experience consisting of supervision on the erection of warehouses and other commercial projects. Piping layout supervision. Considerable office experience in estimating, quantity takeoffs and the preparation of plans for tendering purposes. Presently employed, available upon two weeks notice. File No. 4273-W.

CIVIL ENGINEER, M.A.Sc., Jr.E.I.C., P.Eng. (Man.) graduate 1952. Age 26, single. Two years experience on heavy building construction. Resident engineer on construction of water treatment and sewage disposal plants complete with distribution systems. Related summer experience with water works and private disposal systems. Would like to hear from employer in Canada or U.S.A. who requires a capable worker. References available from all previous employers. Will be available early summer. File No. 4415-W.

SALES ENGINEER four years experience in technical sales promotion, advertising, catalogue writing, marketing, and administration. Chemical engineer, P.Eng. (Que.), Jr.E.I.C., University of Saskatchewan 1950. Age 27, married. Seeking interesting, responsible sales position. File No. 4516-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng., B.A.Sc. honours degree, electrical engineering University of Toronto 1950. One year experience in municipal engineering, one year with industrial electrical contractor as field engineer on construction. Three years experience in paper and board industry, operation, maintenance, construction, hydro-electric plant operation. Seek position in heavy industry or manufacturing. Would locate in one month in Canada. File No. 4545-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng., 1951 graduate, N.S.T.C. Experience in plant engineering (one year) and design (three years). Desires position with increased responsibility. File No. 4559-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng., ten years experience of mechanical and chemical plant design, installation and maintenance. Presently holding management position heading design team on specialized machinery and equipment. Seeks position where initiative, responsibility and organizing ability are used to the fullest. Would consider the commercial aspect of engineering. File No. 4568-W.

YOUNG ELECTRICAL ENGINEER, Jr.E.I.C., invites offers of challenging position requiring initiative and responsibility and providing incentive and opportunity. Graduated from University of Manitoba in 1950, age 27, married with one child, Jr.E.I.C. Has been 4½ years with electric utility and has gained experience in maintenance of electrical equipment, operating problems, estimating, and supervision. More details available on request. Presently employed. File No. 4603-W.

MECHANICAL ENGINEER, age 33, married, no children, University of Toronto 1943, veteran. Ten years industrial experience, four years design, engineering, manufacturing, production and purchasing, six years application, marketing, sales and service. Experience covers power plant equipment, pumps, feed water conditioning apparatus, boiler controls, materials handling equipment, electric hydraulic and pneumatic control systems, petroleum products, mining machinery and power transmission machinery. Presently employed but desires challenging work for aggressive firm with opportunity for administrative and/or management career in sales, service or manufacturing. Would prefer Ontario, Alberta or British Columbia. Particulars willingly supplied to interested employers. File No. 4604-W.

METALLURGICAL ENGINEER, Master of Science degree in Met. Engr., B.Sc. (Hons.) in chemistry, P.Eng., Jr.E.I.C., Diploma of the National Foundry College, England, in Foundry Management and Technology. Applied experience in almost every phase of metallurgy—heat treatment; foundry work—non-ferrous, cast iron; steel melting and rolling; machining; writing standards, etc. Will take full charge of all assignments. Sceks position either with a consulting firm, or as a group leader or supervisor in the manufacturing, development and engineering field. Location and size of company not important. File No. 4648-W.

CIVIL ENGINEERING, Jr.E.I.C., registered in British Columbia, would take responsible position in construction or development work. Past experience includes: design and supervision of permafrost installation, project engineer or heavy construction, construction methods and estimating, town engineering, as well as several years practical construction experience. Would prefer position in western provinces, very interested in permafrost work. File No. 4649-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C., veteran 2½ years R.C.A.F., B.Eng., mechanical engineering, Saskatchewan 1949. Age 32, married, 1 child. Administrative experience obtained as follows: 2 years as a field engineer is charge of parties on water storage and land surveys and related drilling operations; 1 year as an assistant to the heads in both the wood preparing and mechanical departments of a large paper mill; and in a large chemical plant 1 year as a development engineer and 2 years of supervising in production departments. Desires a responsible challenging position with good future opportunities. Prefer Ontario or S.W. Quebec. File No. 4653-W.

INDUSTRIAL ENGINEER, Jr.E.I.C., B.A.Sc., mechanical engineering 1950, Toronto. Single, age 26. Three years experience with management consultant—plant layout, material handling, production planning, inventory control, preventive maintenance, and job evaluation. Position wanted with progressive company, giving responsibility and opportunity for advancement. Available immediately to locate anywhere in Canada. Resume and references will be furnished upon request. File No. 4654-W.

ELECTRICAL COMMUNICATION ENGINEER, A.M.I.E.E. (England), graduate with diploma Leningrad University (Russia). Desires employment on maintenance, installation or development of radio, telephone or telegraph equipment. Ukrainian born, British subject. Recently arrived in Canada from England. Experience: 2 years in the Trunk Telephone Exchange In Leningrad (Russia), 2 years engineer in Telephunken Laboratories in Berlin (Germany), and main work 18 years in research and development of electronic communication equipment in the G.E.C. Laboratories (England). Detailed resume on request. File No. 4655-W.

CIVIL ENGINEER, P.Eng. (Que.), Jr.E.I.C., graduate N.S.T.C. 1952, age 25, married with one child, desires position to gain municipal engineering or town planning experience. 2½ years experience resident engineer highway construction for provincial government. Available on reasonable notice to employer. File No. 4656-W.

INDUSTRIAL AND CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.), B.A.Sc. Toronto. Age 37. Experience in plant engineering; 3½ years in Canada, 5 years in Europe. Experience covers equipment layout, design of mechanical handling, pressure vessels, tanks, heating, ventilation, industrial wastes, piping, steel and reinforced concrete structures, quarries; surveying; development of new equipment and structures and maintenance engineering. Desires position with manufacturing company or consulting engineers in Toronto area. Available on reasonable notice. File No. 4658-W.

MECHANICAL ENGINEER (Scot), A.M.I., Mech.E., aged 30, arriving in Canada (Toronto) mid-April, 1955, would welcome enquiries from prospective employers with regard to responsible position in design, development, project or plant maintenance work, etc. Available for interview immediately upon arrival. Excellent references. 14 years experience including 5 years apprenticeship with 3 years workshops training. Experience includes design work with regard to water tube boilers and refrigeration plant and design, project handling, estimation, construction supervision etc., with regard to special purpose apparatus and machinery associated with explosives manufacture. File No. 4659-W.

MECHANICAL ENGINEER, Jr.E.I.C., '51 graduate, N.S.T.C., B.Sc., B.E., married, no children, 3½ years with Canadian Electrical manufacturer, completed graduate training course, 2 years experience on development, assembly and testing of 7.5 to 230 KV circuit breakers, plant layout, tooling and general machine shop practice. Desires responsible position with opportunity for advancement. File No. 4661-W.

YOUNG ENGINEER, 1953 graduate, Ecole Polytechnique, presently completing M.Sc. degree in Industrial management at the School of Industrial Management, Massachusetts Institute of Technology. Good academic and extra-curricular background. Would consider employment with a medium sized manufacturing concern in the areas of production, marketing or industrial engineering; with a management consulting firm; with a municipality. Thoroughly bilingual. Province of Quebec preferred. File No. 4662-W.

MECHANICAL ENGINEER, P.Eng., M.E.I.C., graduate institution of mechanical engineers Great Britain. Age 36, married. 5 years apprentice British Railways Locomotive Works. 6 years engineers office Royal Air Force (squadron leader), 8 years experience Canadian Aluminum Industry in fields of mechanical engineering and production in smelter and fabrication plants. Past 3½ years production engineer in major aluminum forge plant. Seeks position of responsibility with opportunity for advancement. Preferably in Canada, but will consider reasonable location overseas. Apply to File No. 4663-W.

CHEMICAL ENGINEER, P.Eng. (Ontario), Jr.E.I.C., M.A.Sc. (Toronto), 3½ years experience in research and development in plastics, pulp and paper, fluorescent materials, also

in laboratory testing and analyses. Working knowledge of biochemistry. Desires research and (or) development position in Toronto area. Available on 2 weeks notice to present employer. File No. 4664-W.

ELECTRICAL ENGINEER, graduate 1949 Melbourne University, Australia. B.E.E., Assoc. A.I.E.E., single, age 26 years, five years electrical engineering experience, graduate G.E. test course, at present in U.S., desires employment commencing March, preferably in Toronto or Montreal. 1½ years design experience with Dept. of Civil Aviation and 2½ years experience as sales engineer with Australian General Electric company handling motor and control gear sales and switchgear and transformer sales. Desires employment as sales engineer. File No. 4665-W.

P.ENG., Jr.E.I.C., age 30, estimating and design, 2 years; instrument man on various types of field surveys—2 years; commercial college—1 year. File No. 4666-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C. Married, 26 years old, bilingual. Supervisory experience in inspection. Quality control and methods work. Supervision and responsibility desired. Prefer Montreal area, will consider Eastern Canada. File No. 4668-W.

MECHANICAL ENGINEER, S.E.I.C., Polytechnique 1955, graduating, married, bilingual. Equivalent of 2 to 3 years experience in plumbing and heating line as an apprentice, service man, design, estimate and surveillance of complete plumbing and heating system for a contractor. Desires a position in the heating industry. Also interested in sales. Will consider any offer of situation connected with the heating line, preferably in Montreal. File No. 4669-W.

CIVIL ENGINEER, Jr.E.I.C., graduated 1949. Age 27. Married, 1 child. Two last years with Montreal contractor as job engineer on two large projects including R.C. bridge construction, earthworks, roadwork and tunnelling. Previously employed in Australia by large pulp and paper company in responsible position on civil engineering design and supervision. Also experienced in open cut mining and large scale earthmoving operations. Particularly interested in design and use of precast and prestressed concrete. Desires responsible position with contractor or consultant in Toronto or Western province. File No. 4670-W.

INDUSTRIAL ENGINEER (S.E.I.C.), available after graduation from Wayne University, Detroit, Michigan in June 1955 with B.S.I.E. degree. Theoretic knowledge of motion and time study, industrial organization and management, plant layout, automation, materials handling, statistical quality control, and production control. Experience in solving production problems using digital electronic computors and linear programming. Summer employment including surveying, asphalt paving, machinery maintenance and moving assistant to field engineer on warehouse construction, general office work and plant engineering with a large company. Interested in permanent position with chance for advancement in Industrial engineering field, preferably in Western Ontario but not absolutely necessary. Available July 1, 1955. References. File No. 4676-W.

ELECTRICAL ENGINEER, S.E.I.C., U.N.B., 1953, age 32, married, at present on test course with large electrical industry, desires position offering opportunity for further development, with small or medium sized company. Training in several departments, particularly interested in household appliances, TV and service departments. File No. 4677-W.

CIVIL ENGINEER, M.E.I.C., Sask. '36, is seeking field training on large construction projects. Age 41, married, three children, good health. 8½ years with R.C.A.F.; 7½ years with a prairie construction company specializing in commercial and institutional buildings; 3 years with Central Mortgage and Housing Corporation. Available immediately. Training and employment summary with the Institute. Past experience mainly office and administrative. File No. 4678-W.

METALLURGICAL ENGINEER, B.Eng. (1950), M.Sc. (1951), Jr.E.I.C. Age 28, married, two children. Experience: research work in melting and testing titanium alloys; production, heat treating and testing of steel, plant engineering. Presently supervisor of metallography, physical testing, experimental heat treatment and metallurgical investigations in the laboratory of a large company. Fluently bilingual. Desires work in metal industry, production or research, ferrous or non-ferrous. Will accept position anywhere in Canada or U.S.A. File No. 4679-W.

CIVIL ENGINEER, M.Sc., single, lectured 4 years at University. Experience, highway construction, surveying, soil analysis, municipal engineering, 4½ years as project engineer. Defence construction which included general engineering, attending site and engineers meetings and negotiations with clients. Desires responsible position with architects or consulting engineers. Location Southern or Western Ontario. File No. 4680-W.

CHEMICAL ENGINEER, McGill 1945, age 31, single, with 5 years experience in pulp and paper; quality control, production and development. Desires responsible position in chemical or allied field in Montreal area. Available immediately. File No. 4681-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), B.A.Sc., Toronto, 1949. 31 years old, married, six years experience mechanical and structural design of industrial buildings, materials handling, plateworks, piping, heating and ventilation. Desires permanent position with responsibility and opportunity for advancement. Available on one month's notice to present employer. File No. 4683-W.

CIVIL ENGINEER, S.E.I.C., S.I.C.E., B.Sc. (Hons.) Leeds University 1954. Age 22½, married. Experience in centrifugal pump design, road construction and design, estimating. Has done soil mechanics lab. work and prestressed concrete design. Desires position in S.W. Ontario in soil mechanics and structural design with outdoor work. At present employed in Toronto. Available on 2 weeks notice. File No. 4686-W.

MECHANICAL ENGINEER, 1953 Manitoba Graduate, Jr.E.I.C., single, returning to Canada in December from two years works training on Athlone Fellowship with British turbine manufacturer. Desires to apply for design or manufacturing position, preferably related to Power generation industry. Location Manitoba, Ontario or Quebec Provinces. File No. 4687-W.

CIVIL ENGINEER, P.Eng. (Man.), M.E.I.C., Jr.A.S.C.E. Single, age 27. Graduate U. of M. 1951. Two years experience as resident engineer and field engineer on defence construction projects. One year as structural steel and miscellaneous iron estimator. Presently employed as town engineer in a community with a population of 22,000. Desires a position with a construction or consulting firm. Location immaterial. Available on one month's notice to present employer. File No. 4688-W.

CHEMICAL ENGINEER, P.Eng., M.E.I.C., graduated from the Polytechnic Institute of Bucharest, Rumania 1949. 31 years old, married, two children. Experience: one year as Professor Assistant at the University in Rumania, one year as chemist in Greece with textile company, one year with soap company in Canada, two years with a chemical company in Canada. Desires position in Toronto area. Available one month's notice. File No. 4692-W.

MECHANICAL AND METALLURGICAL ENGINEER, P.Eng., graduate 1946, age 36, varied experience; mechanical design, materials and processes, heat treatment, casting, forging, welding, sales. Presently employed as executive responsible for technical and administrative problems. Seeks senior position with wide scope for initiative. File No. 4693-W.

ELECTRICAL, Jr.E.I.C., McGill '52, presently employed, experience includes utility and power project work, switchgear and control design, and contracts, industrial rectifier sales, and control work on d.c. drives. Interested in consulting or manfacturing in or around Montreal and would be available on one month's notice. File No. 4694-W.

CIVIL ENGINEER, Jr.E.I.C., P.Eng., McGill 1953. Single, age 27. Speaks fluent French and English. Several summers experience, as a student with the Department of Highways of Quebec. 2 years experience as field engineer on an important road contract and on construction of industrial plants. Desires employment which requires initiative. Location Quebec or Ontario. File No. 4695-W.

ELECTRICAL ENGINEER, P.Eng., Jr.E.I.C., age 29, married. 3½ years sales experience, 2 years installation and maintenance electrical equipment in mines. Toronto area preferred. File No. 4698-W.

MANAGEMENT MEN. Can you use an electrical engineer, P.Eng., Jr.E.I.C., Assoc. Mem. A.I.E.E., B.Sc.E.E. 1949, who offers an excellent switchgear application background coupled with aggressive sales and administrative ability. Test course graduate. Age 28, married. Recently completed two years of evening discussion courses in Business Management. Currently employed in responsible supervisory sales capacity with large manufacturer. Capable of contacting and negotiating effectively at management and executive levels. All replies will be given careful consideration. Please reply to File No. 4699-W.

ELECTRICAL ENGINEER, P.Eng., Jr.E.I.C., As. A.I.E.E., 1952 honour graduate, desires position with firm of consulting engineers, architects, or electrical contractors. Also very interested in design of motor and other industrial control circuits. File No. 4701-W.

GEOPHYSICIST, graduate of engineering physics University of Toronto, Jr.E.I.C., age 27, married, one child, with three years experience in magnetic and electromagnetic surveys, desires employment with future leading to position of responsibility not necessarily in geophysics. File No. 4703-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng., with 7 years' experience including manufacturer's test course, industrial control design, industrial apparatus application engineering, and engineering management, graduate Queen's, Canadian born, desires permanent position with opportunities for advancement in return for hard work and proven ability. File No. 4705-W.

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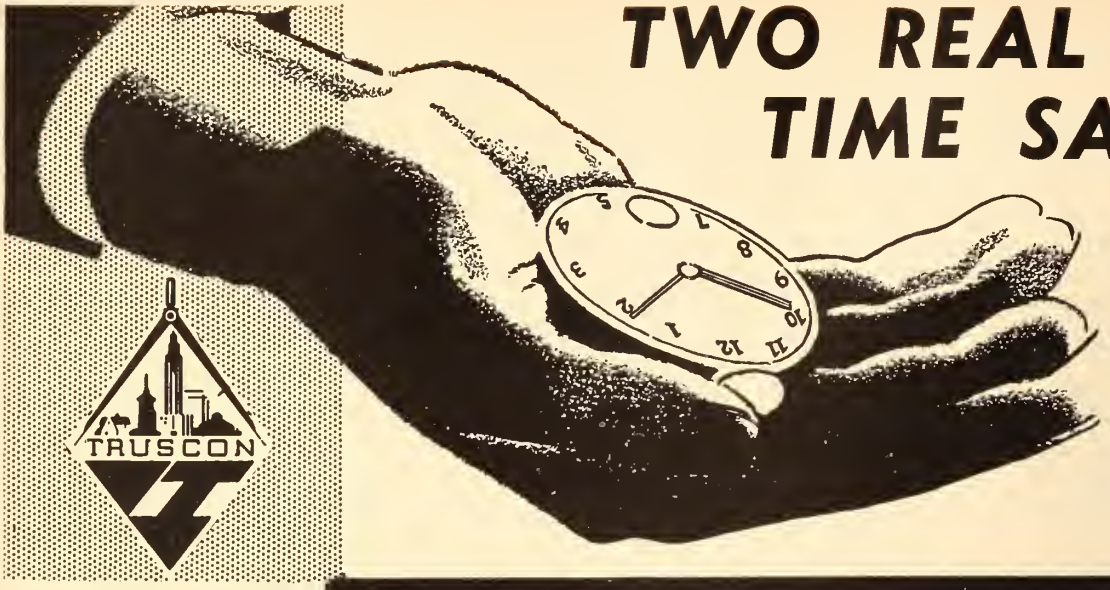

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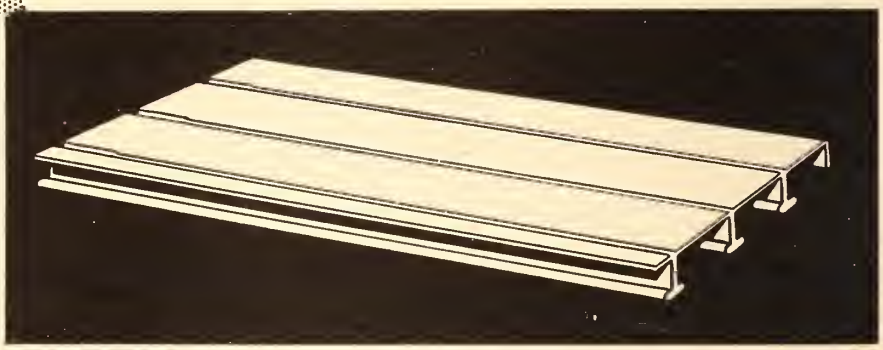

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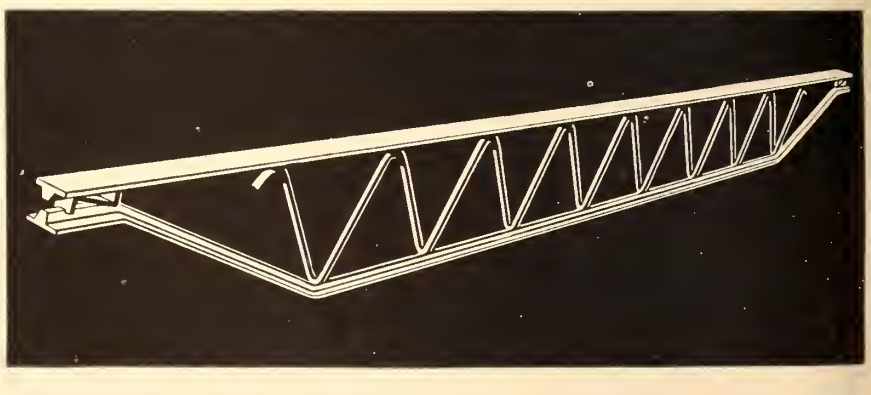

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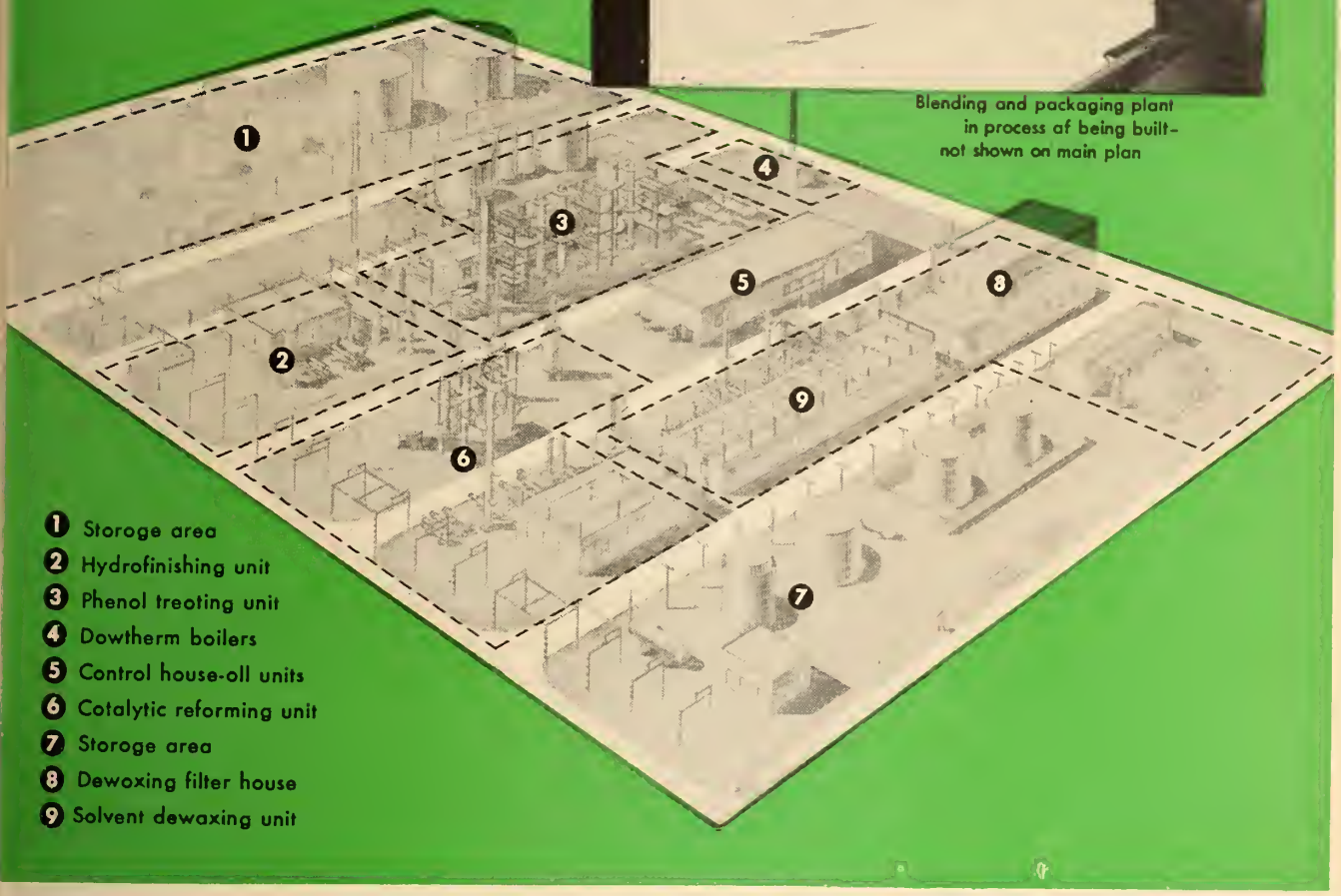
not shown on main plan



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8. Dewaxing filter house
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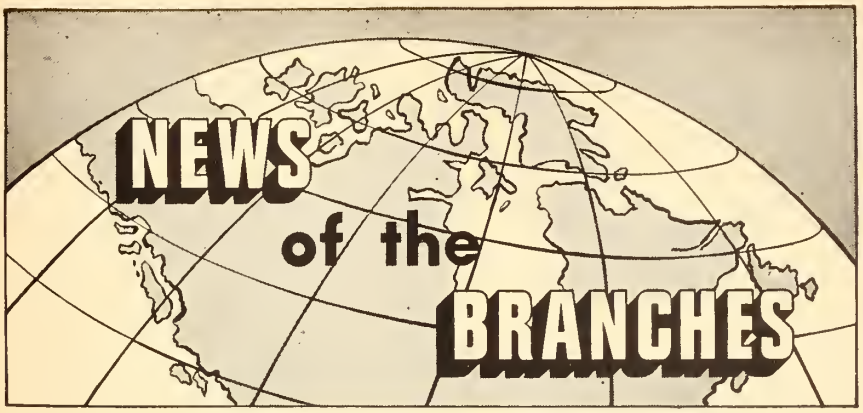


Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Border Cities

P. N. Brown, Jr.E.I.C.,
Secretary-Treasurer

C. M. Armstrong, Jr.E.I.C.,
Branch News Editor

Ladies Auxiliary

The Auxiliary has completed its third successful year. Membership now totals 95.

The following interest groups: bowling, bridge and leathercraft, have enjoyed continued success throughout the year.

At the meeting on January 19, held at the Jeanne Mance Nurses' Residence a film entitled, "Packaged Power" by the Aluminum Company of Canada, was shown.

A joint dinner meeting of the Engineering Institute of Canada and the Chemical Institute was held at the Prince Edward Hotel on February 25 with the ladies as guests. Dr. Murker of Parke Davis and Company Limited spoke on "Forward With Medicine".

The spring tea was held at the home of Mrs. C. G. R. Armstrong on March 27.

The spring meeting, held May 4, took the form of a tour of Hiram Walker and Sons, Limited, conducted by Mr. W. H. Arison, assistant production manager. Following the tour a film entitled, "Keeping Nature on Its Course" was shown.

Mr. and Mrs. Leon Auckland were guests at the fall meeting, October 19, at the Jeanne Mance Nurses' Residence. Slides were shown of their tour of the British Isles and Holland. Mr. Auckland spoke on the historic background and customs of these countries.

The annual dinner dance was held at the Beach Grove Golf Club on October 22. An enjoyable evening was reported.

At the third annual meeting on January 11, the slate of officers for 1955 was presented: president, Mrs. J. W. Greason; first vice-president, Mrs. W. D. Donnelly; second vice-president, Mrs. P. N. Brown; recording secretary, Mrs. J. W. A. Donald; corresponding secretary, Mrs. W. Robert Smith; treasurer, Mrs. D. S. Brown; publicity convenor, Mrs. J. E. Mainwaring; and group convenor, Mrs. E. Robert Carpenter. Councillors for the year are: Mrs. R. J. Trinder, Mrs. C. G. R. Armstrong, and Mrs. R. T. Waddington.

The film entitled, "The Man with a Thousand Hands" presented by The Aluminum Company of Canada was shown.

Brockville

M. H. D. Broadbent, M.E.I.C.,
Secretary-Treasurer

G. M. Woods, M.E.I.C.,
Branch News Editor

Joint Dinner Meeting

The Brockville Branch held a joint dinner meeting with the Chemical Institute of Canada, Brockville-Prescott Section on February 9 at the Manitonna Hotel, Brockville. Seventy engineers heard Dr. W. M. Campbell, Director Chemical Engineering Branch, Atomic Energy of Canada, give an address entitled, "The Chemical Factors in Atomic Power".

S. S. O'Shea introduced Dr. Campbell and, following a discussion period, G. A. Stewart thanked the speaker for his interesting, timely subject.

Town Planning

The Brockville Branch met on Thursday, March 10, to hear Judge D. E. Lewis, chairman of the Brockville and Subsidiary Planning Board give an enlighting talk on "Town Planning" as it applies to Brockville, Ontario.

"Because there is a lack of commercial outlets in this community, last year Brockville had the highest cost of living index in the Province of Ontario", Judge Lewis told 40 engineers at their monthly dinner meeting. Judge Lewis spoke on town planning and zoning, explaining that nothing along this line can be done without the help and co-operation of the general public.

"In order to plan a town or a community for its future growth and development we must plan accurately and in great detail what we now have and then decide what we want to do with it. We must have all the basic information on what exists in our community today before we can plan on what we want to do tomorrow," Judge Lewis continued.

Never Expanded

"The boundaries of Brockville were never expanded from its inception in 1876 until 1953 when a few hundred acres were taken into the community for the development of Churchill Park. At the present time, the town is plugged and we must go outside our town limits for our future development. When we plan for the future of the community we should plan for nothing less than 25 years," stated Judge Lewis.

Loses Industries

If a community does not have an official plan and adequate zoning facilities, many of the industrialists of today are not interested in locating in the town, he said.

The planning board is now preparing both a permanent zoning by-law and an official plan for the town and the adjacent township areas so that the future development will be in the best interest of every citizen living in these confines, Judge Lewis told the meeting.

Judge Lewis was introduced to the members by Jack Waddington, past chairman of the Branch, and thanked by Tom Reade of Cardinal. Fred Walsh, chairman of the Branch, was chairman at the meeting.

Howard Campbell of Cardinal, chairman of the Program Committee, reported that the guest speaker for the April meeting would be Prof. R. Mordell of McGill University, Montreal, who will speak on "Solid Fuel Turbines". A representative from Du Pont Company of Canada Limited will address the May meeting on "Colour" and an official of the General Motors Corporation will be guest speaker at the June meeting. His topic will be "The Car of the Future".

Halifax

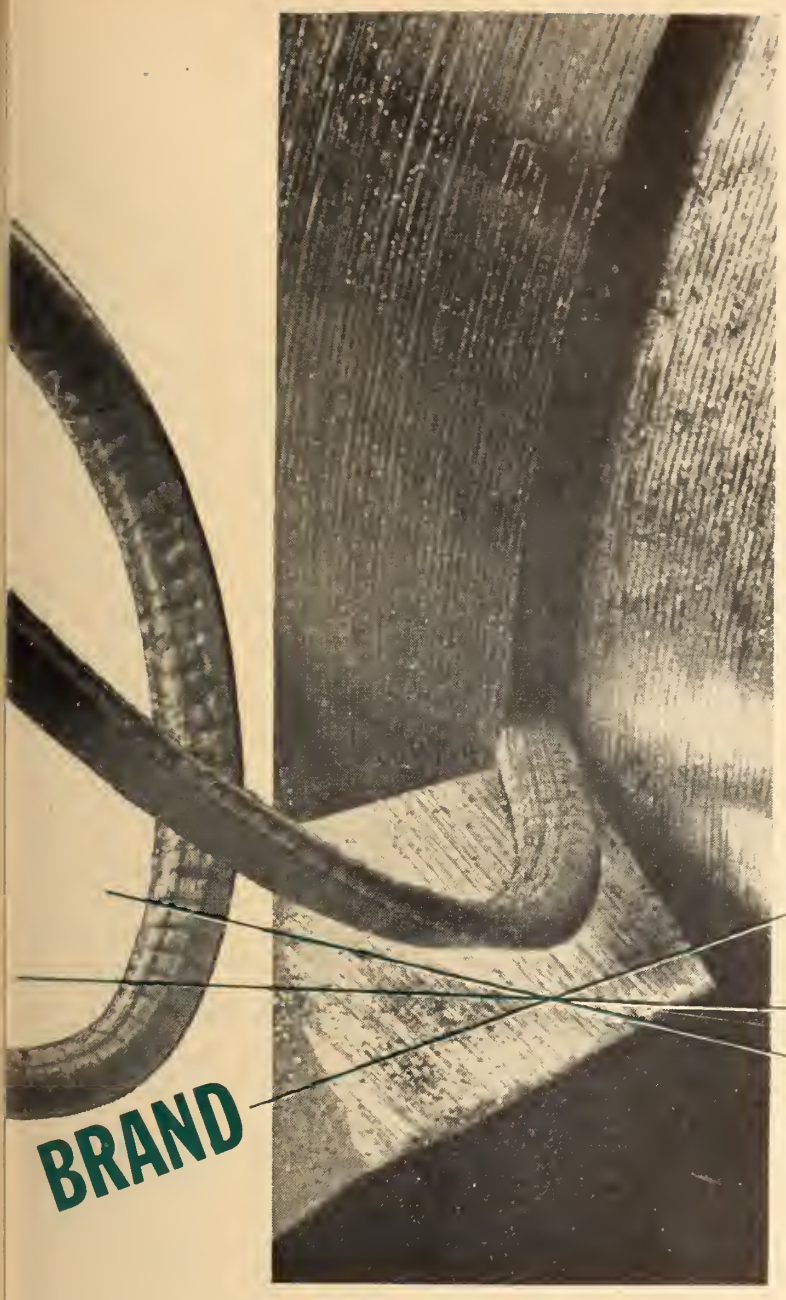
W. D. Pippy, M.E.I.C.,
Secretary-Treasurer

Fred H. Tremain, M.E.I.C.,
Branch News Editor

Modern Condenser Tube Alloys

A meeting of the Halifax Branch was held on February 10, 1955, at 8 p.m. in the wardroom of H.M.C.S. Stadacona. The use of these facilities were granted to the branch by the kind permission of Commander F. C. Fewer, executive officer.

The members were welcomed by Captain J. S. Horam, principal naval overseer, East Coast.



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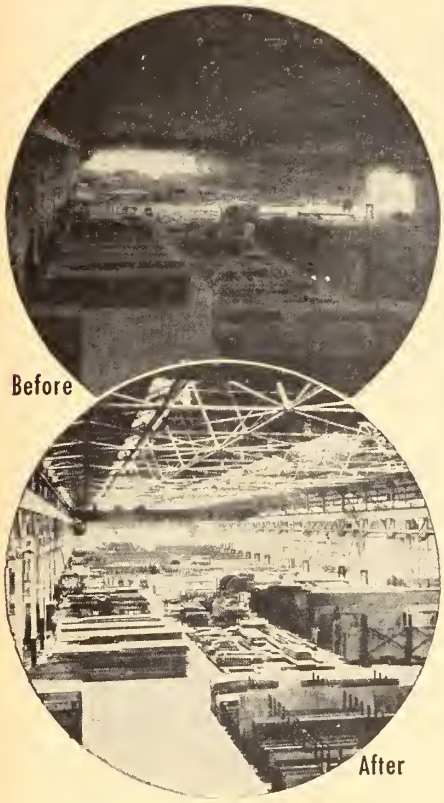

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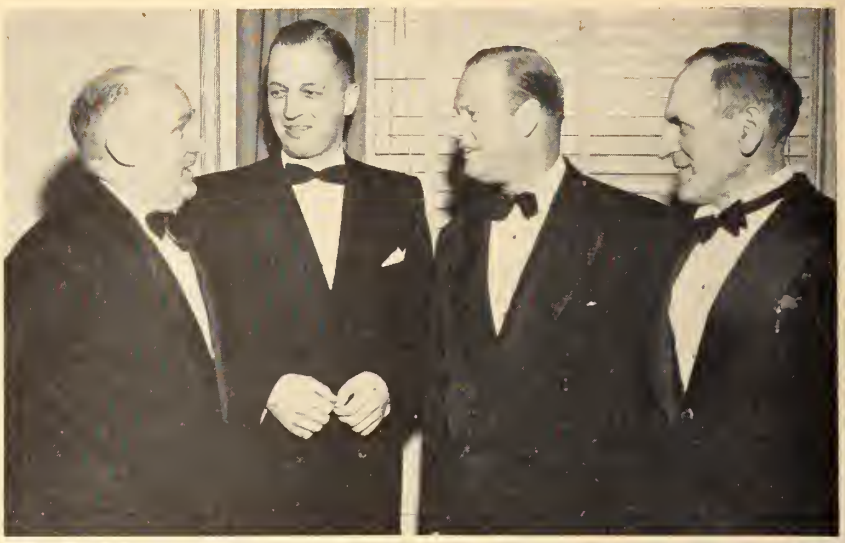
Halifax Branch



Top. At the annual joint banquet of the Association of Professional Engineers of Nova Scotia, and the E.I.C. Halifax Branch. Left to right: Hon. A. W. MacKenzie, minister of highways and public works of Nova Scotia; W. A. Devereaux, Branch chairman; Hon. R. H. Winters, minister of public works of Canada; Prof. M. L. Baker, president of the Association.

Centre. At the February 10 meeting of the Halifax Branch, left to right: G. A. Cunningham, of Imperial Oil Ltd.; Lt. M. R. Kent, of H.M.C. Dockyard, Halifax; T. Howard Rogers, Dockyard Laboratory, Halifax; and Captain J. S. Horam, principal naval overseer, East Coast.

Bottom. The Officers of the Halifax Branch, 1954-55. Front row, Prof. K. F. Marginson, secretary-treasurer; W. A. Devereaux, chairman; Nelson Mann, immediate past chairman. Back row: J. J. Kinley, Jr., O. H. Manual, M. S. Hicks, G. A. Cunningham, J. D. Fraser.

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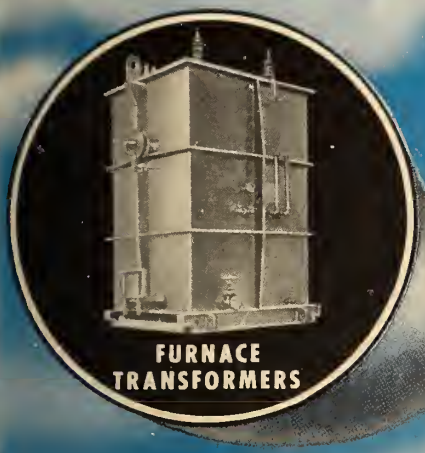

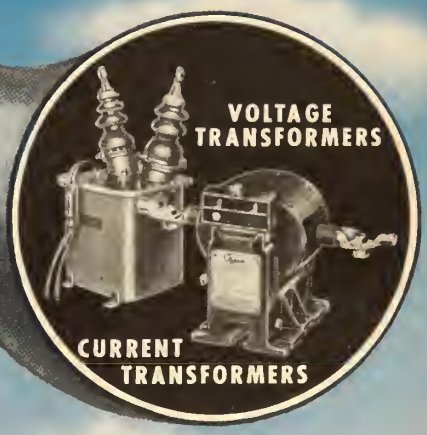

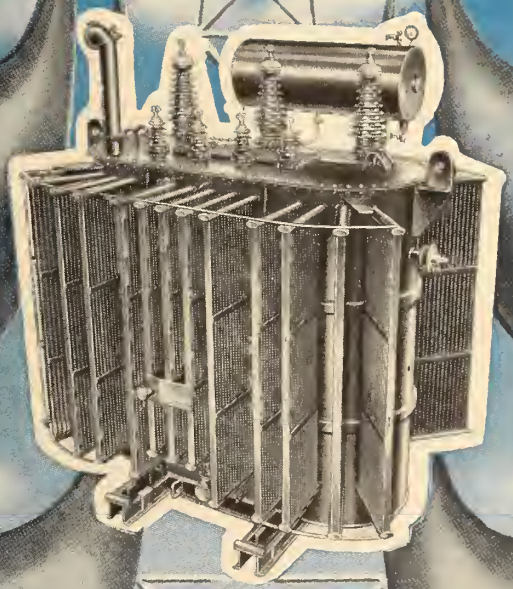

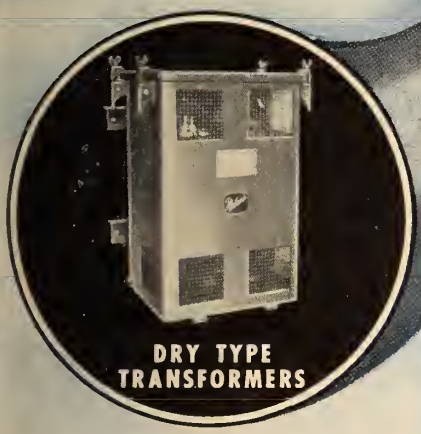

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Speakers

G. A. Cunningham, manager of industrial and consumer sales, Imperial Oil Limited, Halifax, gave an interesting and instructive talk on "New Fuel and New Hope for Merchant Shipping", after which Lt. M. R. Kent, officer in charge of marine engineering instruction, spoke on "Napier's Deltic Diesel Engine". His talk was of great interest and was illustrated by several slides.

Mr. T. Howard Rogers, officer in charge of naval research, dockyard laboratory, chose as his topic "Modern Condenser Tube Alloy". This was also a subject of much interest to the members present.

A discussion period followed during which each speaker answered numerous questions regarding his subject.

John Kaye on behalf of the Branch, moved a vote of thanks to the speakers, Capt. J. S. Horam and members of H.M.C.S. Stadacona who had made such an enjoyable evening possible.

A social period with suitable refreshments available was very much enjoyed afterwards.

Cornwall

L. H. Snelgrove, M.E.I.C.,
Secretary-Treasurer

W. Rothwell, M.E.I.C.,
Branch News Editor

February Supper Meeting

The February meeting of the Cornwall Branch, at which 38 members and guests were present, was held on February 17 at the Cornwall Golf and Country Club.

The evening commenced with a buffet supper which was followed by an address by H. P. Dial on "Engineering Standards". The speaker was well qualified to speak on this subject as engineer in charge of standards of DuPont Company of Canada Limited. He has also been responsible for the creation of the engineering standards now in effect in that company.

Mr. Dial described at some length the procedure adopted by his company in the creation of a standard and he explained the method of classifying engineering standards for purpose of reference. His explanation was illustrated by slides showing sample pages from the Standards Manual and the routing of tentative standards to the various committees, group of experts and group of advisors before finalization and adoption.

The four basic requirements for the successful operation of a standards scheme were given: (1 As many people as possible must be brought into the preparation and evolution of a standard. This is done on the assumption that all who have had some part, no matter how small, in the creation of a standard, will accept the standard more readily when it is offered to them. (2) A continual reminder of the desirability of using the standard is necessary. (3) Standards are not mandatory but should be offered as what has been found to be the best known procedure in using existing tools and materials. (4) Standards must be continually revised in the light of new knowledge, new materials, etc.

Mr. Dial pointed out that the setting of standards does not tend towards regimentation, but on the contrary, is responsible to a large degree for the high standard of living with its wider field of opportunity. By the adoption of good standards costs are reduced and quality improved.

An interesting discussion period followed the address which was indicative of the general interest shown in the subject.

Mr. Dial was introduced by Gordon Biard and thanked later by J. B. Moriarty.

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Hamilton

F. Bernard, Jr.E.I.C.,
Secretary-Treasurer

Ross R. Packer, Jr.E.I.C.,
Branch News Editor

The President's Visit

The president's visit to the Hamilton, Kitchener, and Niagara Peninsula branches was held in Hamilton on February 25 and combined with the joint meeting was the Hamilton Branch's Professional Development Program "Employers Night".

Professional Development Course

After the president was welcomed by the chairmen of the three branches, F. E. Milne of Hamilton, L. J. R. Sanders of Kitchener, and H. S. Davison of Niagara Peninsula, the meeting was turned over to Ted Hill, chairman of the Professional Development group. Mr. Hill outlined the success of the professional development group in Hamilton which was the second group formed in Canada only five years ago and has been a model for the fifteen cities which have since started their own groups. The purpose of the professional development group is to stimulate the young graduates' development to be better engineers and citizens. A review of the three sections of the professional development program showed that the first section consisted mainly of lectures on many subjects, while

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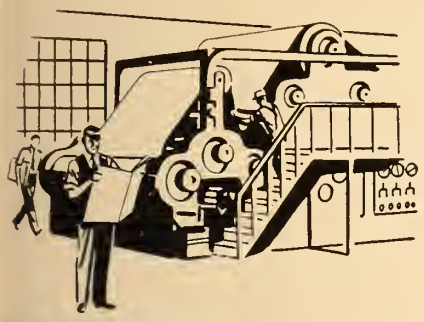

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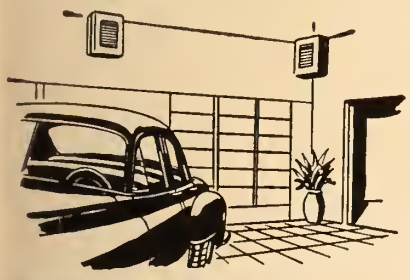

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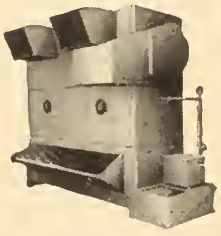
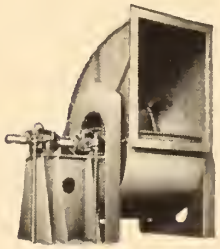


Air Conditioning Equipment



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the third section covered human relations, government and business administration by combined lectures and discussions, and the third section investigated actual cases in the study of business management. The new professional development executive was elected with Bill Filler as chairman.

After a musical interlude the chairman introduced the general secretary, Dr. L. A. Wright, who described an interesting movie recently purchased by the Institute which will be shown across Canada. This colour film on the life of Leonardo Da Vinci shows the marvelous engineering and scientific work performed by this man over 400 years ago.

The progress of confederation with the provincial associations was discussed although through a previous arrangement actual details will not be divulged until the plan is finalized.

F. W. Poulter introduced the president, Dr. D. M. Stephens, who pointed out how the Hamilton Professional Development group had not only contributed to the development of individuals but had been a model for other cities in Canada. The great economic strides taken by Canada in the past was due in great respect, in the speaker's opinion, to the development of our natural resources by engineers.

Canada's Growth

The development of the pulp and paper and base metals industries before the second World War followed by the creation of new industries was due largely to an availability of technically trained personnel. Dr. Stephens reviewed the dynamic expansion of our northern frontier during the last ten years.

As chairman and general manager of the Manitoba Hydro Electric Board, he was well acquainted with that province's recent industrial growth, and Branch members were surprised by the information that manufacturing now surpasses agriculture.

A great expansion of Canada's petroleum industry was predicted by Dr. Stephens, not only in actual well discovery and production, but by great distribution by such systems as the Trans-Canada Pipeline.

Not only has there been great industrial expansion in Canada but we have also pushed back scientific barriers. For these reasons it was easy for us to sell Canada to the Western World, and we do a good job except to the youth of Canada. We must interest more young people in becoming engineers, he said.

Each year the United States graduates 29,000 engineers, Russia 40,000, while in Canada only 1,200 to 1,300 graduate. The president felt that we should have about ten per cent of the graduates of the United States, while we now only have five per cent.

While many, such as teachers, may help us in the job of interesting young people in engineering, this is the responsibility of engineers. It is a challenge to those of our profession, he said.

After his speech the president presented the prizes to the last year's winners of the Students' and Juniors' papers.

Professional Development Program

Four years ago the Hamilton Branch started the Professional Development Program. The primary objective of this program was to stimulate the interest of engineers in fields outside of their daily technical tasks to broaden their outlook and allow them to relate their own work to the rest of industry and thus do more effective work. A secondary objective that developed as the course went on was to develop the talents of individuals in collecting and presenting information and in expressing their own opinions on the subjects studied and contributing to the knowledge of the whole group. The first year's course consisted of a series of 24 lectures on various subjects chosen because of their interest to engineers or their importance in industry. Top calibre speakers were obtained and have been only too glad to help out in this program. During the next two years, activities expanded and three separate groups are now operating as successive steps in the program. Briefly, these groups are as follows: Group I—Series of approximately 24 lectures on various subjects; Group II—Series of four lectures on five or six main topics bringing in speakers of divergent viewpoints on each subject; and Group III—Study of business management principles by pre-

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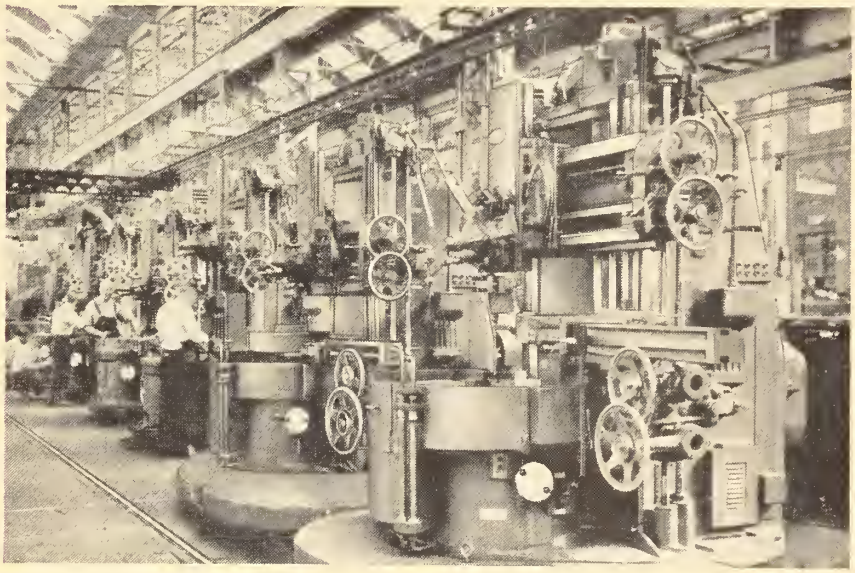

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sentation of subject material by expert speakers and group members with strong emphasis on discussion in the group.

Last year approximately 75 members took part in one of the three groups. When the program was first started it was intended to fill a need for young engineers just out of university, but the interest and participation of older and more experienced engineers has broadened the whole objective of the program.

This year a special effort is being made to enroll more older engineers in the program.

This year's program began Wednesday, September 22, and will continue each Wednesday until spring. There are real benefits in the Professional Development Program. It has been specifically designed for engineers and the lectures are not only of interest and help but also present the opportunity of making many new friends.

Kingston

E. C. Reid, M.E.I.C.,
Secretary-Treasurer
J. A. Smith, Jr.E.I.C.,
Assistant Secretary

Panel Discussion on Amalgamation

The steps which must be taken to bring about amalgamation of E.I.C., the provincial associations of professional engineers, and other technical societies, were discussed by a representative panel at the December 15th meeting of the Kingston Branch held at Queen's University.

Each panel member indicated that the technical group which he represented was necessary either for the dissemination of specialized information, or for the maintaining of the engineering profession's stature. However, it was suggested that the provincial organizations which were set up as licensing bodies by the E.I.C. were usurping some of the duties of the parent organization by publishing technical papers, and convening technical meetings.

In summary, it was generally agreed that closer cooperation through a national agency would be to the advantage of all. This would establish a national authority to speak on behalf of the engineering profession, and result in a reduced fee to those desiring memberships in more than one group.

Professor H. G. Conn, chaired the meeting. Assisting him were Professor A. V. Corlett, Dr. R. H. Hay, D. L. Rigsby, and M. H. Blair-McGuffie. Dr. L. F. Grant was present and took an active part in clarifying the E.I.C.'s stand in this issue.

On January 18, about 80 members attended a showing of the Ingersoll-Rand film "Break Through" at the Royal Military College. The picture showed the mining operations involved in putting through the tunnel from Lake Tashta to Kemano for the power development phase of the Aluminum Company of Canada's Kitimat project. Professor A. V. Corlett, of Queen's University, introduced the film, elaborating on some of the problems involved in an excavation of this nature.

Montreal

R. J. Harvey, M.E.I.C.,
Secretary-Treasurer
J. A. Paget, M.E.I.C.,
Publicity Chairman

Rocket and Guided Missile Development

On January 11, 1955, Gordon D. Watson, a scientific staff officer of the Defence Research Board, engaged in policy planning of armament and guided missile research and development, addressed a meeting of the Branch on this subject.

Mr. Watson said that the Defence Research Board of the National Defence Department is building up a team of scientists and engineers to work on weapons specifically required to meet Canadian military requirements.

This team has developed a highly accurate rocket weapon for the Canadian Army which can be carried by a soldier to give him the capability of destroying large enemy tanks. The team is also working on the development and testing of air-to-air guided missiles for the R.C.A.F.'s CF-100 fighter aircraft. Experimental missiles for test and experiment are now being manufactured, and "should the need arise", said Mr. Watson, "Canada can produce the missiles required by the R.C.A.F."

Rocket Chinese Invention

Mr. Watson said that the development and use of military rockets which were invented by the Chinese 750 years ago, but on which no development took place for 600 years, was now increasing rapidly, due to increasing knowledge in the fields of propulsion, aeronautics electronics and automatic control.

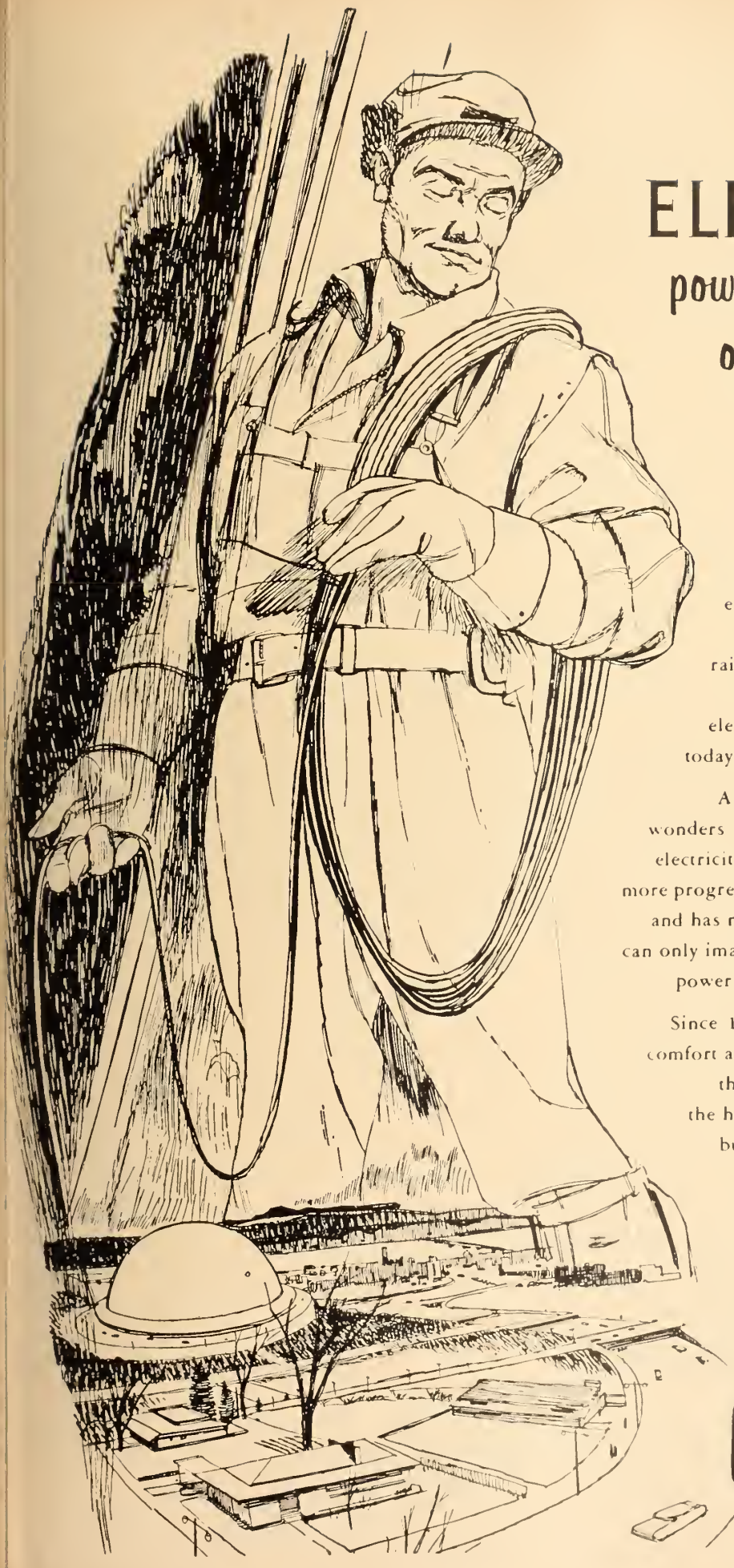
Guided missile design could not be undertaken without the assistance of complicated modern equipment such as the automatic machine computers or "electric brains" which the Defence Research Board operated at CARDE—The Canadian Armament Research and Development Establishment. Other test facilities used to evaluate missiles before firing and telemetering equipment to send back information on how the missile was performing in flight were also available at CARDE.

Mr. Watson said that practically every one of the components of a guided missile is a vital component, the reliability of each individual component must be extremely high.

Actually there are thousands of components in a guided missile of which between 200 and 300 are vitally essential which must operate absolutely perfectly under the environmental conditions of high acceleration, high rates of vibration and wide range of temperatures, and these are probably the guided missile designers' greatest headaches in the manufacturing phase.

Future of Projectiles

As to the future Mr. Watson said in the past military projectiles depended on information fed into the system prior to the launching of the projectile or missile and no correction to the course was possible during flight. "The greatest advance in communications and automatic control techniques has made the guided missile possible and the trend over the next few years will be to replace many of our unguided weapons by the more



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effective guided equivalent," said the speaker. "This trend covers the whole field of military projectiles from artillery weapons to strategic bombers, and although it is too early to be sure whether the equivalent unguided weapon will be completely replaced in the future, or only supplemented, there is no doubt that military operations will require a large number of guided missiles."

O. R. Brumell, M.E.I.C., was in the chair.

R. H. P.

Design Aspects of the Bersimis-Lac Casse Hydro-Electric Development

On January 24, 1955 the Montreal Branch was privileged to hear a joint paper on the Bersimis Development, delivered by Y. de Guise, M.E.I.C., assistant chief engineer, regional operating division, Hydro Quebec, and H. F. Abbot, M.E.I.C., chief design engineer, power development division, Hydro Quebec. The speakers were introduced by W. R. Way, M.E.I.C., who explained that the paper would appear later in the *Engineering Journal*.

Mr. de Guise discussed the annual growth of power consumption in Quebec and pointed out that an additional source of power was required by the fall of 1956. Of the several sites investigated, the Bersimis Development proved the most favourable and had the additional advantage of providing an entirely new power centre in north eastern Quebec.

Dams

The Bersimis and Desroches Rivers are dammed at the outlet of Lac Casse and the water level of the lake will be raised about 150 ft. These dams are 200 ft. high and constructed of rock fill with an upstream blanket of impervious material. The spillway section located on a rock saddle between the dams will discharge into the Bersimis River.

Water passes through the intake located on an arm of Lac Casse to the main tunnel which is 7½ miles long and 31 ft. lined dia. (horseshoe). Minimum rock cover over the tunnel roof was maintained to balance the internal water pressure at any point.

A surge shaft is located near the downstream end of the main tunnel and immediately upstream from the penstock manifold. The shaft is 335 ft. high and enlarged to 80 ft. in diameter above a restricted orifice at the lower end.

The main tunnel forms a manifold downstream from the surge shaft, and eight penstock branches continue on a 50 degree slope to the underground powerhouse. Eight units with a rated capacity of 150,000 hp. each operating under a gross head of 875 ft. will be installed to yield 1,070,000 hp. with a 70% load factor.

Temporary Construction Power

Mr. Abbot discussed the arrangements for temporary construction power which consisted of installing 2—7,500 hp. turbines below the Lac Casse falls on the Bersimis River. These units were obtained from an old powerhouse at St. Timothe, Quebec, and were dismantled, transported to the site, and again placed in service 12 months later. To supply the temporary powerhouse, it was necessary to pass water through a tunnel under the Bersimis dam during construction.

Mr. Abbot continued with a discussion of the hydraulic features of the plant, the electrical and generating equipment, switching station, and the 300 KV transmission line to Quebec City.

A. G. T.

Student Guidance Forum

A forum was held for English speaking High School students at the E.I.C. Auditorium, 2050 Mansfield Street, on January 27, 1955, at 4.00 p.m.

Approximately 220 students attended despite unfavourable weather conditions and the meeting lasted until 6.00 p.m.

After an introduction by the chairman, J. Hahn, the speaker, Dr. F. S. Howes, director of university extension, McGill University, presented a very comprehensive picture of the engineering profession. He explained what is required to become an engineer; what are the prospects and salaries, and where in Canada most engineers work. He illustrated the work engineers are doing and the different branches of engineering by an example—the design of a complete radio station.

A motion picture entitled "Engineering" loaned by the Provincial Publicity Bureau was shown, and held the students' attention completely.

The discussion period was very active with most of the questions answered by Dr. Howes. H. Tinkler and W. H. Moore assisted, and Mr. Moore brough

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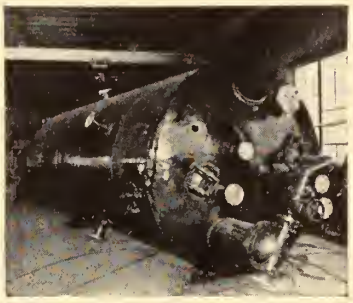

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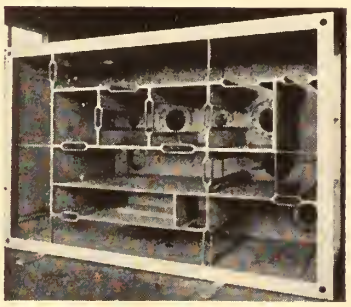

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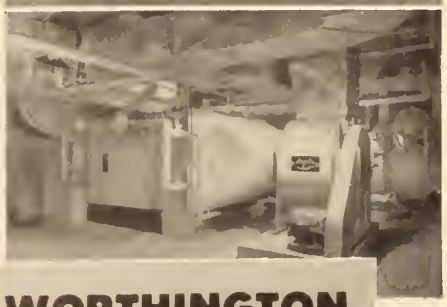

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the forum to a very successful conclusion by summarizing the question period.

The following High Schools were invited: Baron Byng High School, Cardinal Newman High School, Catholic High School, Daniel O'Connell High School, D'Arcy McGee High School, High School of Montreal, Lachine High School, Lower Canada College, Loyola College, Montreal West High School, Mount Royal High School, Rosemount High School, Chambly County High School, St. Leo's Academy, Strathcona Academy, Verdun High School, West Hill High School and Westmount High School.

Invitations were also sent to the members of our committee, the chairman and secretary of the Branch and other prominent engineers. H. W. Moore, H. Tinkler, H. Audet, A. Goodwin, J. A. Randle and Colonel H. G. Thompson attended the forum.

R. H. Parson arranged for advance publicity in the Montreal Daily Star and Gazette.

J. H.

The Role of Human Relations in Management

On January 25, 1955, the Montreal Branch heard an address by C. R. Armstrong on the subject of human relations in management.

Mr. Armstrong in his position of assistant vice-president, employee relations of the Bell Telephone Company of Canada, described how his company, by careful placement and careful attention to all other aspects of employee relations, obtains the dividends in quality and quantity of work that such a program is designed to produce.

Mr. Armstrong joined the company on graduating from McGill with a Masters Degree in Phychology in 1926 and has been dealing with people in industry and studying their behaviour ever since.

The meeting arrangements were by D. Davylkiw and the chairman was E D. Gray-Donald.

J. A. P.

Recent Developments in Insulation for Large Electric Machinery

A joint meeting of the Engineering Institute of Canada and the American Institute of Electrical Engineers was held on February 21, 1955, under the sponsorship of T. F. Palmquist. C Ritchie, acting as chairman, introduced the speaker of the evening, G. L. Moses Fellow, A.I.E.E., of Westinghouse Electric Corp., East Pittsburgh. Mr. Moses spoke on "Recent Developments in Insulation for Large Electric Machinery", a subject on which he is eminently qualified to speak since the past 17 years of his professional life have been spent in its study.

Mr. Moses began his address by showing the audience samples of mica tapes and a piece of resin. He explained that the new insulation was a combination of the two materials. The tape is made by placing mica splittings on a strong fibrous backing on which a synthetic resin is used to hold the mica, a second backing is now placed on top and the resultant product is a strong, dry tape. The new impregnant is a solventless varnish which is liquid at room temperatures and below. When heated in the presence of a catalyst the varnish forms a solid material without any by-products being given off and consequently a bubble free mass.

The coils to be insulated are wrapped with the dry tape to the required insulation thickness and are then placed in a large pan. The pan and coils are run into a tank which is evacuated to remove moisture and air. The impregnant with the catalyst is run into the tank and impregnation takes place. The coils are removed and clamps are attached around them and heat is applied The impregnant sets under the restraining action of the clamps to the required coil dimensions.

The resultant insulation, called thermalastic, forms a solid mass with the tape and is superior to the former asphalt impregnated insulations electrically and physically. It is solid at relatively high temperatures and is elastic enough to permit cyclic changes in winding temperature without migration or rupture. The new insulation has been used on a very large number of new machines and has proved entirely satisfactory.

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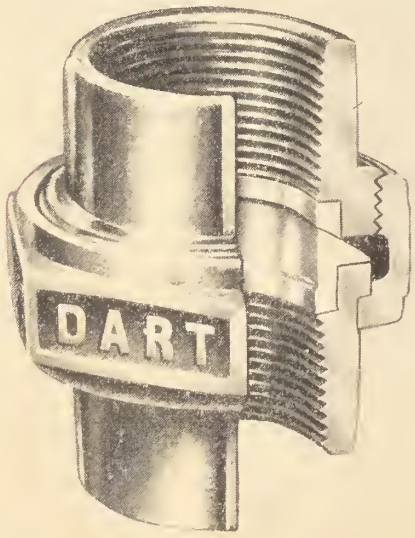

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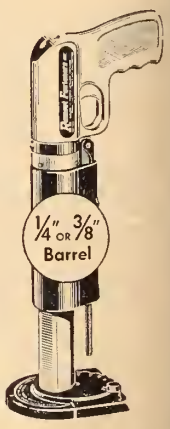

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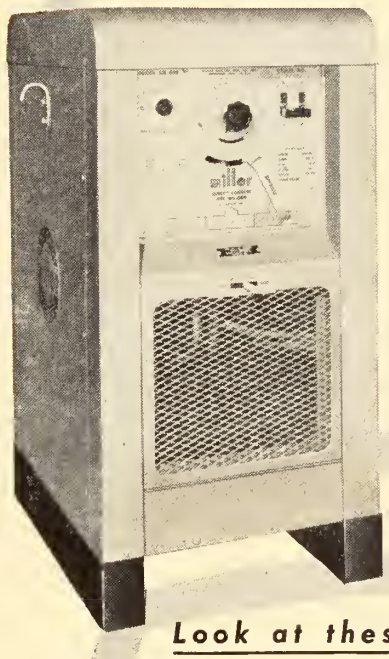

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Insulation Failure

Mr. Moses then showed slides on the different types of insulation failure. One of the most common was tape separation which resulted due to cyclic changes in winding temperature. A second type of failure resulted from slot discharge which caused surface deterioration of the insulation and burning of the slot filler pieces.

Methods of testing and special instruments have been developed to locate where insulation failure is likely to occur. Maintenance tests made by utilities have been responsible for much of the known data on insulation failure.

Mr. Moses advocated high potential d-c. tests for windings because of the ease of making this test over the standard a-c. test; d-c. tests are less destructive to weak windings than a-c. Mr. Moses recommended a d-c. test voltage of 1.6 times the a-c. root mean square test voltage as being reasonably safe.

A large number of questions were answered by Mr. Moses and indicated the interest in the subject. During the question period, Mr. Moses showed slides to illustrate thermal life expectancy of insulation.

H. F. Abbott thanked Mr. Moses for his talk after which the meeting was adjourned.

M. A. F.

Peterborough

J. I. Beggs, Jr.E.I.C.,
Secretary-Treasurer

D. G. Donaldson, Jr.E.I.C.,
Branch News Editor

E. A. Allcut Guest Speaker

Approximately 40 members of the Peterborough Branch of the *Engineering Institute of Canada* gathered at the Kawartha Golf and Country Club, Wednesday evening, March 16, to hear a paper given by Prof. E. A. Allcut, professor of mechanical engineering, University of Toronto.

Investigation and Litigation

Professor Allcut is widely known for his activities in civic and national affairs as well as in engineering circles. The topic he chose for his talk was "Investigation and Litigation" and was based on his own personal experiences in giving evidence in the courts of Canada and the U.S. He outlined in a very humorous fashion the course of action he followed in a number of cases and in doing so emphasized the need of being thoroughly familiar with one's subject. He also warned that as an expert witness one must expect to be asked questions about subjects quite unrelated to the subject of argument.

Some points that might be useful to remember if called in as an expert witness are: a) Showing pictures to prove or demonstrate the point; b) bringing up points which opposing council is obviously avoiding; c) sticking to the facts and avoiding speculation; d) avoiding use of technical expressions where simple words will do; and e) speaking slowly, clearly and above all even in the fact of unreasonable provocation, avoiding loss of temper.

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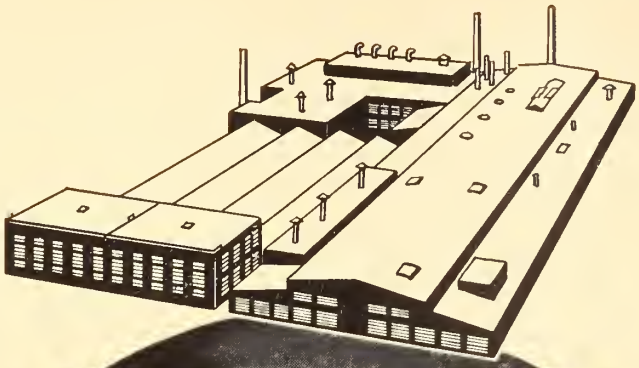

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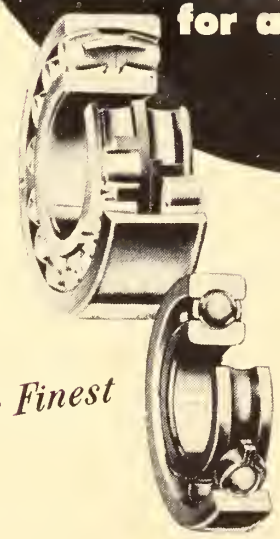

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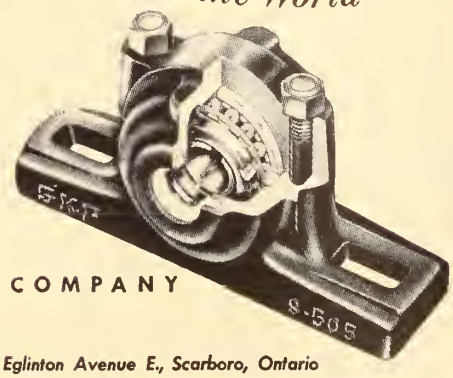

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Prosperity in the Balance

By merely playing lip service to the trade policies it advocates, the United States is jeopardizing the future of Peterborough, said Morgan Reid, assistant vice-president of Simpson-Sears Ltd., speaking to members of Peterborough Branch at the library on Wednesday, February 2. His subject was "Prosperity in the Balance".

Mr. Reid criticized the United States for asking for reservations in the GATT rules to exclude agricultural produce. "This is most serious to Canada, Peterborough, CGE, Simpsons-Sears and everyone in the country," he declared.

"They can buy at artificial prices and dump their stuff on world markets at any price they can get for it and if that happened, Canada's advantage would disappear overnight and Canadian farmers would take one heck of a licking.

"However if GATT talks in Geneva are successful general trade during the next ten years should improve."

1955 Improvements Seen

He said he expected an improvement in imports and exports in Canada, capital investment and consumer spending in 1955. It added up to a year "moderately better" than 1953 and 1954 but unlikely to be better in per capita terms.

"The increase in manpower will not be absorbed by expanding industries and projects and there may be some unemployment," Mr. Reid told the Branch. "In general, if the world retains its sanity and we keep our common sense the scales will tip to a rise in Canada's prosperity." He warned, however, that "there is a little danger that we may become complacent about our accomplishments in the last ten years.

"Our present level of prosperity has been a little fortuitous. My impression of business opinion in America is that this is a suddenly discovered Utopia. That is a very dangerous assumption."

He said the rapid wage increases in Canada were becoming serious to manufacturers but Canada was catching up though not yet level with the United States standard of living. "There is still far to go in this respect but we sometimes behave as if we had actually overtaken them. Probably we are affected by a keeping up with the Jones' complex. While we have great prospects our population is still small and only in a few cases can we take advantage of mass production. We must not jeopardize our growth by attempting to live beyond our means."

He considered that the strongest factor in 1953's outlook was the recent expansion in shipments of wheat to overseas customers.

European Prosperity

"Almost as important is the prosperity of Europe. Industry there is expanding and there has been a healthy improvement in the balance of payments position," he said.

"Our financial help to Europe has had a good effect for although our heavy industries have been hurt badly through competition from Europe's reviving industries, wages there have started to climb rapidly. Thus the competitive advantage they have over us will eventually disappear."

Mr. Reid was introduced and thanked

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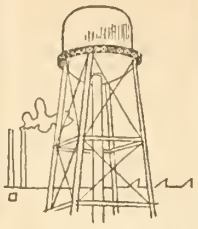
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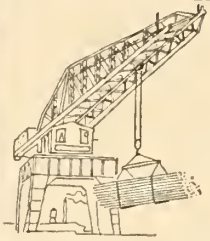
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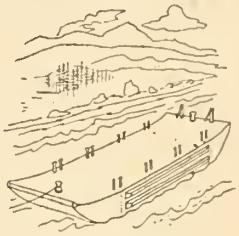
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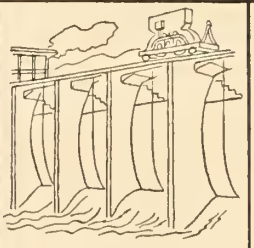
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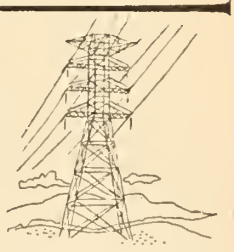
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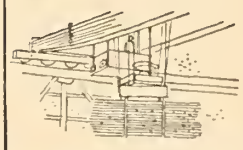
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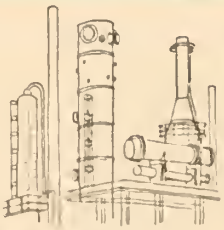
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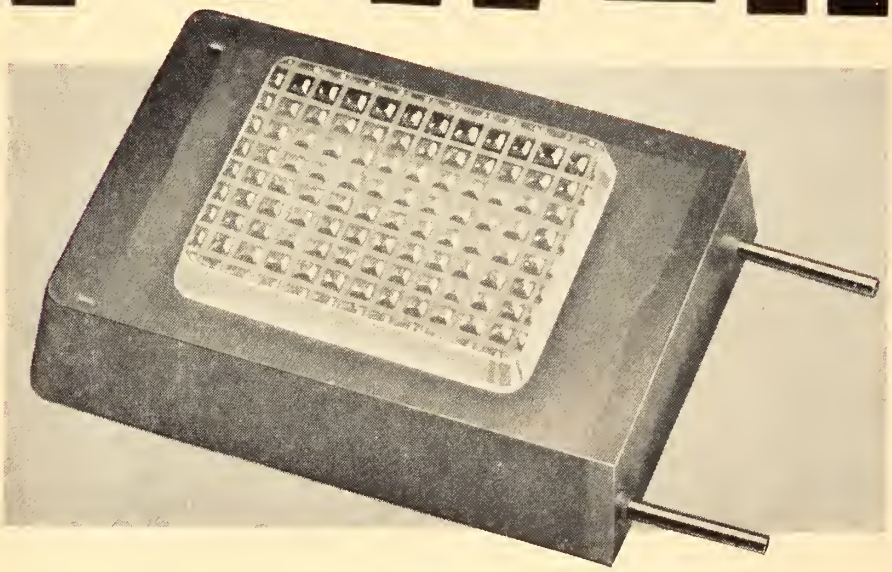

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by Don Lamont, the Branch's new chairman. A discussion followed.

Sudbury

ALLISTAIR FINLAYSON, JR.E.I.C.,
Secretary-Treasurer

A. ELDRIDGE, M.E.I.C.,
Branch News Editor

President's Visit

On February 28, 1955, the Sudbury Branch of the Institute was host to Dr. D. M. Stephens, president of the E.I.C., and Dr. L. Austin Wright, general secretary of the Institute. Mrs. Stephens accompanied her husband.

During the morning, W. J. Ripley, past chairman of the Sudbury Branch, and E. Russell Eaton accompanied Dr. Stephens and Dr. Wright on a short tour of one of the International Nickel Company plants. Lunch for the visitors at the Caswell Hotel was attended by the executive of the Sudbury Branch and visitors from the Nipissing and Upper Ottawa and Sault Ste. Marie branches of the Institute. During the afternoon an informal meeting took place at the Caswell Hotel at which Dr. Stephens and Dr. Wright discussed Institute matters. Later in the afternoon Dr. Stephens was conducted on a tour of the International Nickel Company Frood-Stobie Open Pit by H. J. Mutz, manager of mines.

The visiting ladies, including wives of members from the Nipissing and Soo Branches, were entertained at lunch at the Copper Cliff Club.

Dinner and Dance

The main event of the day was a dinner and dance at the Granite Club in Sudbury, attended by about 100 persons. At the dinner C. O. Maddock, representing the neighbouring municipalities, welcomed the visiting party and briefly discussed the mining industry in the Sudbury Basin. Dr. Stephens delivered a most thought-provoking and interesting talk on the insufficient supply of young engineers in relation to the sharply increasing requirements of industry, business, government, and technical institutions. A comparison of the number of men receiving technical training in Russia compared with the numbers in the United States and Canada indicated this matter to be urgent from the viewpoint of national survival. Dr. Stephens was introduced by Russ Eaton and thanked by J. Millar of North Bay. W. J. Ripley presented the president with a copper ash tray inscribed with a list of the metals mined in the Sudbury District.

Dr. Austin Wright then spoke on the question of "Federation" of the Engineering Institute of Canada with the Dominion Professional Engineers. Close study of this question is required in

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TOMMY CLARK has a craftsman's hand and eye. He needs them, for, in the Pattern Shop at Jenkins, he accurately carves the wooden patterns which are the first step in transforming blueprint design into finished valve. "It may sound like whittling," he says, "but just find me a front-porch whittler who can work from a blueprint to tolerances of one sixty-fourth of an inch. Just find me one!"

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When the president visited Sudbury, February 28, this group was photographed. Left to right: F. A. Orange, chairman; Russ Eaton, councillor, and President Stephens.

view of the overlapping fields of responsibility of the two organizations. Active discussions are now under way by committees of the two organizations and positive action may be possible during the next two years.

Dancing was enjoyed for the remainder of the evening.

Toronto

L. F. Bresolin, jr.e.i.c., *Secretary-Treasurer*

H. Fealdman, m.e.i.c., *Branch News Editor*

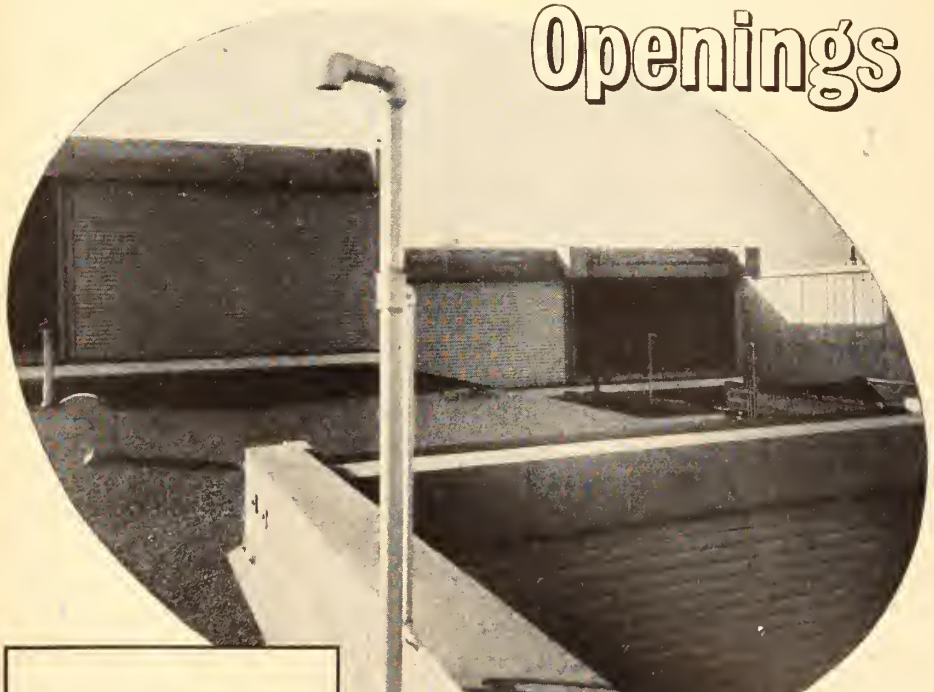
Address by C. R. Armstrong

The Toronto Branch was visited on Thursday, March 3 last by C. R. Armstrong, vice president, employee relations, The Bell Telephone Company of Canada, whose subject was "The Engineer and Industrial Management".

Industrial Management

Mr. Armstrong first covered the organization and importance of industrial management and briefly traced the growth of management from its early beginnings. He then went on to describe the position of the engineer in the management organization, and how his development and growth were influenced very largely by his duties and function, i.e. whether he is a planner, designer or research worker, etc. The subject of remuneration for the engineer was also discussed, and as it is obvious that engineers in many fields cannot by virtue of their functions, achieve the highest levels of management, Mr. Armstrong expressed the opinion that those at the top of their particular branch function should receive remuneration commensurate with that received by the leaders of management. Mr. Armstrong also contended that the place of the professional engineer was entirely

(Continued on page 564)



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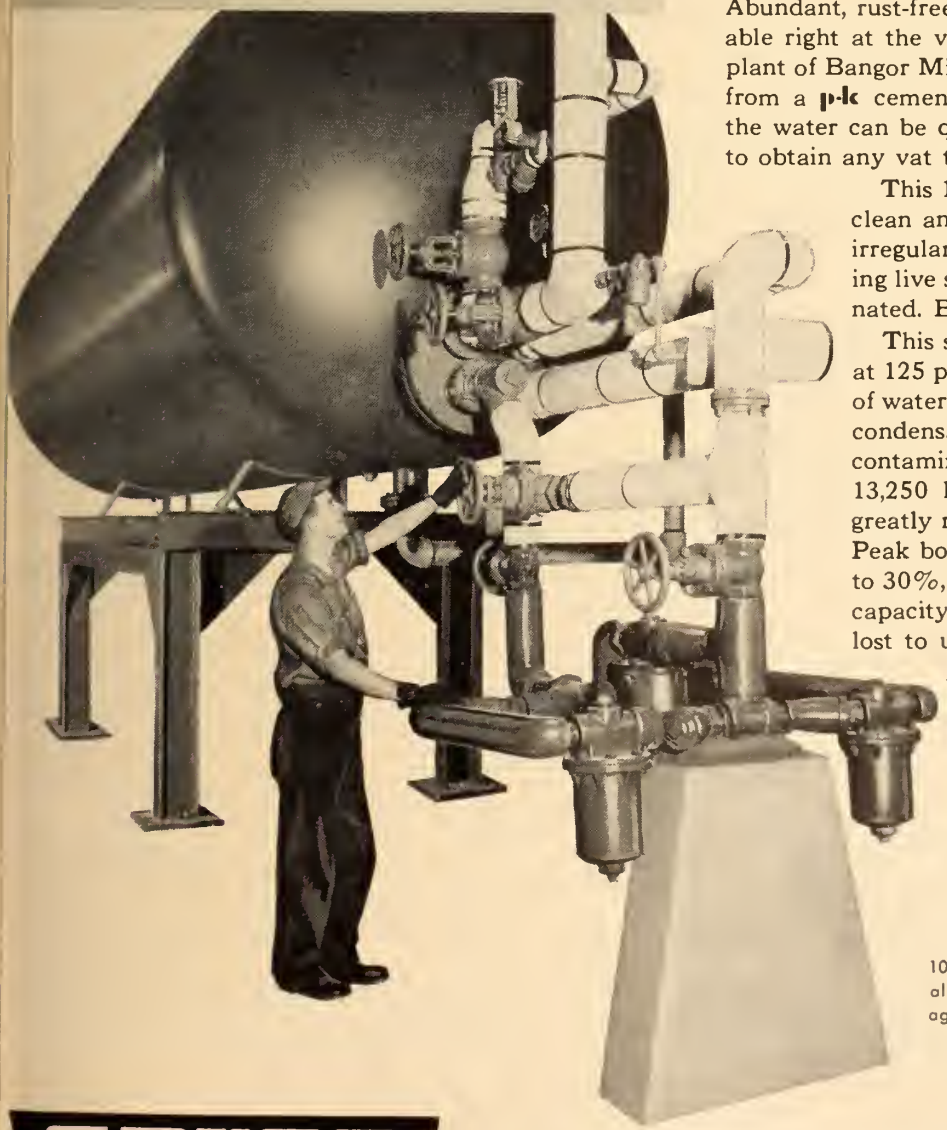

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Students' Quiz Night, Toronto Branch. Left to right: C. J. McCrea, J. L. McFarland, R. M. Gibbons, C. Wheeler, R. Wier, R. J. McLeod, W. M. Laughlin, T. Dembie. At right, the meeting chairman and Quiz Master W. H. M. Laughlin presenting the first prize to C. Wheeler.

and completely within the management group. This last contention was the basis for a very spirited and enlightening discussion which followed this most interesting paper.

The Abadan Refinery

The Toronto Branch at its meeting on Thursday, March 17, heard a paper by John Fulcher, chief mechanical engineer, Directorate of Works (Army) design division. Mr. Fulcher spent eight years in the Middle East as assistant chief production maintenance engineer in the oil fields and refinery of the former Anglo Iranian Oil Company. After describing the growth and almost unbelievable development of the Abadan refinery, Mr. Fulcher went on to analyze the situation which led to the evacuation of the refinery and the subsequent return of the British, in terms of local economic, social and political conditions. In the discussion which followed much interest was centred on the economic and social conditions, not only of the Iranis, but also of the neighbouring

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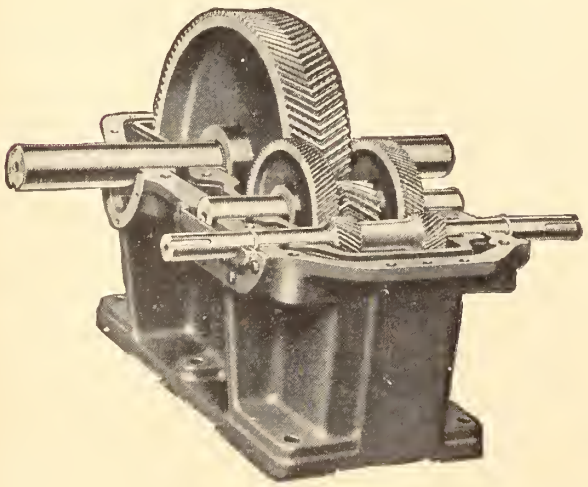

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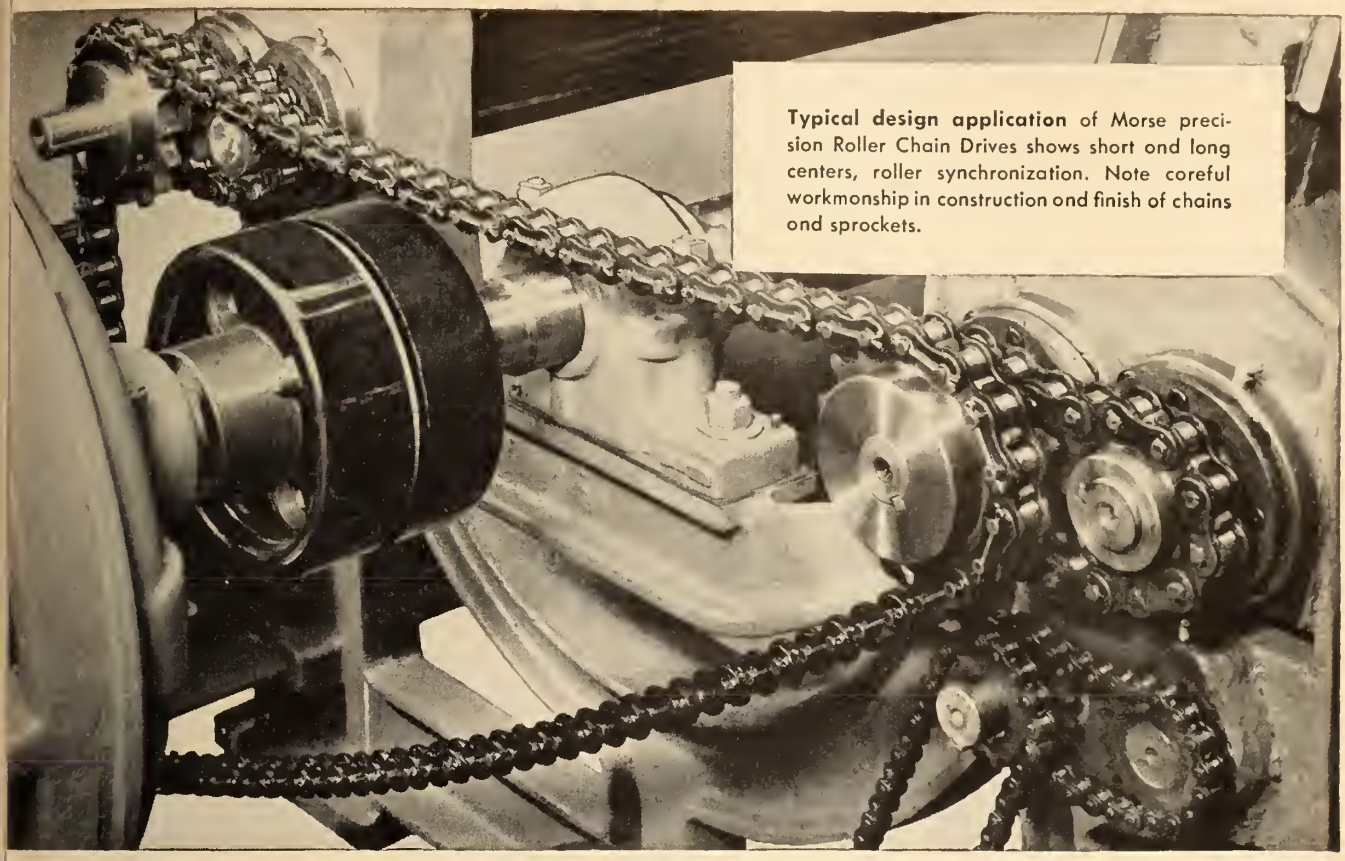

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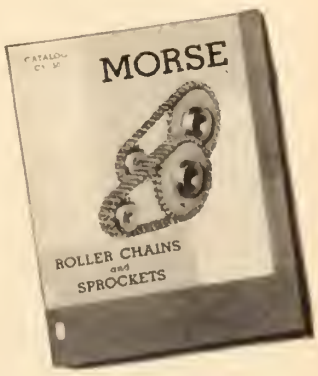

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Students' Night 1955

A most successful Students' Night was held on Thursday, January 27. Modelled on the pattern of last year's meeting, which drew much acclaim, the evening took the form of a "quiz" night. The victims were a panel of students representing each of the clubs of the University of Toronto Engineering Society. The inquisitor-in-chief was W. H. M. "Monty" Laughlin who performed his duties in the best traditional style. Cash prizes were awarded to those contestants who were judged to have made the best showing. Students in the audience also had an opportunity to answer questions fired at them, the rewards for correct answers to these questions being student memberships in the Institute. Nor were the members of the Branch forgotten as they were eligible to compete for "lucky draw" prizes. After the end of the "inquisition" the students were allowed to turn tables and fire questions at a panel of experts (?) drawn from the engineering world of Toronto. The evening concluded with an informal gathering for cakes and coffee. The genius who thought up the questions and other mild forms of torture was Tom Dembie.

Visit of Sir Claude Gibb

The Toronto Branch turned out in force on Friday, February 18, to hear Sir Claude Gibb, C.B.E., F.R.S., chairman and general manager of C. A. Parsons Ltd., England, deliver a most important paper entitled "Investigation in the Failure of two 100 MW Turbo-Generators." It will be remembered that April 1954 marked the failure of two generators in the R. L. Hearn Generating Station of Ontario Hydro in Toronto. This paper dealt with the extensive investigations that were carried out following the failures and how the conclusions reached are being put into practice to avoid the possibility of a repetition of the failures. Since the paper is to be published in an early edition of the *Engineering Journal*, no attempt will be made to summarize the paper here. Sir Claude presented the paper in a most interesting and clear manner and merited most deservedly the tremendous applause which the audience gave him. So great was the interest in this paper than an emergency "switch" had to be made to a large hall shortly before the meeting was due to commence. Even so this hall was filled to capacity with many people sitting in the aisles. The most conservative estimate puts the number present at over 600!

Sir Claude presented this paper before the Institution of Mechanical Engineers in London, England, on February 15 and then immediately flew to Toronto for this meeting. He brought with him the greetings of that Institution to the Engineering Institute of Canada.

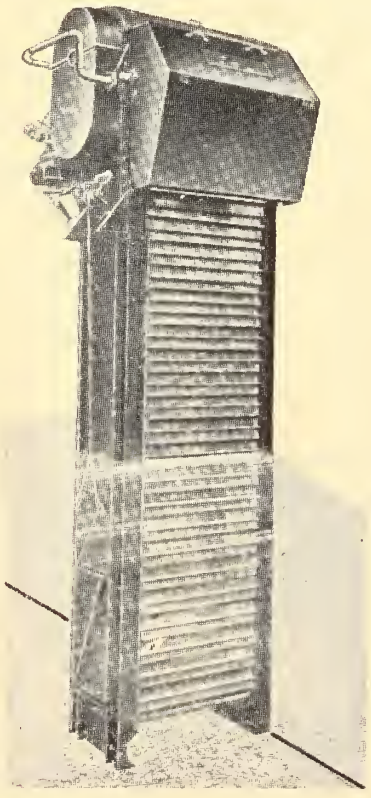
The president D. M. Stephens attended a meeting of the Toronto Branch at Hart House, February 22. President Stephens is shown (centre of the front row) with the executive of the Toronto Branch.

Toronto Welcomes the President

A very warm welcome was given by the Toronto Branch to the president and Mrs. Stephens when they paid a visit on Tuesday, February 22. They were accompanied by the general secretary.

A large number of members and their wives gathered to hear the president discuss some aspects of nation building in Canada from an engineer's point of view and to hear the general secretary bring us up to date on all the affairs of the Institute. After the showing of a movie, the gathering retired for refreshments at which time members and their wives were able to meet informally with the president and his charming wife. A very large number took this opportunity and availed themselves of the privilege, thus enabling the president to meet a large cross section of the Toronto Branch membership.

Branch News is continued on page 604. Please refer to continuation for Ottawa, Saguenay, Saint John and St. Maurice Valley Branch reports.



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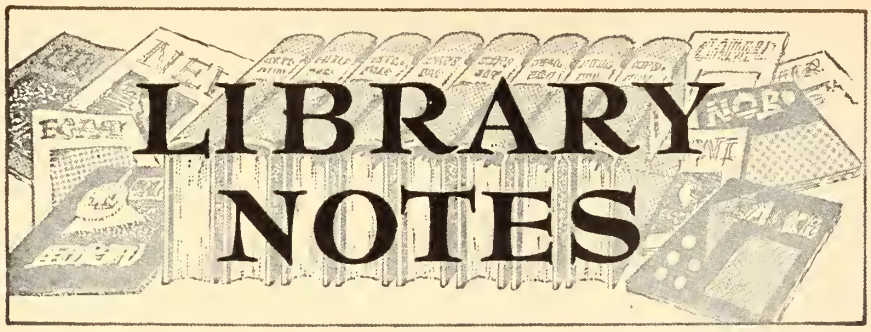

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

SAE handbook, 1954. New York, Society of automotive engineers, 1954. 1,096 pp., illus., $20.00 (U.S.) ($10.00 (U.S.) to SAE members).

This 1954 edition of the SAE handbook gives one the impression of being a very weighty volume, especially in comparison with the earlier editions available in the library. In addition to having over a thousand pages, it is of much larger format than the majority of books.

There are three types of material to be found in the handbook; SAE standards, specifications based on sound established practice; second, recommended practices, which are based on engineering principles, and are intended as being guides towards the establishment of a practice; and lastly, SAE general information reports which present useful data. The individual articles are clearly labelled standard, recommended practice or general information.

The material is grouped under nine general subject headings; ferrous metals, nonferrous metals, nonmetallic materials, threads, fasteners and common parts, electrical equipment, power plant components, passenger cars, trucks, and buses, tractors and earth-moving equipment and marine equipment. There is a detailed table of contents, and an extensive index, both of which add to the value of the handbook. There is also a listing of the SAE designations for various materials and parts, giving also the relevant SAE standard, etc., together with the page on which it appears in the handbook.

Much of the material is presented in tabular and diagrammatic form, and here the large size page is a distinct advantage, as all the tables and diagrams are very clear.

In addition to this technical information, the handbook lists the Society's officers, technical committee personnel and representatives in other technical organizations.

Certain of the reports in the Handbook are available as reprints, but anyone connected in any way with the automotive industry will certainly wish to obtain a copy of this very useful volume.

S.C.

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Mon.-Fri. . . . . 9 a.m.-5 p.m.
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Bibliography and Reference Service

Short subject bibliographies are compiled on request. When placing these requests, please give as much detail and background information as possible.

Borrowing

Books, periodicals, pamphlets and films may be borrowed for two weeks at a time. All books included in the Library Notes Section of *The Engineering Journal* are available for loan. **A fine of 25c per day is charged for each day borrowed items are retained beyond the two-week period.**

A library deposit of $5.00 at par in Montreal is required, for which two items may be borrowed at a time. Temporary deposits (30 days or less) $10.00. Books are sent anywhere in Canada, and carrying charges are payable by the member concerned.

Ordering

Any book or pamphlet may be ordered through the library. All publications of affiliated societies, whether books, pamphlets, or periodicals, should be ordered through the library, as reduced rates are applicable on these to all members. Except in the case of library deposits **please make no payments in advance.** Non-members may consult the library, but may not borrow material. Please address all requests to **The Library.**

BOOK NOTES

Prepared by the Library The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Advanced television servicing techniques. RETMA Pilot Training Course Teaching Staff. New York, Rider, 1954. 163pp., diagrs., $3.60 (U.S.)

... laboratory workbook. New York, Rider, 1954. 46pp., $0.95 (U.S.)

This manual, with its accompanying laboratory workbook, was prepared for practicing television technicians. It is written in easily understandable language and presents recent television receiver trends and developments.

Some of the chapter headings will illustrate the scope of the book: TV test equipment; sweep section servicing; high-voltage servicing; sync servicing; video and sound section servicing; alignment; antennas and transmission lines; customer relations.

The material in both manuals is well suited for courses in TV troubleshooting procedure.

Air pollution. A bibliography. S. J. Davenport and G. G. Morgis. Washington, G.P.O., 1954. 448 pp., $1.75 (U.S.) (Bureau of mines bulletin No. 537.)

The thirty-nine hundred references listed in this useful bibliography cover all aspects of outdoor atmospheric pollution: cause, effect and control. The majority of the references are to periodical articles, and cover literature from the early nineteenth century to 1952. The authors have drawn on a variety of sources in compiling this work, including earlier bibliographies.

The references are arranged by subject, and are in chronological order. The main topics are subdivided, the section on the nature and origin of air pollution including such sub-headings as automobile exhaust, fuel oil, railroad locomotives and steamboats. There is a section on legal aspects of air pollution, and also one on its cost.

Abstracts are given for each item, and there is an author index. This bibliography is a valuable addition to the library, covering the field as exhaustively as it does.

Air pollution. Report of the committee. London, H.M.S.O., Ottawa U.K.I.O., 1954. 80 pp. 65 cents (Cmd. 9322)

The Committee preparing this report was appointed in July 1953 with Sir Hugh Beaver as Chairman, "to examine the nature, causes and effects of air pollution and the efficacy of present preventive measures; to consider what further preventive measures are practicable; and to make recommendations."

The Interim report published in December 1953 described the nature and amount of air pollution in Great Britain, whilst this report details its effects, and puts forward recommendations for improving the situation.

The report is divided into sections dealing with such topics as industrial, railway and domestic smoke, and sulphur pollution. The Committee also considered legislation on the subject. The

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appendices cover such subjects as economic cost, chimney design, costs of room heating, smokeless fuel, and measures taken in other countries to abate pollution.

Atoms in the family: my life with Enrico Fermi. Laura Fermi. Toronto, University press, 1954. 265 pp., illus., $4.00.

The private life of a great scientist must be interrelated with his life work, and to know something of the former helps the reader to visualize and appreciate the latter. The widow of one of the world's leading physicists not only describes Enrico Fermi as a family man but she also explains with clarity some of the basic facts behind the atom bomb.

The author is able to record the story of early married life with her rather eccentric husband, of their forced departure from Italy, of hardship in a new land with the same humour and objectivity with which she tells of some of the first atomic discoveries and of the many famous scientists whom she and her husband have known intimately. She has had the intelligence to keep pace with Fermi's ideas, experiments and discoveries and is able to discuss them in a manner that will be admired by those readers who are themselves scientists.

The climax to this interesting biography is an account of the dramatic moment in 1942 when Fermi and his associates completed the first atomic pile at the University of Chicago, just one more exciting event in the life of this man and his wife.

***Automatic digital calculators.** A. D. Booth and K. H. V. Booth. Toronto, Butterworth, 1953. 230 pp., illus., $6.00.

A guide to the theory, design, construction, and use of digital calculators, written for new workers in the field. Following introductory chapters on the nature, function and history of calculators, the book deals with design, controls, storage, coding, and programming. Brief treatment of applications in crystallography, translation, and games is given in the last chapter. A bibliography is included.

Basic electricity. Van Valkenburgh, Nooger & Neville, Inc. New York, Rider, 1954. 5 vols., illus., $9.00 (U.S.) a set.

These volumes are patterned on the Basic electricity course taught at United States Navy specialty schools in which one basic concept is presented at a time without involving complicated mathematics, and with simplified illustrations and text.

Volume 1 covers current flow, voltage, resistance, magnetism and dc meters. In volume 2 the discussion centres on direct current circuits, Ohm's and Kirchhoff's laws and electric power. Volume 3 describes alternating current circuits; resistance, inductance, capacitance, and reactance. The last two volumes cover impedance, ac circuits, series and parallel resonance, transformers, dc generators and motors, alternators and ac motors, and power control devices.

Canada's flying heritage. F. H. Ellis. Toronto, University press, 1954. 388 pp., illus., $7.95.

The publication of this history of Canadian aviation will certainly create a stir among all those Canadians who have any interest at all in the contribution of their countrymen to the development of world flying. The author is wonderfully qualified for the task as a pioneer pilot himself and as a research expert on this subject.

Besides recording the significant events of Canadian flying, Mr. Ellis pays tribute to many forgotten flyers of the early years following 1907. An interesting chapter on the Barnstormers, between 1906 and 1914, tells of their attempt to make a living from the air. Then follows the story of the great advance in technical manoeuvres and in pilot skill during the First World War and the boom in aviation which followed those four years. The conquest of the Atlantic and the spanning of the continent contain many tales of heroism. One of the most exciting parts of the history is the account of the bush pilots who tamed the Canadian north, men who are now legendary names.

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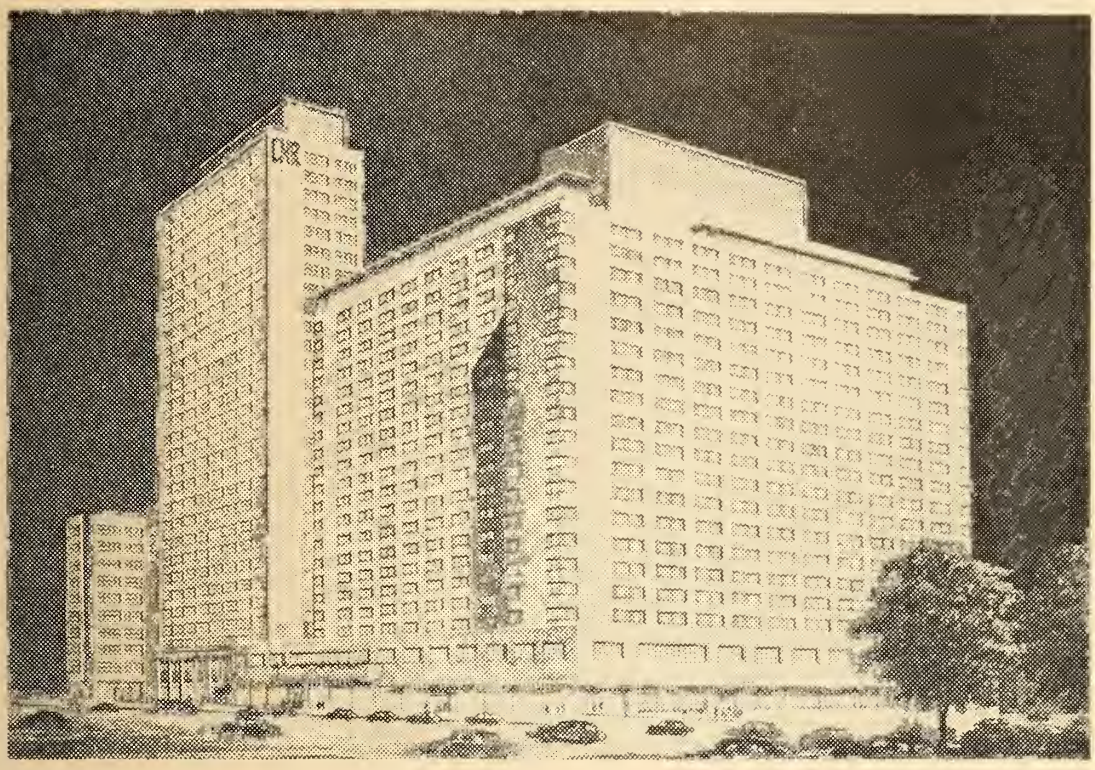

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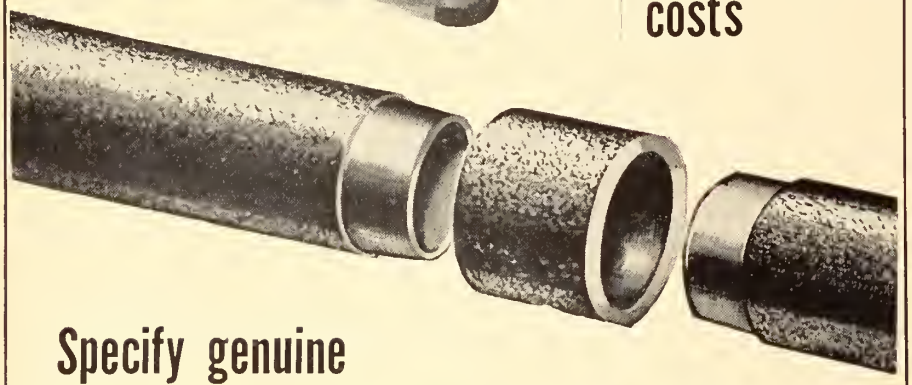

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The appendices include chronological lists of outstanding events in Canadian aviation, air mail events, and cairns and monuments erected to commemorate famous milestones in flying.

***Chemical process principles. Part 1: Material and energy balances,** 2nd ed. O. A. Hougen, K. M. Watson and R. A. Ragatz. New York, Wiley, 1954. 504 pp., diagrs., $8.50.

This is the first of three volumes designed to cover comprehensively the application of physical and chemical principles to problems of the design and operation of chemical processes. It deals primarily with applications of general physical chemistry, thermophysics, thermochemistry, and the first law of thermodynamics. In this edition, numerous changes have been made to bring the volume up to date, and new material has been included on mathematical procedures, equilibria in ternary systems, thermochemistry of nuclear reactions, and other subjects. New problems selected from actual industrial situations have been added.

Concrete roads. F. N. Sparkes and A. F. Smith. Toronto, Macmillan, 1952. 492 pp., illus., $16.00.

A special type of road construction is the subject of this book by two well-qualified English authors. It deals with the construction of concrete roads and gives special attention to the soil and subsoil on which the roads are built although the general principles of this latter subject are not stressed.

Mechanical methods of handling, placing and compacting the concrete are then discussed with chapters also on quality control and testing.

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Defects in concrete roads arising from deficiencies in the subgrade and from other causes are covered in two chapters, while the last section discusses maintenance and repair of concrete roads. There is a ten page list of references, its value being increased by the inclusion of an author index.

Electrical year book, 1955. Manchester, Emmott, 1954. 360 pp., illus., tables, 3/-.

The 1955 edition of the Electrical year book has a rewritten section on control gear which deals comprehensively with a wide range of industrial equipment. Notes are given on the care of electric motors and on electric brazing and soldering and there is an entirely new part covering the suppression of interference with radio reception. There is a new table on the relative weights of patterns and castings, in addition to all the information found in earlier editions.

***Elevated-temperature properties of selected super-strength alloys. Report.** Philadelphia, American society for testing materials, 1954. 208p., $4.75. (Special technical publication No. 160.)

This report is primarily a graphical summary of strength data for thirteen alloys. Summary curves are included for tensile strength; 0.2 per cent offset yield strength; per cent elongation and reduction of area; and stresses for rupture and creep rates. Chemical composition

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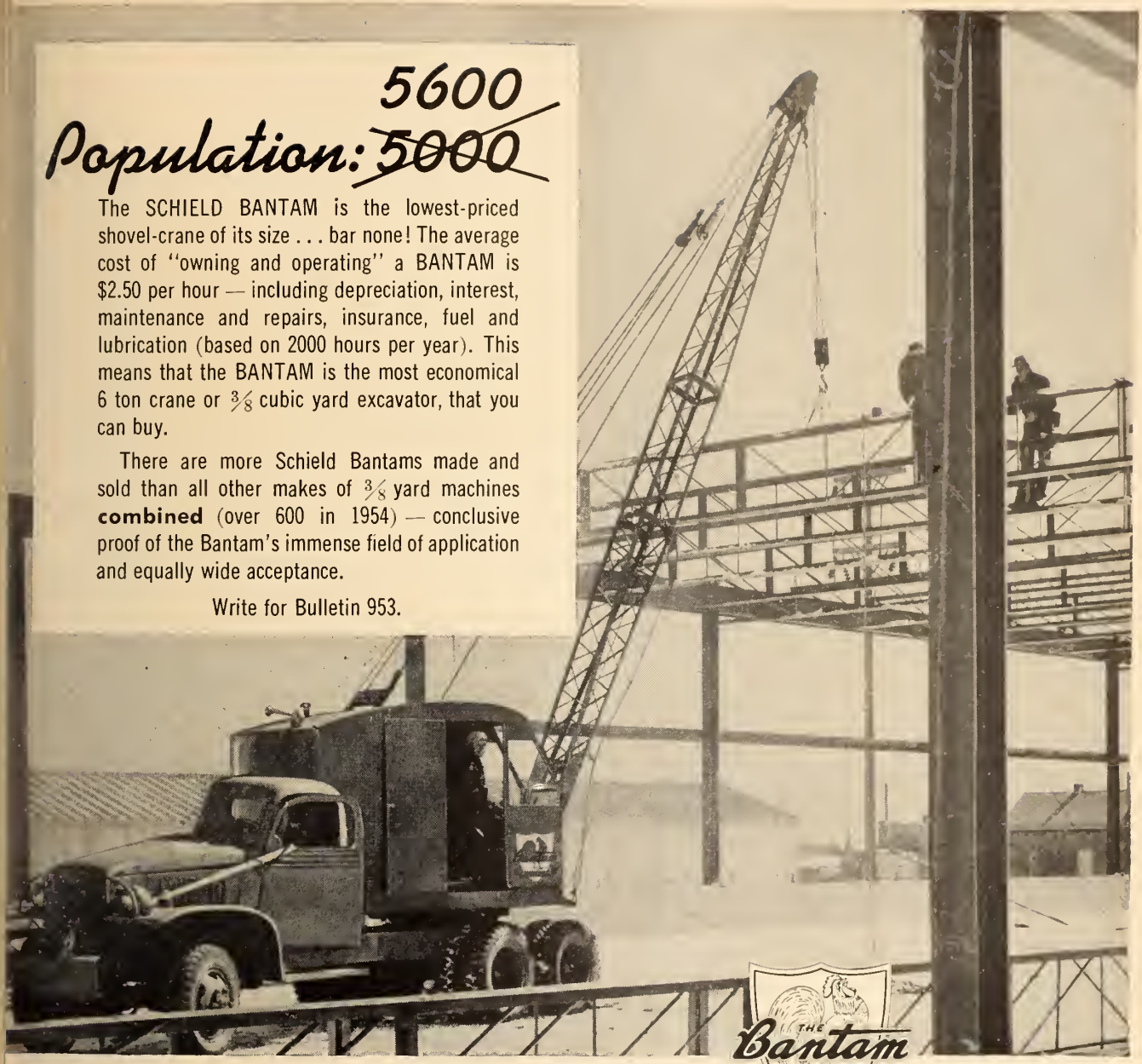

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and recommended heat treatments and processing are given for each alloy. An appendix contains very-short-time rupture data for some of the alloys, and chemical compositions for about 100 super-strength alloys.

Engineering dynamics. v. 1. Theory of elasticity; analytical and experimental methods. C. B. Biezeno and R. Grammel. London, Blackie, 1955. 307pp., diagrs., 50/-.

Volumes 3 and 4 of this set, on steam turbines and internal-combustion engines, are already in the library. This latest volume follows the same general aim of excluding elementary engineering mechanics and concentrating on the more advanced and complicated problems in engineering dynamics.

Part 1 of this volume is entitled Fundamental laws of elastomechanics and contains chapters on the state of stress, the state of strain, stress-strain relations, the differential equations of stress and strain and the neutral elastic equilibrium. In the second section the general theorems of elastomechanics are presented, including variational theorems, energy and reciprocal theorems and the stress functions of two-dimensional stress problems. Among the methods of solution suggested in Part 3 are numerical solutions of eigen value problems, discontinuous methods of calculation, the soap-film, electrical and optical methods.

The English windmill. Rex Wailes. Toronto, British Book Service, 1954. 246pp., illus., $7.00.

Those who regard as important the preservation, in literature and in physical form, of ancient buildings and practices will find this an extremely interesting book. The author is a successful mechanical engineer and writes with authority on this subject which has been his hobby for many years.

This is not only a historical and descriptive account of English windmills but contains as well a technical section on the machinery of the mill. Engineers who like to look back on the progress of their profession will especially enjoy this part.

Part 1 discusses the different types of windmills—the post mill, the smock mill, the tower mill and the drainage mill—and illustrates their variations. Following the account of their machinery there is a section on how the mills are worked and the men who operate them. The last chapter deals with the decline of windmills in Great Britain and how they should be preserved and recorded.

Many fine drawings and photographs increase the value of the book.

***Fluoridation as a public health measure.** J. H. Shaw ed. Washington, American association for the advancement of science, 1954. 232 pp., illus., $4.50 (U.S.).

The major emphasis in this monograph is on the effectiveness of fluoridation in reducing dental caries and on its validity as a public health procedure. It includes a review of the benefits of fluoridation, studies of results in a number of test areas, and an evaluation of vehicles other than water —salt, solid foods, tablets, etc. Separate chapters deal with engineering and chemical aspects, and with the determination of fluorides in water. References are listed after all chapters but one.

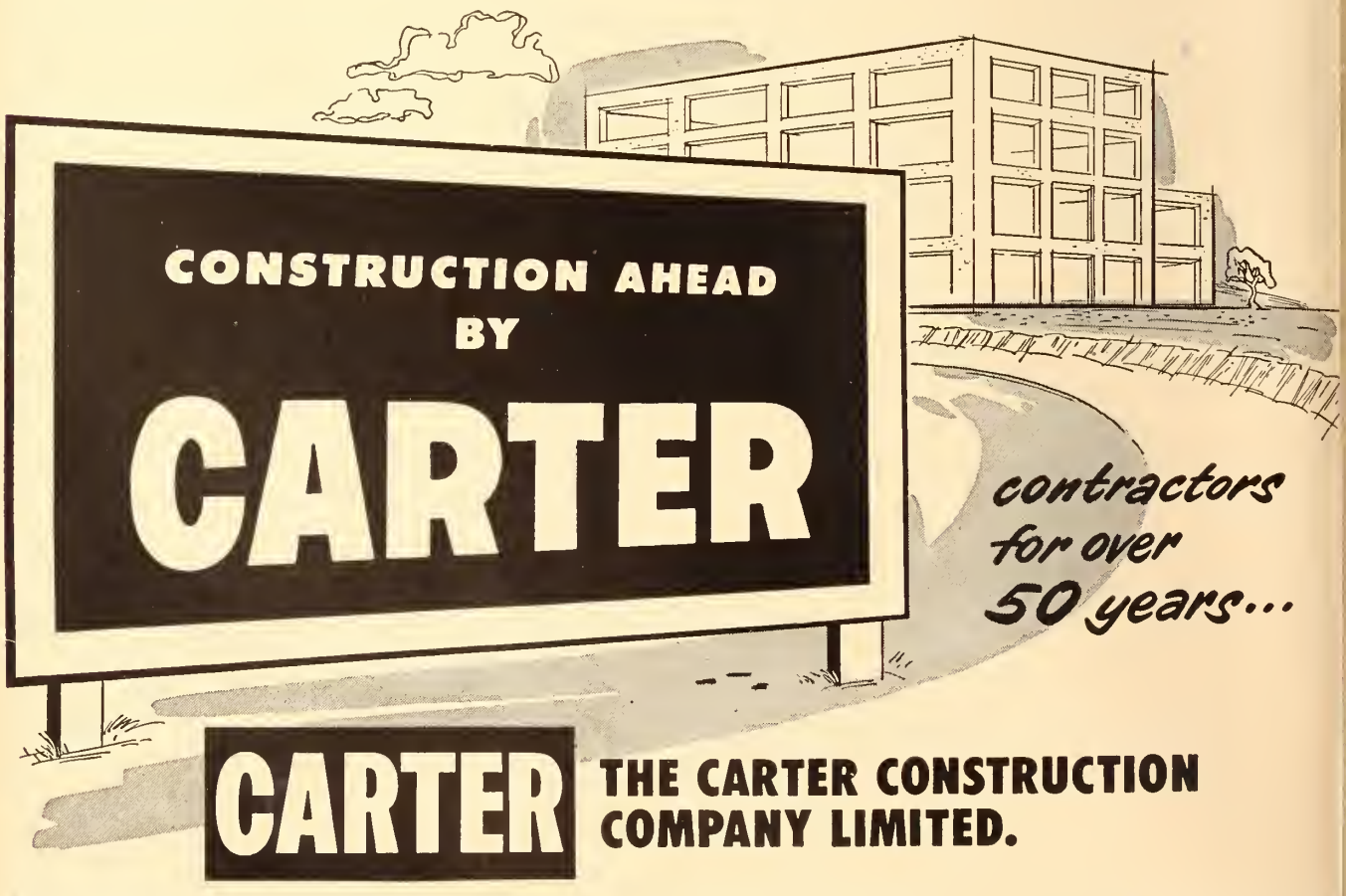
Fundamentals of colour television. W. F. Boyce. Indianapolis, Sams, 1954 232 pp., pa., $2.00 (U.S.).

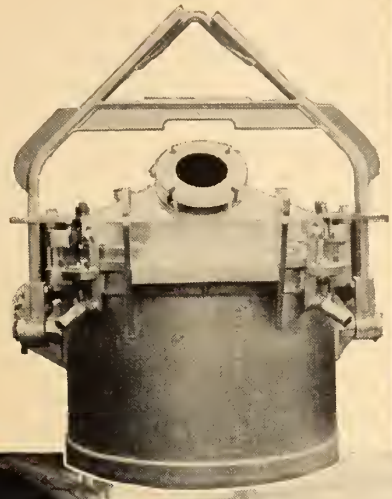
This book has been issued to assist those interested in the technical aspect of television to understand the basic principles of electronic transmission of colour without pronounced reference to mathematics.

There are six chapters covering such topics as: colour picture reproduction, colour receiver systems and block diagrams, service notes for colour receivers, etc. Each chapter covers the latest techniques and each is profusely illustrated to show basic principles, typical circuits, wave-forms and designs.

Machine drawing and design, 6th ed. W. Abbott. London, Blackie, 1954. 253 pp., illus., 15/-.

This is a university text on a quite





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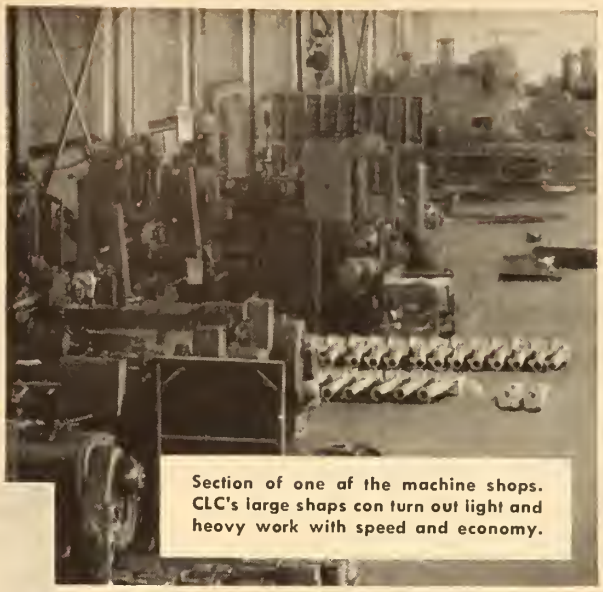

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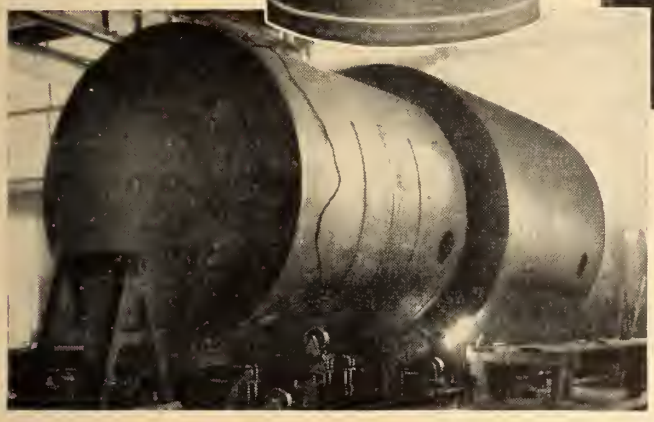

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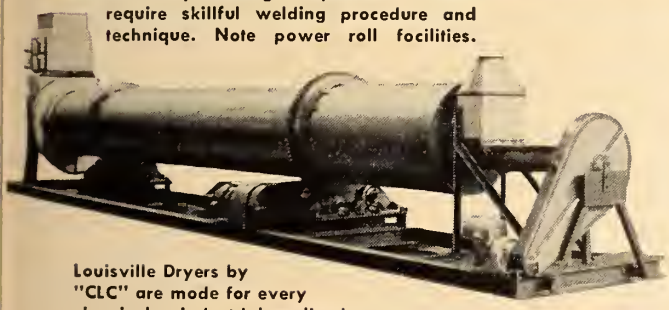

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elementary level, but might also be of use to draftsmen. The text supplements the drawings and provides an introduction to the design of the more common details of machinery. The subjects of mechanics and strength of materials are not included and the allocation of tolerances to dimensions is given only elementary treatment.

The first chapter on machine drawing describes the principles of projection. Following this are the elements of machine design; fastenings, bearings, gearing, valves, etc. The last part of the book consists of exercises in drawing and design graded in difficulty and is supplementary to the text of the preceding part.

Magnetic-amplifier circuits. W. A. Geyger. Toronto, McGraw-Hill, 1954. 277 pp., diagrs., $7.50.

In a carefully developed discussion of magnetic-amplifier circuits the author puts special emphasis on magnetic servo amplifiers, and outlines the fundamental principles and applications of the subject. Rather than making use of complicated mathematics he interprets the essential facts by descriptive and graphical methods. The material is arranged by circuit functions thus inviting comparison of various circuits for accomplishing a particular purpose.

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The author has referred to European as well as American literature, so that some of the material presented is new and relatively unknown.

Mechanical and electrical equipment for buildings, 3rd ed. C. M. Gay, Charles de Van Fawcett and W. J. McGuinness. New York, Wiley, 1955. 564 pp., illus., $8.50.

The third edition of this comprehensive work has been greatly revised and enlarged. The first four sections, which cover mechanical equipment, deal with water supply, sanitation, heating and air conditioning, and illustrate the most modern types of this equipment. Turbine, jet, and submersible pumps are described and the subject of water impurities and treatment expanded. New material in the heat section includes power-circulated warm air and hot water systems and the hot water section has been extended to cover baseboard heating. There is a new chapter on radiant heating.

New information on electrical equipment ranges from switchboards and panelboards to elevators and escalators. In the chapters on lighting many modern types of fluorescent lights have replaced outdated units. The latest sound-absorbing materials have been added in the section on acoustics, while the chapters on ac and dc machinery have been simplified.

Many typical problems, with their solutions, are offered for practice.

Mechanical world year book, 1955. Manchester, Emmott, 1954. 240 + 254 pp., illus., tables, 3/6.

In this 1955 edition of the Mechanical world year book sections on materials are now located in one group of pages. This makes for convenience of reference and comparison of ferrous, non-ferrous and plastic materials. Special attention has been given to the data on steels and non-ferrous alloys, and to materials for special purposes. A detailed index increases the value of this useful handbook.

***Nuclear geology: a symposium on nuclear phenomena in the earth sciences.** Henry Faul, ed. New York, Wiley, 1954. 414 pp., diagrs., $7.00.

Twenty-six scientists have contributed to this symposium which is intended as an introduction to the subject for the graduate student and practising geologist. It includes a simple introduction to nuclear physics; an outline of such important techniques as nuclear emulsion, mass spectrometry, and isotope dilution; discussion of radioactive elements in rocks and oceans; and description of thermal, physical, and chemical effects; radioactivity. Separate chapters treat nuclear methods of exploration and well logging, absolute age determination, and the origin of the earth. An extensive bibliography is appended.

***Prestressed concrete,** 3rd ed. Gustave Magnel. Toronto, McGraw-Hill, 1954. 345 pp., illus., $9.75.

A concise account of theoretical principles and practical design data for prestressed-concrete structures, brought up to date to include developments since publication of the previous edition in 1950. About fifty pages of new material have been added, including descriptions of new methods of prestressing, a section on the breaking strength of statically-determined beams, and additional examples of bridges and buildings.

Simplified design of structural steel, 2nd ed. Harry Parker. New York, Wiley, 1955. 244 pp., diagrs., $5.75.

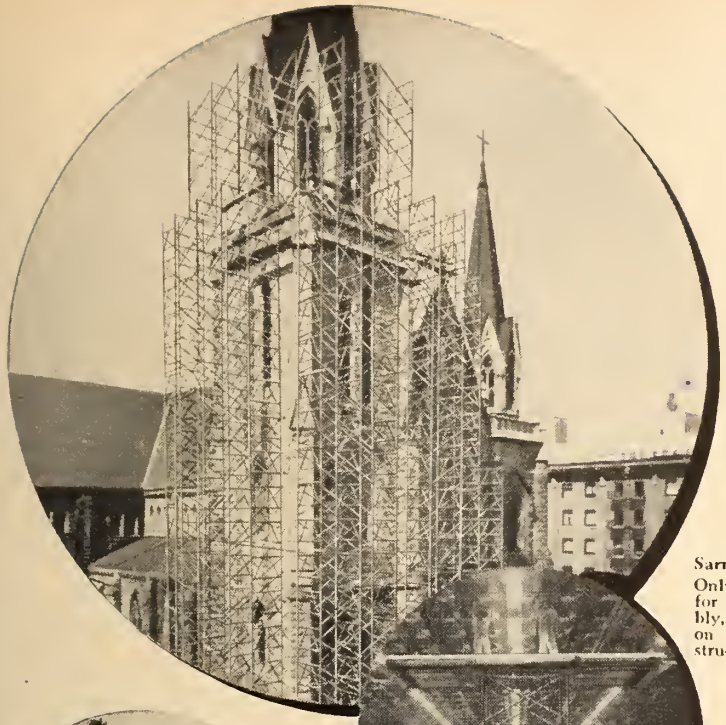
The design of the most common structural steel members that occur in building construction is the subject of this volume. The basic principles underlying engineering tables and formulas are explained, beginning with problems relating to simple direct stresses and going on to more involved examples.

New material in this edition includes the design of open web steel joists, a safe load table for steel pipe columns, and the proper method for the design of a beam having a long span and a relatively light load. Many new examples and problems have been added.

Single sideband for the radio amateur. West Hartford, Conn., American radio relay league, 1954. 208pp., illus., $1.75 (U.S.)

In the manual articles which have been published in the periodical QST during the last six years have been selected and arranged to form a handbook of currently useful information on the subject of single-sideband telephony.

Subjects discussed include the building of single-sideband exciters, amplifiers, receivers and accessory gear; ad-



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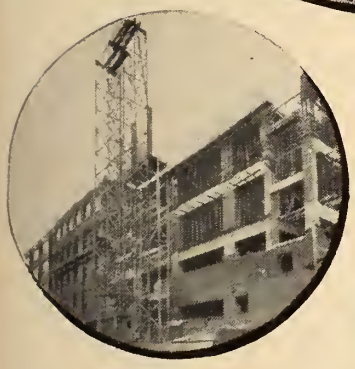

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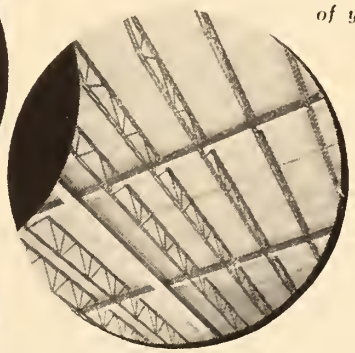

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justment of single-sideband equipment; modulation; detection; filter system; receivers; phasing system; and linear amplifiers.

This would be a valuable reference work and training text for class or home study.

Sonics. T. F. Hueter and R. H. Bolt. New York, Wiley, 1955. 456pp., illus. $10.00.

The scope of this important new book includes the analysis, testing, and processing of materials and products by the use of mechanical vibratory energy. While the applications of sonics are wide and varied they are based on the same physical principles, and by presenting these in general form the authors have devised a framework for their material.

By presenting the underlying physics as simply as possible the authors have directed the book to both physicists and engineers, with the chief emphasis on the techniques and instrumentation for application of sonics in industry. The basic physics of vibration and sound are followed by design principles of electroacoustic and fluid-dynamic transducers. The applications are covered by three chapters on sonic processing and sonic analysis. A topic of particular interest is the molecular aspects of sound propagation in fluids. Another point of interest is that much of the material on magnetostrictive transducers has never been presented before in book form.

The mks system of units is used, and tables and design curves condense results of equations for immediate engineering use.

TV field service manual with tube locations, v. 3. Harold Alsberg, ed. New York, Rider, 1954. 121pp., diagrs., spiral binding, $2.10 (U.S.)

Another in the series, this particular field service manual applies especially to Emerson and Fada television receivers. Like the others, it is issued to serve the need for information that will help the technician to locate and eliminate quickly any troubles he may find when working on equipment in the field.

TV manufacturers' receiver trouble cures, v.6. M. S. Snitzer. New York, Rider, 1954. 120 pp., diagrs., pa., $1.80 (U.S.)

This book is the sixth in a series dealing with specific television receiver troubles and their cures. These cures are the manufacturers' own answers to some of the problems that may arise in their particular receivers. The fact is that many receivers in the field do develop certain peculiarities of operation for which the manufacturer has a definite tried-and-tested cure.

The testing of bituminous mixtures, 2nd ed. D. C. Broome. Toronto, Macmillan, 1949. 396 pp., illus., $8.00.

This book was designed as a laboratory manual to be used when making tests on bituminous road and building materials. New material in this second edition includes tests especially applicable to tar and tar mixtures.

The manual describes methods of making heat, physical, chemical and electrical tests on tars and bitumens, aggregates, asphalt and tarmacadam mixtures. Section 4 is devoted to mechanical tests on road mixtures while the last chapter deals with the equipment of laboratories for testing bituminous mixtures.

Some of the useful material found in the appendices includes tables of yardages, road areas and tonnages of material, viscosity conversion and softening-point conversion tables.

Transistor audio amplifiers. R. F. Shea. New York, Wiley, 1955. 219 pp., diagrs., $6.50.

The author's purpose in writing this book is to explain, with a minimum of mathematics, the use of the transistor in constructing audio amplifiers. Some basic network theory is included before the specific design material, the latter covering such data as the variation of

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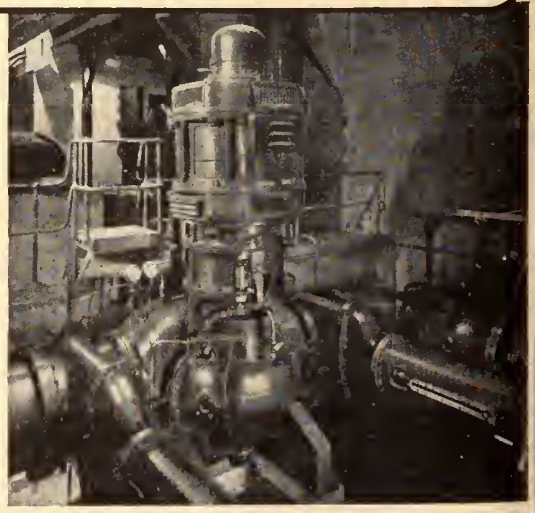

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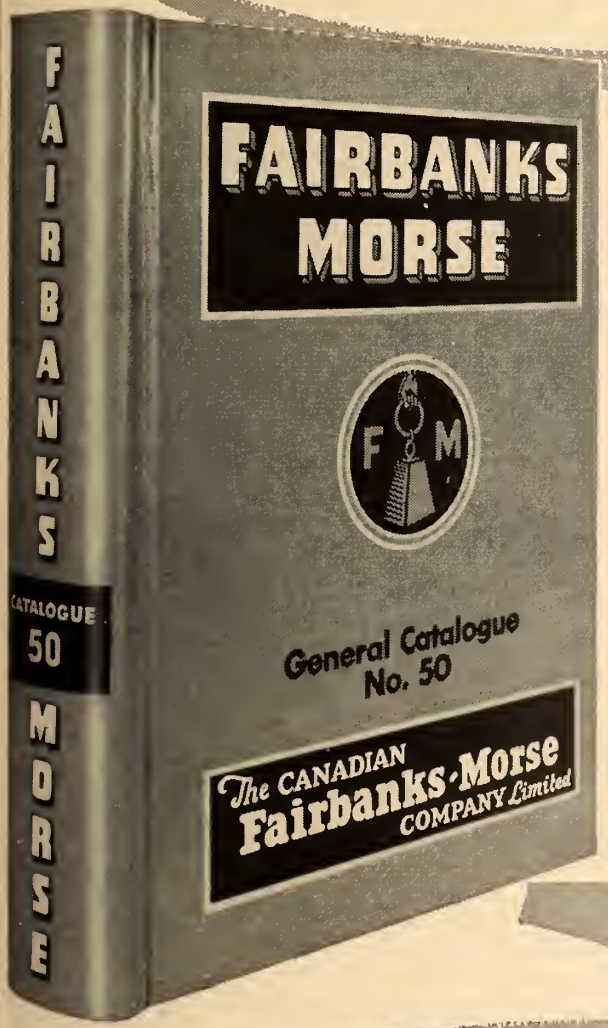

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transistor parameters with operating point, with temperature and between units. The limitations imposed by such variable factors as input and output resistances and power gain are made clear. The various methods of coupling transistor stages together are analyzed and examples are given of the design of amplifiers for a variety of applications, from preamplifiers to relatively high-powered output amplifiers.

The author has based most of his more specific designs on the characteristics of General Electric junction transistors, although many other makes are included.

Unionization of professional engineers. Bibliography. Engineering societies library. New York, The Library, 1954. 8 pp., mimeog., $2.00 (U.S.) (E.S.L. bibliography No. 10.)

Prepared by the Engineering Societies Library in answer to many enquiries received, this bibliography contains a hundred references to pamphlets and periodical articles on the subject available in the New York Library. The majority are also available in the library of the Engineering Institute of Canada.

The period covered is 1937 to 1954, the references being arranged chronologically. In view of the interest in this topic in the profession, this bibliography should prove of interest to many of our readers.

Urban planning methods and techniques, selected references. Chapel Hill, North Carolina University, Dept. of city and regional planning, 1954. 20 pp., mimeog., $2.00 (U.S.).

The references in this bibliography are arranged by subject, although unfortunately there is no table of contents or index of any type.

A wide variety of topics is covered, some of the subject headings being Economic base studies; Population studies; Land use; Thoroughfare planning; Parking; School, residential, recreational and business areas, and the Comprehensive plan.

Although many of the references are to reports issued by individual cities on their particular problems and solutions, periodical articles, books and pamphlets of a more general nature are also included.

BOOKS RECEIVED

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Agricultural process engineering. S. M. Henderson and R. L. Perry. New York, Wiley, 1955. 402 pp., illus., $8.50.

American men of science: a biographical directory. 9th ed. v. 1. Physical sciences. Jacques Cattell, ed. New York, Bowker, 1955. 2180 pp., $20.00 (U.S.).

Analysis of statically indeterminate structures. J. I. Parcel and R. B. B. Moorman. New York, Wiley, 1955. 57 pp., diagrs., $9.50.

Applied soil mechanics. W. S. House. Ann Arbor, Mich., Edwards, 195 (c. 1938). 134 pp., illus., $2.25 (U.S.

Cams; design and layout. Louis Kasper. New York, Chemical Publishing, 1954. 101 pp., diagrs., $3.50 (U.S.).

Circuits and networks. Glenn Koehler. Toronto, Macmillan, 1955. 349 pp. diagrs., $6.50.

Conversion factors and tables, 2nd ed. O. T. Zimmerman and Irvin Lavine. Dover, N.H., Industrial research service, 1955. 501 pp., $5.50 (U.S.).

Elements of food engineering. v. 2. Unit operations — 2. M. E. Parker, E. H. Harvey and E. S. Stateler. New York, Reinhold, 1954. 241 pp., illus. $6.75 (U.S.).

The engineer buyers' guide, 1955 ed. London, Engineer, 1955. 745 pp., 5/-.

Kempe's engineer's year-book for 1955, 60th ed. B. W. Pendred and C. E. Prockter, eds. London, Morgan Bros., 1955, 2v., diagrs., 75/-.

The Macmillan world gazetteer and geographical dictionary. T. C. Collocot and J. O. Thorne, eds. Toronto, Macmillan, 1955. 792pp., $6.95.

Magnetic amplifiers. H. F. Storm. New York, Wiley, 1955. 545pp., illus., $13.5

The radio amateur's handbook, 32nd ed. West Hartford, American radio relay league, 1955. 768pp., illus., $3. (U.S.)

Safety in industry. D. I. Macfarlan. London, Iliffe, 1955. 71pp., illus., 7/

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The statesman's year-book, 1954, 91st ed. S. H. Steinberg, ed. Toronto, Macmillan, 1954. 1608pp., $6.75.

Storage batteries, 4th ed. G. W. Vinal New York, Wiley, 1955. 446 pp., illus., $10.00.

Transistors; theory and applications. Abraham Coblenz and H. L. Owens. Toronto, McGraw-Hill, 1955. 313 pp., illus., $7.20.

The world almanac, 1955. New York, World-Telegram, 1955. 896 pp., $1.10 (U.S.)

Your local government: a sketch of the municipal system in Canada. D. C. Rowat, Toronto, Macmillan, 1955. 148pp., $2.50.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

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No. 2039—Selected papers on nationwide toll dialing and automatic toll ticketing.

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No. 2227—Transmission formulas and charts for laminated coaxial cables, by R. A. King and S. P. Morgan. No. 2235—Nonreciprocal loss in traveling-wave tubes using ferrite attenuators, by J. S. Cook, R. Kompfner and H. Suhl. No. 2237—Minimum noise figure of traveling-wave tubes with uniform helices, by J. R. Pierce and W. E. Danielson. No. 2249—A mass spectrograph for the analysis of solids and mass spectrographic analysis of solids, by N. B. Hannay and A. J. Ahearn. No. 2269—Factors determining the permanent magnet properties of single crystals of Fe_2NiAl, by E. A. Nesbitt, H. J. Williams and R. M. Bozorth. No. 2286—Domain formation and domain wall motions in ferroelectric $BaTiO_3$ single crystals, by W. J. Merz. No. 2305—Distribution of random determinants, by H. Nyquist, S. O. Rice and J. Riordan. No. 2318—Type-N carrier telephone deviation regulator, by E. H. Perkins and J. J. Mahoney. No. 2322—Topics in guided wave propagation through gyromagnetic media, by H. Suhl and L. R. Walker.

Canada. National research council. Associate committee on soil and snow mechanics. Technical memoranda:
No. 30—Canadian papers presented at the 3rd international conference on soil mechanics and foundation engineering, held in Zurich, Aug. 1953. No. 33—Proceedings of the 7th Canadian soil mechanics conference, Dec. 10 and 11, 1953. No. 32—Annual report of the Canadian section of the International society of soil mechanics and foundation engineering, June, 1953-June, 1954.

Canada. National research council. Canadian government specifications board. Specifications:
2-GP-101—Synthetic detergent; liquid, hand cleaner. 2-GP-103—Synthetic detergent; powder, for use in soft, hard or sea water. 2-GP-104—Synthetic detergent; paste, general purpose. 2-GP-107—Synthetic detergent; liquid, general purpose. 2-GP-113—Synthetic detergent; paste or liquid, for low temperature laundering. 2-GP-115—Synthetic detergent; powder, general purpose, heavy duty. 2-GP-175—Synthetic detergent, concentrated; liquid, paste, flake or powder, for use in soft, hard, or sea water. 18-GP-6—Coal, bituminous, American. 37-GP-31—Compound; joint, sewer pipe; plastic, hot-pour, mineral-filled. 45-GP-9—Saws; circular, pneumatic, portable. 53-GP-0—Methods of testing general office stationery.

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No. 42—Metals engineering and radioactive materials, comp. by G. G. M. Carr-Harris.

Canadian electrical manufacturers association:
Canadian electrical manufacturing industry: an economic analysis, by F. A. Knox, C. Barber and D. W. Slater.

Geography. Reprint:
The pattern of Canada's post-war growth, by J. W. Watson.

Institute of radio engineers. Transactions. Reprint:
Transistors and their applications: a bibliography, 1948-1953, A. R. Krull, ed.

Institution of electrical engineers. Advanced papers:
An examination of high-voltage d.c. testing applied to large stator windings, by R. T. Rushall and J. S. Simons. Maintenance principles for automatic telephone exchange plant, by R. W. Palmer. Performance characteristics of high-frequency radiotelegraph circuits, by A. M. Humby, C. M. Minnis, and R. J. Hitchcock.

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Co-operation in engineering research between educational institutions and industry; Part 1 by E. Giffen, part 2 by V. C. Davies; part 3 by J. H. R. Nixon.

Kansas. University. Engineering and architecture bulletins:
No. 30—Transactions of the fourth annual conference on sanitary engineering.

New York. Power authority:
St. Lawrence power; recreation, housing, highways and related matters.

Society of automotive engineers. Pamphlets:
The SAE story.

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List of inspected appliances, equipment, and materials, 1954.

United States. National research council. Highway research board:
Effect of water on bitumen-aggregate mixtures (Bibliography No. 17). Laboratory analysis of soils; grain size and liquid limit (Bulletin No. 95).

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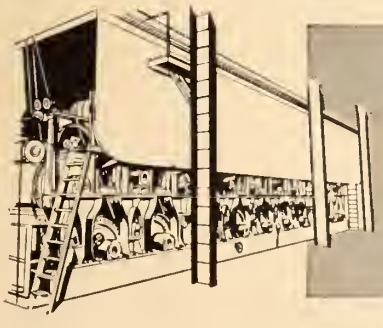

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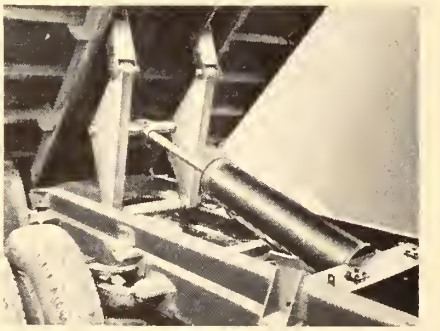

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STANDARDS REVIEWED

American concrete institute, 18263 W. McNichols Road, Detroit 19, Mich.

A.C.I. Standards—1954. 270pp., pa. $3.50 (U.S.)

The twelve standards in this book are those currently issued by the American concrete institute, except for the manuals of standard practice for Detailing reinforced concrete structures and for Detailing reinforced concrete highway structures, which are available only as separates.

The standards for reinforced concrete cover: building code requirements, metal supports, and design and construction of chimneys. There are recommended practices for winter concreting, selecting proportions for concrete, measuring, mixing and placing concrete, application of portland cement paint, construction of concrete farm silos, and application of mortar by pneumatic pressure. The other topics covered are concrete pavements and bases, cast stone and precast concrete floor units.

All the standards contained in this handy compilation are also available separately.

Association of short-circuit testing authorities (inc.) 36 Kingsway, London, W.C. 2.

A.S.T.A. Publication no. 16. Rules governing the short-circuit testing of air-break circuit-breakers for alternating current systems. 10/–.

This publication has been drawn up to ensure uniformity in the short-circuit testing of air-break circuit-breakers pending the completion of clause 40 of B.S. 862-1939 and the publication of a British standard for air-break circuit breakers of voltages greater than 660-volts.

It contains all the necessary data to conduct these tests.

British standards, British standards institution, 2 Park Street, London, W. 1. British standards are available from the Canadian standards association, National research building, Ottawa, Canada.

B.S. 125:1954 — Hard-drawn copper conductors for overhead power transmission purposes. 3/–.

This is a revision of B.S. 125:1947.

Changes made include the adoption of the Centigrade temperature scale, with a basic reference temperature of 20°C, instead of the Fahrenheit scale with a basic reference temperature of 60°F. and the introduction of revised values for constant-mass temperature coefficient of resistance and coefficient of linear expansion. The requirements of the tensile tests have also been altered.

B.S. 2051: part 3:1954—Steel compression pipe fittings for engineering purposes. 3/6.

This standard refers to steel compression fittings for use with pipes of steel and other suitable materials. It covers two ranges of fittings, namely, (1) for use with pipes having fractional outside diameters, ¼ in. to 1½ in. inclusive; (2) for use with pipes designated by their nominal bores, ⅛ in. to 1 in. inclusive. However, it does not attempt the complete dimensional standardization of these fittings since the variety in the designs and methods of production already established make such an attempt impracticable. It does lay down

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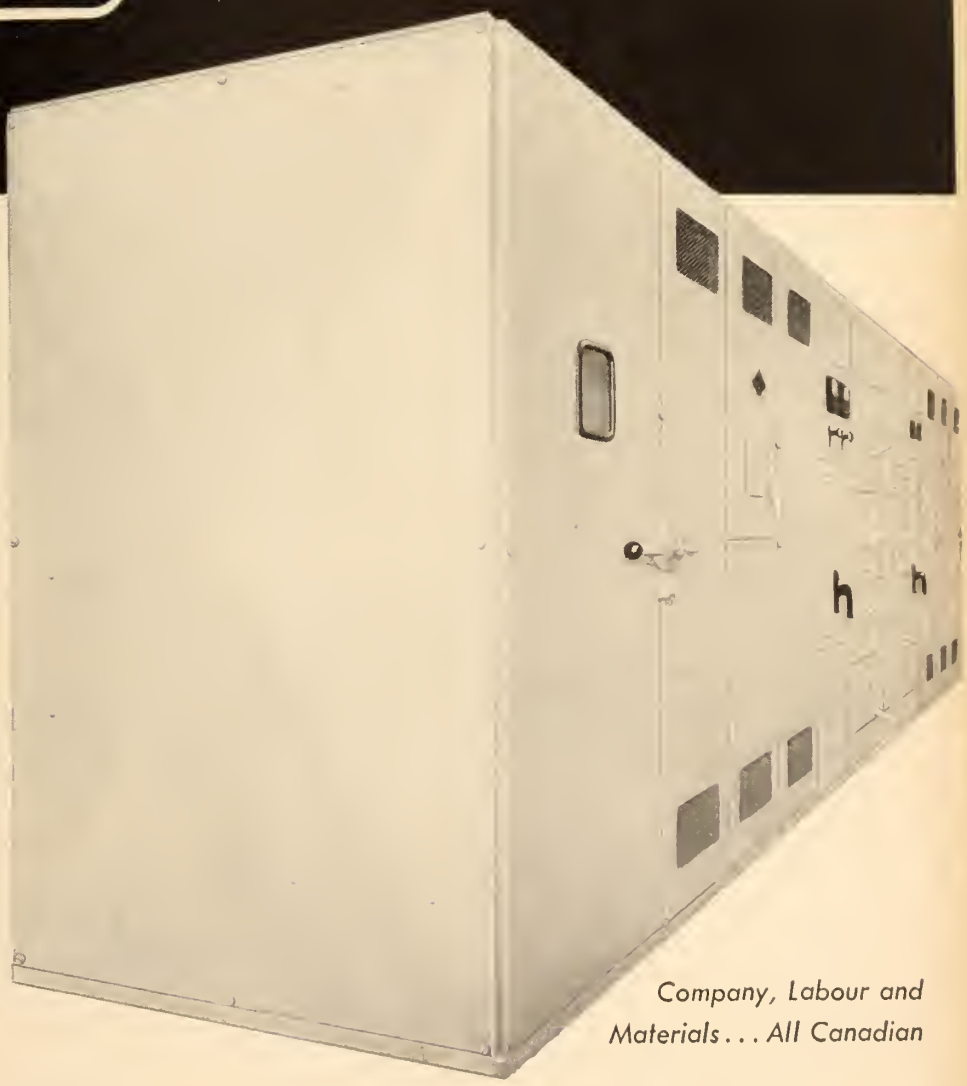

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those dimensions and requirements which are essential to ensure satisfactory installations and performance.

This standard incorporates a number of general requirements concerning materials, design, construction and workmanship and specifies a hydraulic test and a test for porosity in addition to stating temperature and pressure ratings for these fittings.

A. 125-A. 168: 1954 British standards for stiffnuts (UNF threads) for aircraft. 10/6.

These standards specify the dimensions, materials, testing and identification requirements for aircraft stiffnuts of ¼ in. nominal size with Unified threads.

The preparation of the standards afforded an opportunity to co-ordinate the development of a new series of nuts, the incorporation of which has resulted in a much more comprehensive standard than was formerly possible.

The aim throughout has been to define and dimension the product completely, so that the standards are adequate for manufacture and inspection—except for the friction element, which is defined by the space which may be occupied and the performance which it must attain. Stiffnuts supplied to A. 125-A. 168 will, therefore, be interchangeable, one with another, within the specified limiting conditions of temperature, etc.

The steel (including corrosion resisting steel), brass (or bronze), and aluminum alloy nuts covered by the standard are capable of functioning satisfactorily at sustained temperatures of 200°C., 150°C. and 125°C., respectively. All nuts are capable of remaining effective for service operations at −40°C. and are satisfactory for use at −75°C.

B.S. 2518: 1954—Rotary form-relieved gear cutters. 7/6.

This is intended to replace the original brief section in B.S. 122: 1938 'Milling cutters and reamers' which dealt with rotary form-relieved gear cutters.

The present standard recommends the use of the 20° pressure angle for gear milling cutters, and a modified basis rack gear tooth profile designed to avoid undercutting in gears with a small number of teeth while allowing sufficient tips for teeth cut. An odontograph diagram accompanied by a table of dimensions for 1 D.P. cutters enables the cutter tooth profiles to be set out for the full range of cutters for gears from a 12 tooth pinion to a rack.

The standard draws attention to the fact that gears cut with form-relieved cutters are satisfactory only if they are meshed together under conditions of service which are not severe.

B.S. 441: 1954—Rosin-cored solder wire 'activated' and 'non-activated' (non-corrosive). 3/-.

This is a revision of the standard published in 1932. Since then methods of activating the rosin-core of the solder have been developed, and the new edition specifies solder wire with a core or cores, incorporating the advantages of these methods. The scope of the standard has been widened by the inclusion of five grades of solder, for each of which information is given with regard to melting characteristics and typical uses. In addition tests have been included relating to the hardening of the flux residues, and to their freedom from corrosive action.

B.S. 2517: 1954—Definitions for use in mechanical engineering. 6/-.

This is the latest addition to the series of what may be termed basic engineering standards.

The definitions given relate to terms of general application in the engineering industry, and more particularly in mechanical engineering. The eight sections of the standard relate to construction, drawings and schedules, geometry of parts, size and tolerances, limits and fits, screw threads, surface texture and gauges, respectively. Numerous illustrations are included.

Canadian standards, Canadian standards association, National research building, Ottawa, Canada.

C.S.A. C22.2 No. 9—1954—Construction and test of electric fixtures. 3rd ed. $1.50.

Another in the series of Part Two of the Canadian electrical code, this specification applies to electrical fixtures intended for use in non-hazardous locations, both indoors and outdoors, and for connection to branch lighting circuits of not more than 600 volts between conductors and involving lamp voltages of not more than 7,500 volts, in accordance with the rules of Part I of this Code.

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It does not include outline lighting, fixtures of the explosion-proof types or flood lights.

C.S.A. C22.2 No. 56—1954—Construction and test of flexible metallic conduit, 2nd ed. 75 cents.

Also in the series of Part Two of the Canadian electrical code, this Specication is relevant to flexible metallic conduit designed for use as a metal raceway in the installation of wires, cables and flexible cords.

C.S.A. C22.4 No. 104—1954—Tolerable limits and special methods of measurements of radio interference from vehicles having internal combustion engines, 50 cents.

A section of Part Four of the Canadian electrical code, this Specification applies to radio noise from vehicles using internal combustion engines and which are meant for use on public highways.

Tolerable limits have been set which are intended to provide a practical degree of protection to radio reception of signals including sound, television, facsimile, relay operation, etc.

C.S.A. C22.4 No. 105—1954—Tolerable limits and special methods of measurement of radio interference from electrical appliances and equipment, $1.25.

An addition to Part Four of the Canadian electrical code, this specification embodies limits to radio interference from low-voltage electrical appliances and equipment. It covers domestic and commercial appliances and equipment operating on 300 volts and does not refer to heavy industrial equipment.

C.S.A. C22.2 No. 32-1954—Construction and test of electrically-operated refrigerating machines, 2nd ed. $1.00.

Another in the series of Part Two of the Canadian electrical code, this Specification applies to domestic refrigerating machines, of both compression and absorption types, for potentials up to and including 250 volts, and to commercial refrigerating equipment for potentials up to and including 600 volts between conductors, designed to be employed in accordance with the rules of Part I of this Code.

C.S.A. C22.2 No. 73-1953—Construction and test of electrically equipped machine tolls, 2nd ed. 75 cents.

Also in the series of Part Two of the Canadian electrical code, this Specification refers to machine tools, not portable by hand, (but which may have certain portable parts), having electrical equipment mounted thereon and designed to be installed and employed in accordance with the rules of Part I of the Code.

It does not apply to machine tools which produce hazardous atmospheres due to their operation; the mechanical features of machine tools, except as these affect the electrical equipment used in connection with such machines; woodworking machines; portable electric tools and welding or gas-cutting machines.

C.S.A. C22.2 No. 100-1953—Construction and test of weatherproof wires, types WP and NWP. $1.00.

One of the series of Approval Specifications of Part Two of the Canadian electrical code, this specification applies to single-conductor weatherproof wires.

The requirements of this Specification are minimum requirements only.

C.S.A. G24-1929 (re-affirmed 1948)—Sampling for check analysis of steel billets, bars and shapes. 50 cents.

This is the 1929 Specification as modified by several revisions issued in 1948.

C.S.A. 0118-1953 — Specification for western red cedar shingles and machine groved shakes. $1.00.

This applies to shingles and machine groved shakes manufactured from western red cedar. It covers length, width, thickness, grain, characteristics, colour, packing, and grading tolerances, and although not mandatory, it is hoped it will assist in securing uniformity.

C.S.A. 0122-1953 — Specification for glued-laminated timber construction. $1.50.

This specification applies to beams, truss chords, compression members, arches and other structural members manufactured by gluing laminations together, and its purpose is to permit the evaluation of laminating practice, the assessment of the strength of the materials used in laminating, and the quality of the bond in glued construction.

It covers the selection and grading of laminating stock, the glues or adhesives used, design, stresses and inspection. The appendices include methods for block-shear and vacuum pressure cycle tests.

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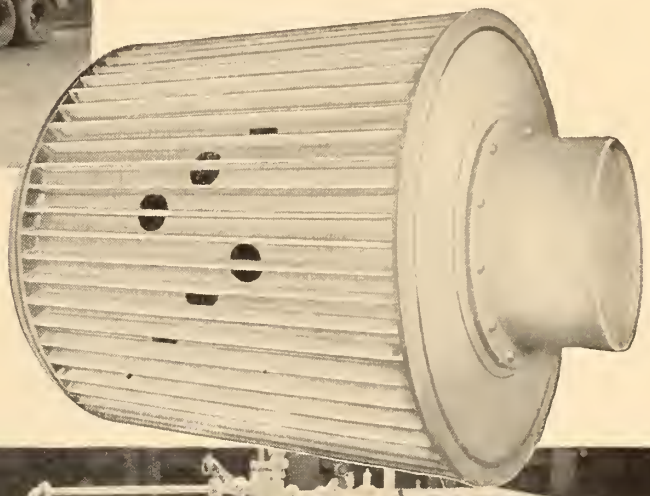

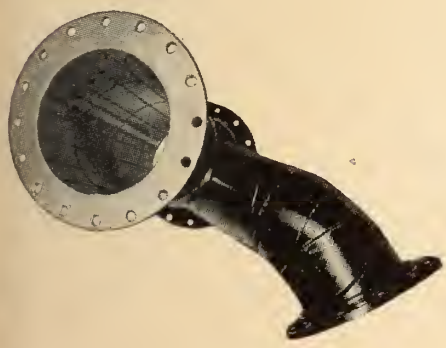

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A Digest of Information

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The Editor

Appointments and Transfers

Developments At Canada Iron Foundries.—Mr. T. F. Rahilly, chairman and president, Canada Iron Foundries, Limited, has announced that arrangements have been made with Walworth Co. Inc. to manufacture Walworth products at Canada Iron's Trois Rivieres plant. These consist principally of valves for application in such industries as petroleum, natural gas, chemical, marine, mining and pulp and paper fields. An initial stock order is already arranged, and production will commence immediately. Walworth valves will be marketed in Canada by Walworth Co. of Canada Ltd.

R. Lyle, vice-president, sales, Canada Iron Foundries, Limited, has announced the appointment of E. R. Snell as sales manager, Dominion Wheel & Foundries Division. Mr. Snell is a graduate in business administration of the University of Toronto, and has been in the sales department of the company for fifteen years. He is a councillor of the American Society for Metals, and has been with the sales department of the company for some years.

●

New Canadian Subsidiary.—George W. Behnke, president of Simplicity Engineering Company, Durand, Michigan, has announced a new Canadian subsidiary, Simplicity Materials Handling Limited, located at Guelph, Ontario.

General manager of the Canadian firm is E. L. A. Whitaker, former industrial commissioner for the City of Guelph. During his service Mr. Whitaker helped attract 46 new industries to Guelph, among these Simplicity Materials Handling Limited. His experience covers the banking, insurance and sales management fields. During World War II he spent two years at sea with the Royal Canadian Navy.

The new Canadian subsidiary sells, installs and services all Simplicity equipment and maintains a full stock of replacement parts. All parts not fabricated at Durand are bought from Canadian sources. Plant area is sufficient to handle manufacturing as future sales in Canada warrant it.

Simplicity Materials Handling Limited is staffed by Canadian personnel.

Simplicity equipment is not new to Canada, since it has been sold for many years by Canadian Bridge Engineering Company Limited.

It includes foundry shake-outs and sand conditioners, incline gyrating screens, horizontal screens, vibrating pan type conveyors and Simplicity Os-A-Veyor feeders. These items of materials handling and processing equipment are in wide use in Canadian foundries, mines, quarries and food processing plants.

●

New Director At Shawinigan Chemicals.—Hugh D. Ross, assistant vice-president of Shawinigan Chemicals Limited in Montreal, has been elected a director of the Company, it was announced by V. G. Bartram, president.

Mr. Ross, a graduate of Dalhousie University, joined Shawinigan Chemicals at Shawinigan Falls 26 years ago, and became successively superintendent of various divisions of the Company's plants until his appointment as an assistant vice-president in 1953.

●

Developments Within Foundation Company. — Dick Crudge graduated from Mount Allison University in 1946 with a B.Sc. and Nova Scotia Technical College in 1948 with a B.Eng.

He joined the Engineering staff of Foundation in 1948. In 1953 he was promoted to Assistant Division Engineer and attained the rank of Supervisor of Structural Design with FENCO.

In January, 1954, he was appointed Assistant to the Vice-President of FENCO in the Toronto office, which position he held until his appointment on December 1, 1954, as Vice-President of FENCO in charge of personnel in the Toronto office.

Emil Dinkla joined Foundation in 1942 at the Pictou Shipyards where he was shipyard superintendent until 1945. From 1946 to 1947 he was superintendent on the "Beaverhill" job.

He was superintendent on various projects from 1947 including Brown Corporation at La Tuque, Que., James Maclaren Co. Ltd., at Buckingham, Que., K. C. Irving at Pembroke, Ontario. He was at Pine Falls from 1950-1951.

In February, 1951, he was made superintendent at Sault Ste. Marie for the Algoma Steel Corporation Limited expansion project, and appointed project manager in October, 1951, until March, 1954.

He joined Special Projects in Montreal Office in October, 1954, as General Superintendent of Heavy Construction.

Norman Jackson was born in Yorkshire, England, and attended Goole Technical School and Leeds College of Technology.

He started in the construction industry in 1928 in England specializing in quantities and estimating. During the war years he was with Ordnance Factory and Airfield Construction.

Norman came to Canada in 1948 and joined Foundation in March, 1953, in Montreal with the Quebec District as an estimator. He was recently appointed District Estimator.

●

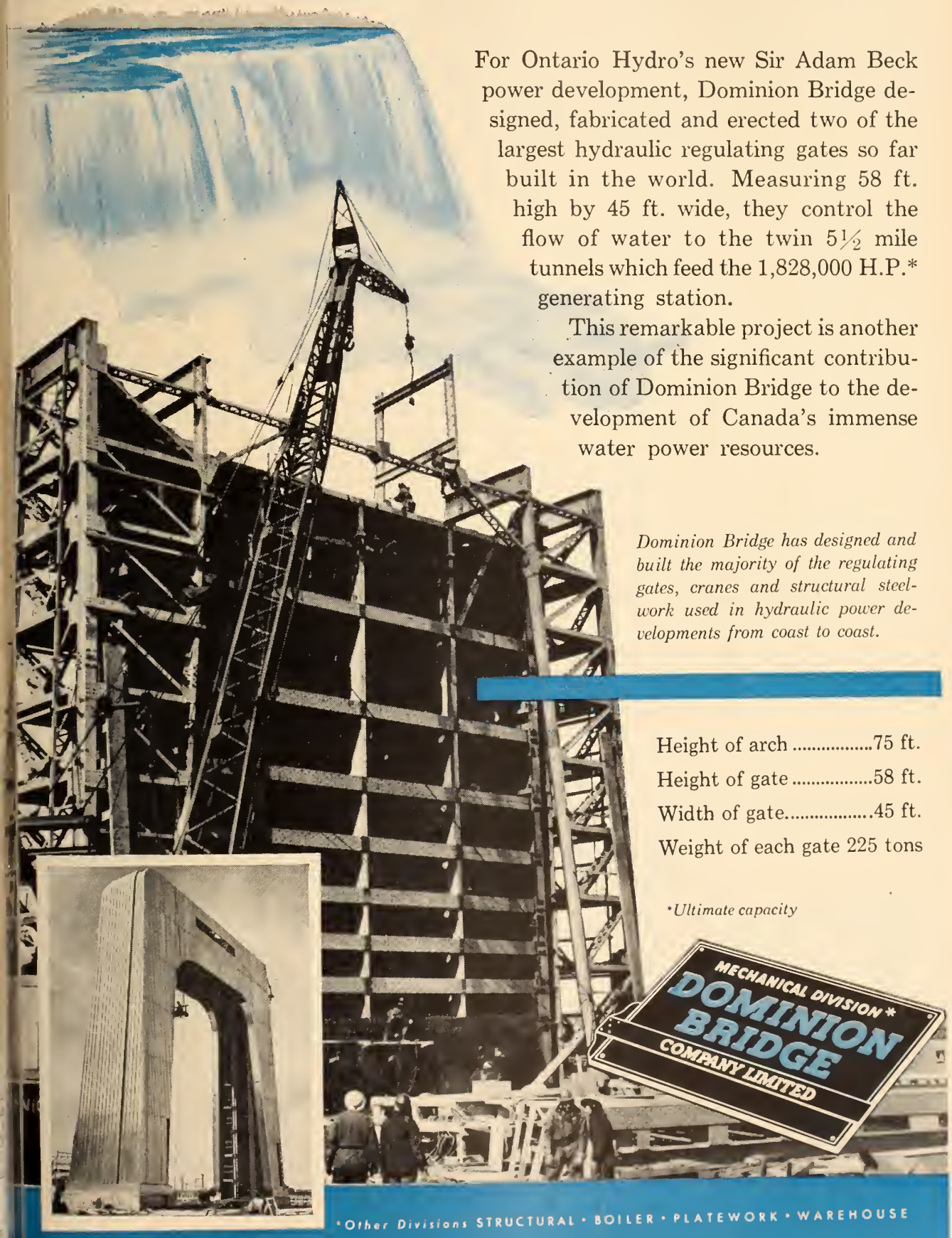
St. Maurice Chemicals Names Vice-president.—James H. Alexander, manager of the plant of St. Maurice Chemicals Limited at Varennes, Que., has been appointed a vice-president of that Company and, at the same time, assistant to the president of a subsidiary, The McArthur Chemical Co. Ltd., it was announced recently.

St. Maurice Chemicals was organized two years ago jointly by Shawinigan Chemicals Limited, of Montreal, and Heyden Chemical Corporation, of New York, and in turn bought control of McArthur Chemical and its subsidiary, Chemicals Limited. McArthur was founded 113 years ago.

President of St. Maurice Chemicals, and of Shawinigan Chemicals, is V. G. Bartram. Robert W. Berry is president of McArthur.

Mr. Alexander, born in Toronto, graduated from the University of Toronto in

Controlling 1,828,000 H.P.* at Niagara



For Ontario Hydro's new Sir Adam Beck power development, Dominion Bridge designed, fabricated and erected two of the largest hydraulic regulating gates so far built in the world. Measuring 58 ft. high by 45 ft. wide, they control the flow of water to the twin 5½ mile tunnels which feed the 1,828,000 H.P.* generating station.

This remarkable project is another example of the significant contribution of Dominion Bridge to the development of Canada's immense water power resources.

Dominion Bridge has designed and built the majority of the regulating gates, cranes and structural steelwork used in hydraulic power developments from coast to coast.

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chemical engineering in 1942. He joined the Royal Canadian Engineers immediately, and was posted overseas to the 6th Field Company, going into Normandy on D-Day as a lieutenant with the 3rd Canadian Division. A few months later at the Scheldt estuary, he won the Military Cross.

Returning to Canada for his discharge in 1946, he joined Shawinigan Chemicals Limited in the research laboratories at Shawinigan Falls, and two years later, on loan from Shawinigan to the National Research Council, was assigned to the atomic energy plant at Chalk River, Ont.

Mr. Alexander rejoined Shawinigan Chemicals in 1950 as a process supervisor in the operations department at Shawinigan Falls, then becoming a project engineer. Late in 1951 he was transferred to the Montreal office of the company to undertake liaison duties in co-ordinating plans for the establishment of St. Maurice Chemicals Limited. When the plant at Varennes was completed in 1953, Mr. Alexander was appointed manager.

He is a member of the Corporation of Professional Engineers of Quebec, the Chemical Institute of Canada, and the American Institute of Chemical Engineers.

●

B. F. Goodrich Appointment. — The appointment of Russel R. Tartaglia as Industrial Engineer was made known recently by M. G. Morgan, general manager-manufacturing, of B. F. Goodrich Canada Limited.

A chemistry graduate of McMaster University, Mr. Tartaglia has been with B. F. Goodrich since 1947.

Mr. Morgan commented, "Mr. Tartaglia's extensive production experience will prove a distinct asset in his new assignment."

●

Staff Changes By Canadian Marconi Company.—The appointment of Harry A. Rice as general manager of new facilities for the development and production of magnetrons, and various types of power tubes has been announced by Canadian Marconi Company.

Construction of a new factory in the Town of Mount Royal, Quebec, will commence immediately.

Mr. Rice first became associated with Canadian Marconi in estimating and commercial equipment sales work. In 1942 he was made Assistant Factory Services Manager and later was appointed Planning Superintendent. At the end of the war he was named Manager of the Company's Maritime Division which post he retained for two years. He was then moved to Toronto as Assistant Manager of the Ontario Division, becoming Manager in 1949. Four years ago he was appointed Manager of the Commercial Products Division, which manufactures electronic devices of all types for Canadian industry.

C. P. McNamara has become manager, commercial products division, it has just been announced by the Company. Mr. McNamara succeeds H. A. Rice.

During the War, Mr. McNamara served as an officer with the Royal Canadian Corps of Signals, and entered Canadian Marconi in 1951 on the engineering staff. The following year he was promoted to head the radio relay group engineering, and a short time later was named assistant to the manager of the commercial products division.

The commercial products division encompasses Marconi's research and development laboratories, electronic engineering and the manufacture of electronic devices for use by industry, police and fire departments, trucking fleets, hospitals, shipping, aviation, broadcast and television stations, as well as equipment for national defence and in many other fields.

●

New Company in the Oil Production Field. — Canada's largest all-Canadian oil company will enter the oil production field in western Canada this spring, W. Harold Rea, Canadian Oil Companies, Limited president has announced.

As the first step in its production program, Wallace M. Luthy, has joined the company to head up and organize a production department with headquarters at Calgary, Alberta. Mr. Luthy has been associated with crude oil production and supply for the past 20 years. He was previously crude oil supply manager of the Ashland Oil and Refining Company of Ashland, Kentucky.

Incorporated in 1908, and with more than 98 per cent of the shares Canadian-owned, Canadian Oil Companies, Limited has been primarily a marketing company. The company now markets its products through more than 3,000 outlets in all provinces except British Columbia and Newfoundland.

Two years ago the company built an ultra-modern refinery at Sarnia, Ontario, currently running 22,000 barrels a day. It is to be increased to 30,000 barrels a day by 1957.

In recent years the company also has built a chain of marine terminals on the Great Lakes and the St. Lawrence. Rounding out its modern transportation system, it has made a substantial investment in oil pipeline companies for delivery of crude oil directly to its Sarnia refinery and finished products to major marketing areas.

●

Minnesota Mining & Manufacturing of Canada.—The appointment of Gordon W. Swann as sales supervisor for the Irvington Varnish & Insulator Division of Minnesota Mining & Manufacturing of Canada Limited, London, was announced by Robert T. Todd, general sales manager, electrical products.

Mr. Swann joined the company as sales representative in September, 1946, and subsequently served in this capacity in all Irvington Varnish territories across Canada.

To his new position Mr. Swann brings a wide background of practical experience in electrical and related fields served by the Irvington Division.

Born in Hamilton, Ont., and educated at the Hamilton Technical Institute and the Teachers Training College Hamilton, he served with distinction in the R.C.A.F. during World War II.

He will tour Western Canada during the spring, paying special visits to offices in Winnipeg, Calgary, Edmonton, Vancouver and Victoria. Later Mr. Swann will cover the Eastern Provinces.

●

Du Pont Company of Canada.—R. F. Walker, technical manager at Maitland (Ont.) Works of Du Pont Company o

(*Continued on page 603*)

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*See U. S. Bureau of Reclamation's current Concrete Manual, Page 130.

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Fatigue Life of Steel I-Beams

At Normal and Sub-Zero Temperatures

by

J. Dubuc, Jr.E.I.C., *Associate Professor,*

Dr. T. A. Monti M.E.I.C., *Consultant,*

and

Dr. George Welter, *Professor of Applied Mechanics,*
Ecole Polytechnique, Montreal.

A paper presented at the 69th Annual General and Professional Meeting of the Engineering Institute of Canada at Toronto, Ont., May 11 to 13, 1955.

Brittle failures in welded joints and riveted structures, such as in Liberty ships during World War II, are still only partly understood. In 1952, the National Research Council and the Canadian Institute of Steel Construction sponsored a series of fatigue flexure tests on mild steels. Here the testing apparatus is described, and the behaviour of each type of beam under test is related. Finally results and conclusions from the tests are recorded.

It is well known to engineers that ductile mild steels give rise to some anxiety regarding their possible brittle failure at low temperatures, especially when used in a welded structure. In recent years, the increased use of welded joints in highly stressed parts of structures, such as ships, bridges, pressure vessels, has been associated with a number of sudden and unexplained brittle failures.

However, this behaviour does not seem to be a characteristic peculiar to welded structures, because these same brittle failures have also occurred in a number of riveted structures, including quite a few ships, as recorded in a "Critical Survey of Brittle Failure in Carbon Plate Steel Structures other than Ships" made by Professor M. E. Shank (Welding Research Council Bulletin Number 17, January 1954.)

The relatively recent failures, especially in the welded Liberty ships and tankers of World War II, have stimulated many extensive research programs, but, in spite of an enormous amount of study, this problem is still only partially understood.

In 1949, at which time many different approaches to the brittle failure problem had already been made without producing any conclusive evidence, it was thought possible that a study of the fatigue life of mild steels at sub-zero temperatures, as compared to a normal temperature of +70°F, might yield some useful information.

For this purpose it would be necessary to have a machine capable of applying, repeatedly, the high loads necessary for performing fatigue flexure tests on full size beams. In addition, this machine would have to be equipped with suitable refrigerating equipment for carrying out tests at sub-zero temperatures.

Early in 1950, application was made to the National Research Council at Ottawa, by Ecole Polytechnique of Montreal, for a grant to cover the cost of building such a machine. After the grant was authorized, the design and construction of the testing machine was undertaken.

The fabrication and assembly of the machine was carried out in the workshop of the Ecole Polytechnique under the direction of the authors. Then, in 1951, the Canadian Institute of Steel Construction agreed to sponsor a recommended program of fatigue tests on steel beams of various compositions. These tests, which were commenced in 1952 and completed in the Spring of 1954, form the subject matter of this paper.

Testing Program

The program of fatigue tests was drawn up jointly by the staff of the Strength of Materials Laboratory at Ecole Polytechnique, and a committee of the Canadian Institute of Steel Construction. The first part of the program was to compare the behaviour of equivalent rolled, riveted and welded I-beams under fatigue loadings. The second stage was a similar comparison of welded beams made of rimmed steel and killed steel. It was proposed to conduct the tests at two temperatures, namely room temperature of +70° Fahrenheit and a sub-zero temperature of −40° Fahrenheit.

The rolled beams chosen to suit the capacity of the testing machine were 10 in. WF, 21 lb. per foot, I-beams. The riveted and welded I-beams were made equivalent in depth and strength to these rolled beams. All beams were 14 feet long and tested on a span of 13 feet. (Fig. 1). The load was applied directly in line with the central stiffener plates, the end-supports being in line with the end stiffener plates.

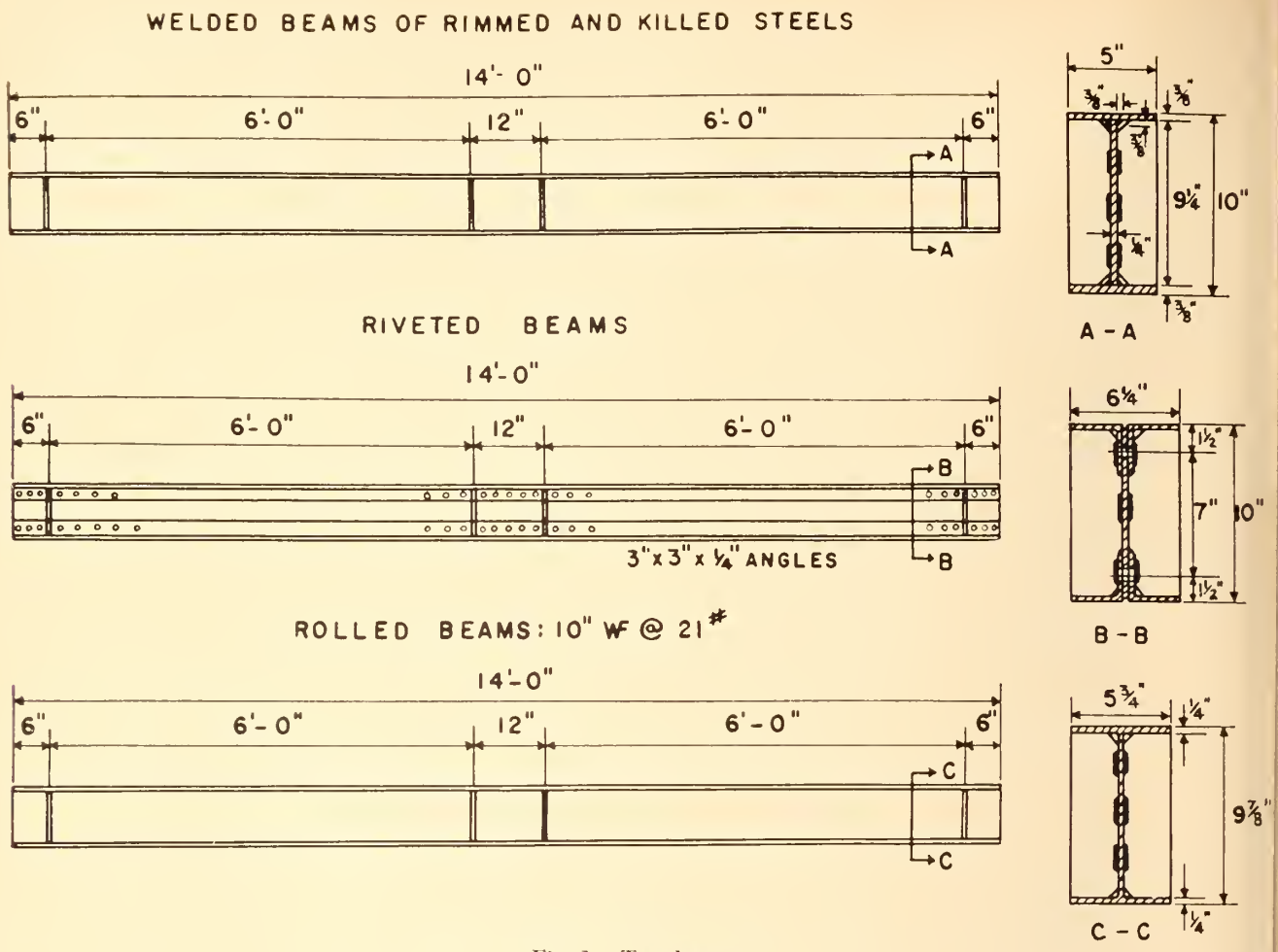


Fig. 1. Test beams.

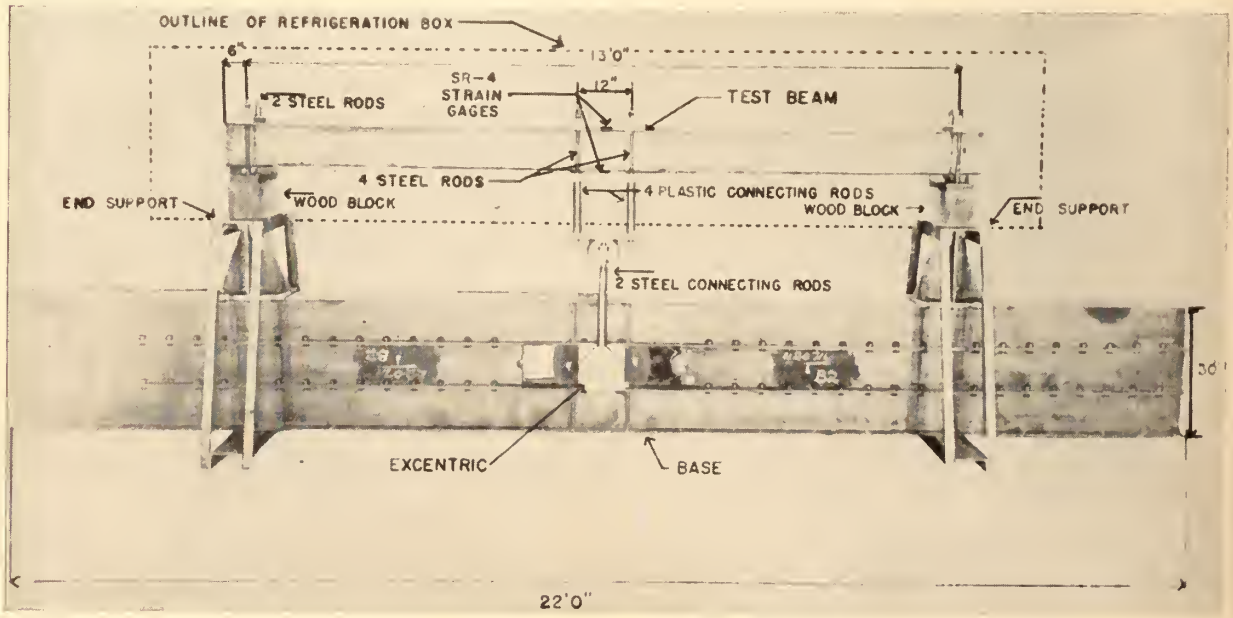


Fig. 2. Fatigue testing machine.

All of these stiffeners were welded to the web only and fitted closely to bear against the flanges.

Extreme care was taken to obtain rolled beams, as true to profile as was theoretically possible and, in the case of the welded beams, to maintain accurate dimensions. All welding was done by the same qualified operator, to ensure the greatest possible uniformity in the test specimens.

A preliminary static flexural test, preceding the fatigue test, was carried out on each beam to obtain a load-strain diagram and thereby check the characteristics of each beam. Strains were measured on top of the flanges by means of SR-4 electric strain gages. This static test was stopped after the first indication of yielding, which was possible since the strains were measurable to a precision of a few millionths of an inch per inch.

A preliminary program of fatigue tests under reversed bending was also carried out, to determine the intensity of flange stress which would cause failure in about two hundred thousand cycles. After this value was found, all subsequent tests were carried out at this stress level and the comparison of behaviour, under fatigue, of the different types of beams and of steels was made on the basis of fatigue life or number of cycles to failure.

Furthermore, it was decided to carry out Charpy impact tests on the keyhole type of specimen, at temperatures ranging from +70°F. to −70°F., in order to determine the transition temperatures of the rimmed and killed steels and their correlation if any, with the fatigue tests.

Testing Machine

The machine (Fig. 2), consists of a 22 foot long base made up of six 10-inch I-beams welded and bolted together. Above this base can be seen the beam to be tested. The beam is supported at its two ends on rollers, both top and bottom, while the load is applied at mid-span through a controlled deflection, produced by an eccentric, mounted in the middle of the base of the machine. The eccentricity can be varied infinitely from zero to a maximum of one inch.

A positive or negative deflection, or both alternatively, may be applied at will, producing tensile and compressive stresses which may or may not be reversing, as desired. The application of the load takes place about 165 times a minute through two steel and four plastic connecting rods; the latter being used because these rods extend through the insulated refrigeration box and the plastic thus minimizes heat losses during low temperature tests. The machine is powered by a 5 horsepower electric motor.

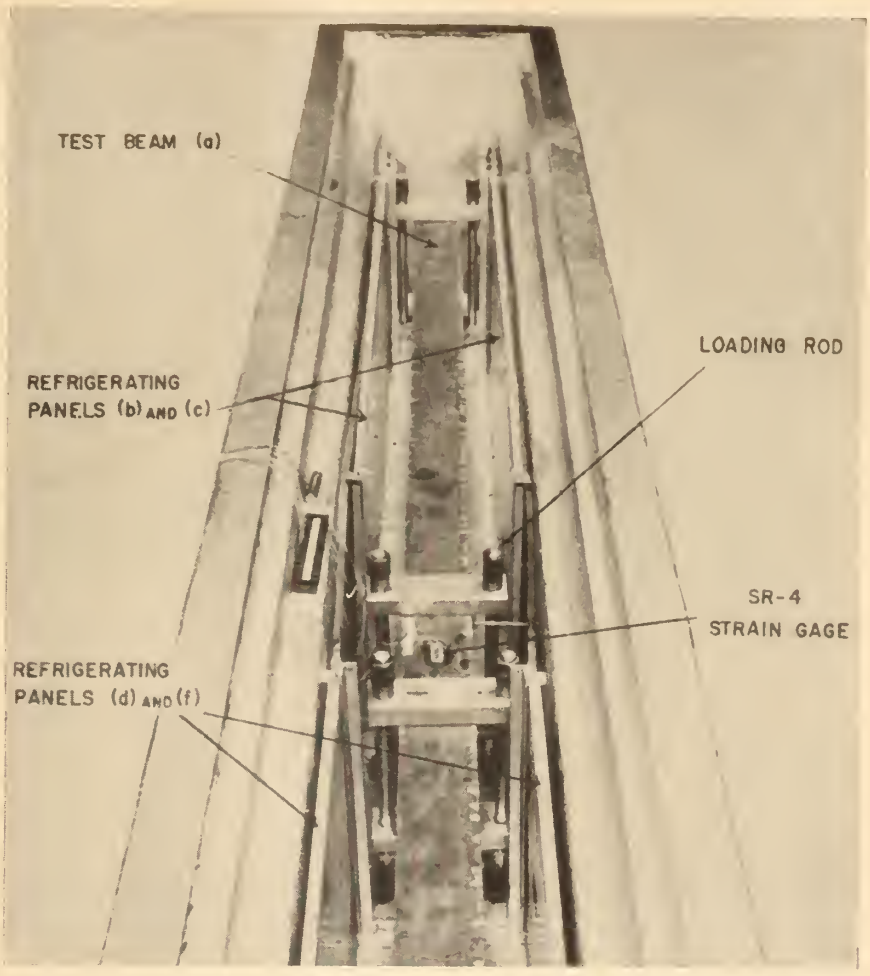


Fig. 3. Refrigerating box containing a test beam.

The central load on the beam is applied at two points, twelve inches apart, so that between these two sections, shear due to flexure is zero and the moment, with the corresponding tensile and compressive stresses, is constant. This arrangement facilitates observations and strain measurements which are all made at the exact mid-span.

Both ends of the tested beam are held fast through two steel rods connected to hardened steel rollers, and so designed as to eliminate all but vertical end-restraint. This system of end-supports is insulated from the supporting base of the machine by means of wooden blocks.

For low temperature tests a large refrigerating box, insulated by means of a six-inch thickness of cork all around, contains the tested beam, the insulated end-supports and the load-applying connecting rods. The dotted lines of Figure 2 show the outline of this box, relative to the testing machine. In Figure 3, this refrigerating box is seen from above when in place atop the testing machine. It is seen open and containing a beam (a) to be tested. On each side of the beam are seen the four refrigerating panels, (b), (c), (d) and (f) through which the coolant is circulated.

The four rods in the centre of the figure are the steel loading rods below which are the four plastic loading rods. Midway between these rods is visible a small black rectangle inside a small white one. This is one of the two SR-4 electric strain gages glued to each flange of the beam in order to measure precisely the strain and thus the stress applied to the beam.

A great advantage of this type of strain gage in that measurements of strains can be made easily when the cold box is closed to maintain low temperature, since it is only necessary to lead out a few small electric

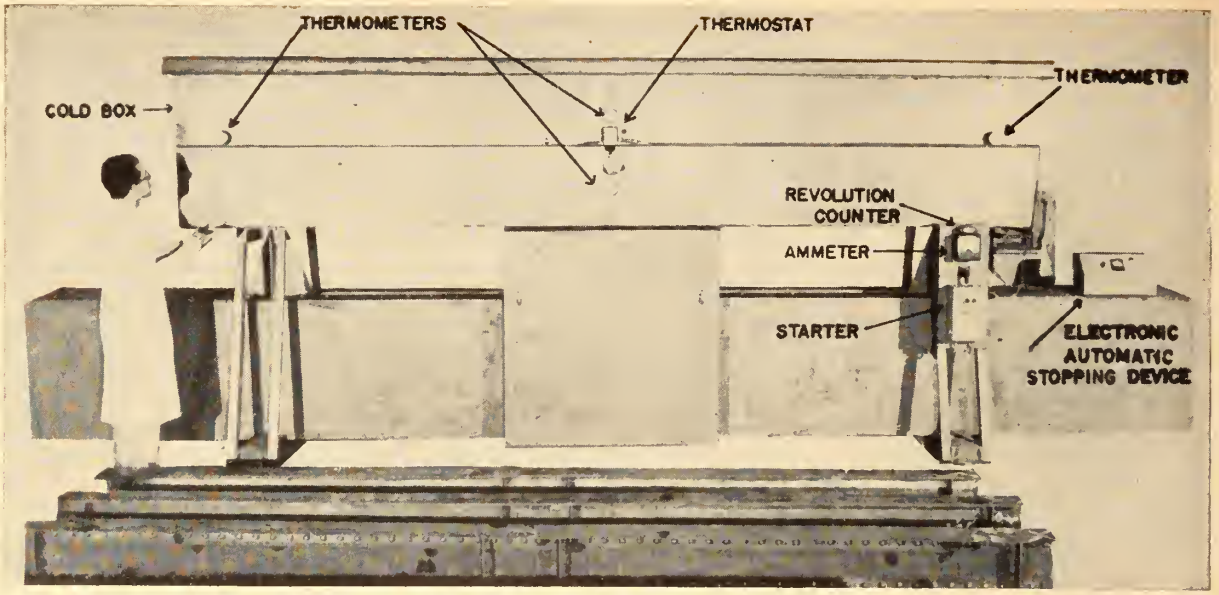


Fig. 4. Final appearance of testing machine.

wires. Thus the stresses applied to the refrigerated beams can be easily checked at any time during the fatigue test.

The refrigerating unit can reduce the temperature in this box to −47°F.; and can, through thermostatic control, maintain the specimen at any intermediate temperature desired. The unit requires only a 1 horsepower electric motor, this high efficiency being made possible through the use of a special cooling medium, Freon 22. The fatigue testing machine was completed by enclosing its base in a box of insulating fibre board, to dampen the otherwise objectionable noise from the gears.

The final appearance of the machine is shown in Fig. 4. The cold box is seen on top, the small square box in the middle is a low-temperature control thermostat and the four round dials are long-stem metallic thermometers. Below the cold box (near its right end) are seen the starter and the ammeter of the driving electric motor, while just above these instruments is the revo-

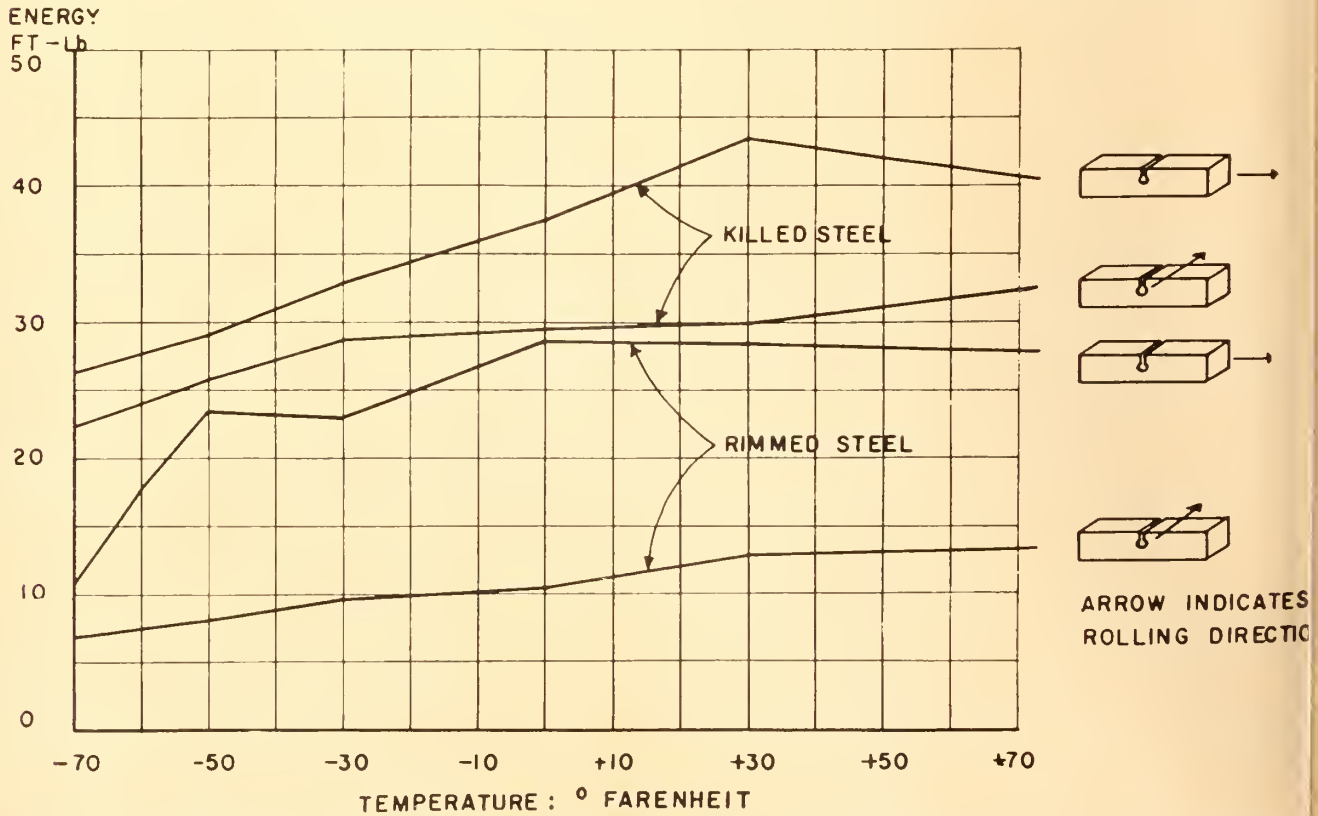


Fig. 5. Charpy keyhole impact tests of rimmed and killed steel, for the Canadian Institute of steel construction.

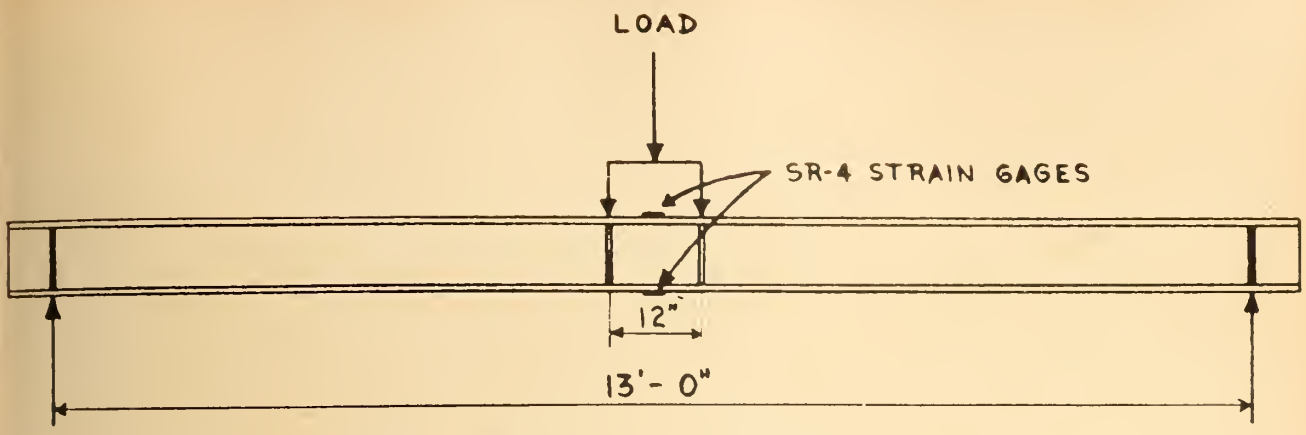


Fig. 6. Loading set-up for static flexure tests.

lution counter which records the loading cycles applied to the tested beam.

Still further to the right, and resting on the base of the machine, is a new type of electronic automatic stopping device specially developed for this work. Fatigue testing machines of all types necessitate some kind of automatic stopping system but the conventional stopping systems were not suitable in this case.

Preliminary tests showed that the fatigue failure of a beam, subjected to reversed bending, occurs by a sudden cracking of one of the flanges, followed by propagation of the crack through the web at a relatively slow rate with each cycle. However, as the beam does not break instantly into two separate parts, the fall of one part cannot be made use of to cut off the driving electric motor. Furthermore, in this machine the deflection of the beam does not vary after fatigue failure of a flange occurs, since the machine continues to apply a given deflection, dependent only on the setting of the eccentric.

It was therefore decided that the principle of operation of the new automatic stopping device should be based on the fact that the load necessary to deflect a beam by a given amount decreases immediately when partial failure of the beam occurs, and likewise the load on the connecting rods. In this testing machine any decrease in applied load is detected instantaneously by SR-4 electric strain gages, which are mounted on the connecting rods.

In conjunction with suitable electronic circuits, any decrease of current actuates a relay, placed in the starter circuit of the driving electric motor, and promptly stops the machine at the instant of initial failure of the specimen. At the same time, of course, the revolution counter stops indicating the exact number of cycles applied to the beam up to the moment of failure, even though failure has occurred at only a part of the beam's cross-section. This apparatus was designed and built in the Electronics Laboratory of the Ecole Polytechnique, and has functioned satisfactorily.

Results

Charpy Impact Tests

Impact tests were made on Charpy keyhole specimens cut from the same plates of rimmed and killed steel, from which the welded beams were constructed. These specimens were taken both parallel to and transverse to the direction of rolling and were tested at various temperatures between +73°F and −70°F, to determine the transition temperature of these two steels.

Three specimens of each type were tested at seven different temperatures. Fig. 5 shows the variation of absorbed energy at fracture in relation to decreasing temperature for both the rimmed and the killed steel, tested either parallel or transverse to the rolling direction.

The most striking fact about these impact tests is that they brought out an important difference of behaviour under dynamic stresses between the rimmed and killed steel. The killed steel showed a capacity

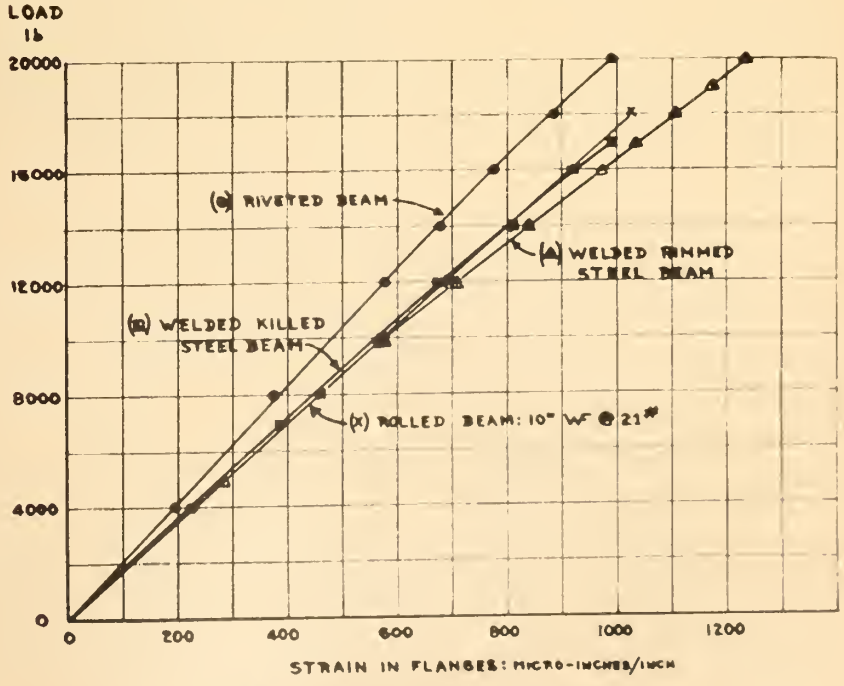


Fig. 7. Static load-strain diagrams.

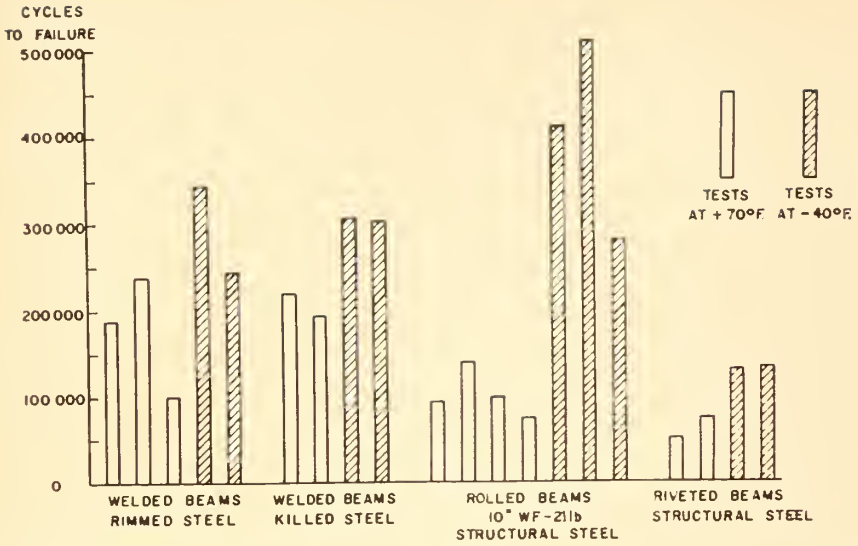


Fig. 8. Comparative fatigue life of various types of equivalent I-beams at push-pull cyclic stresses of ±26,000 p.s.i. in flanges for the Canadian Institute of steel construction.

at the higher temperature to absorb energy, which was roughly 50 per cent greater than the rimmed steel.

This result is of interest when compared to the static ultimate strengths and elongations of both steels, which in this respect had about the same values. These were respectively about 58,000 p.s.i. and 28.5 per cent for killed steel, and 60,500 p.s.i. and 28.0 per cent for rimmed steel. This illustrates the considerable difference that can exist between the static and dynamic properties of metals, and still not be indicated by conventionally specified test procedures. These Charpy impact tests emphasize the differences between killed and rimmed steels when subjected to shock, which static tests fail to do.

Another result of interest is the much lower energy absorption when the stresses were transverse instead of parallel to the rolling direction. For the rimmed steel, the transverse energy absorption was only about 40 to 50 per cent of that in the parallel direction, while for the killed steel it varied between about 70 to 85 per cent.

The rimmed steel exhibited a very low but definite transition temperature at −50° Fahrenheit, and then only for the specimens in which the stresses were parallel to the rolling direction. The transverse specimens of rimmed steel and both types of specimens of killed steel showed a rather gradual decrease in absorbed energy, beginning generally around +30° Fahrenheit.

It will be recalled that the testing program required fatigue tests to be carried out at −40°F, and from these Charpy impact tests it is seen that this sub-zero temperature is still above the transition temperatures of these rimmed and killed steels.

It should be noted that all Charpy impact tests were made on relatively thin plate material, i.e., ⅜ in. thick. It is probable that similar tests on specimens cut from plates of 1 in. thickness, or more, would have shown a greater disparity in energy absorption, as between rimmed and killed steel.

Static Flexure Tests

As a preliminary to the fatigue tests, every beam was statically tested under flexure to obtain a load-strain diagram designed to check the behaviour of each beam. The load was applied directly in line with the central stiffener plates, the end-supports being in line with the end stiffener plates. (Fig. 6).

For the first few beams tested, the strains were measured by means of SR-4 electric strain gages located on top of and in the center of each flange, and also at the intersection of the web and flanges. It was observed that the strains, hence the stresses, produced by the load at

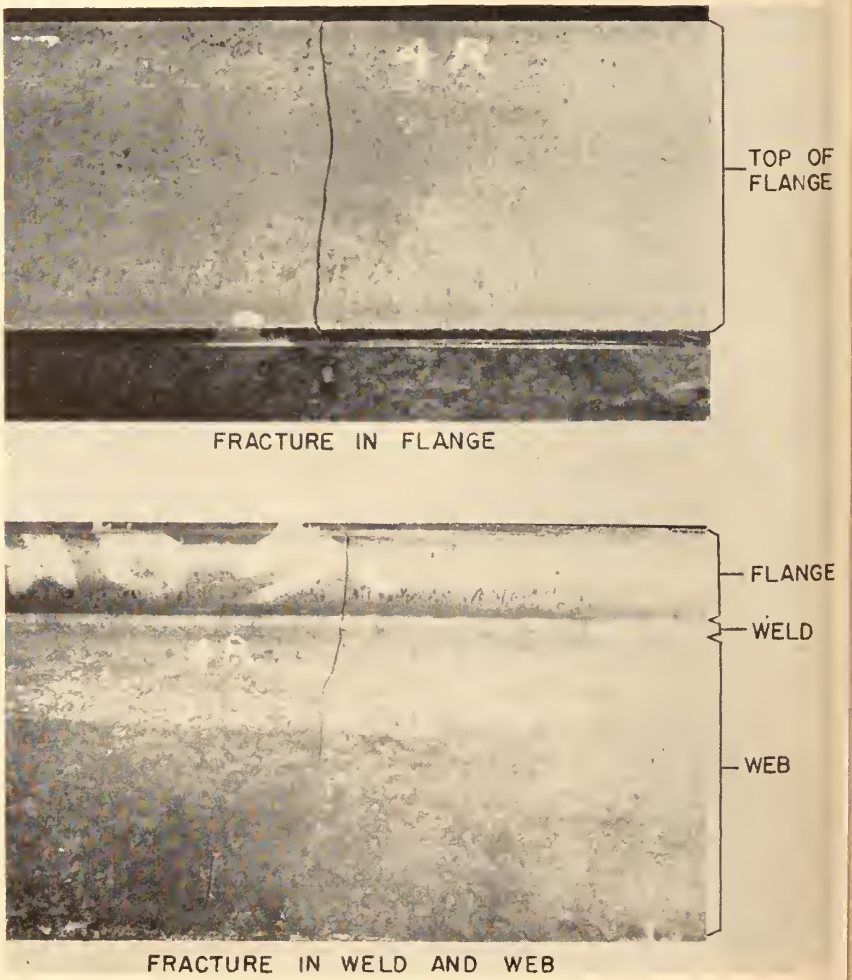


Fig. 9. Fatigue fracture of welded rimmed steel beam.

FRACTURE IN FLANGE

FRACTURE IN WELD AND WEB

Fig. 10. (above) Fatigue fracture of welded killed steel beam.

this intersection of flange and web, were lower than those on the extreme fibres of the flanges. From this it followed that no stress concentration existed, either in the rolled or in the welded beams, even though residual stresses were probably present in the rolled beams and certainly in the welded beams, at this location. Consequently, for all the other beams tested thereafter, it was considered sufficient to measure strains on top of the flanges only.

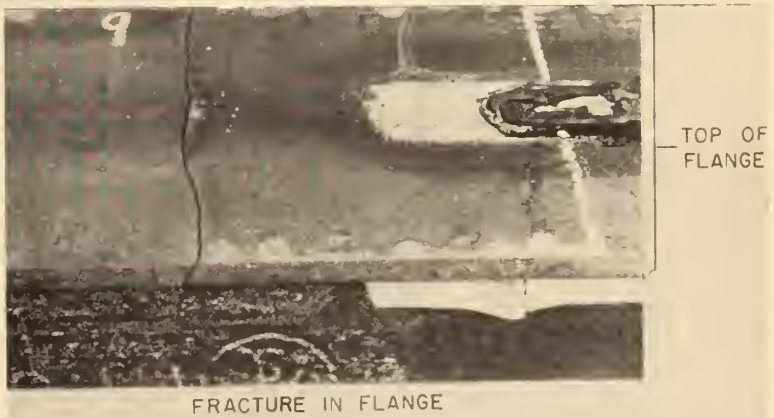
In the static flexure tests, the loading was increased gradually until very slight yielding occurred, the strains being measured to a precision of a few millionths of an inch per inch. Care was taken to ensure that the beams would not be damaged in any way, previous to the fatigue test.

Figure 7 shows a set of typical load-strain diagrams for each type of beam; one rolled, one riveted, one welded of rimmed steel and one welded of killed steel. A general examination of these diagrams shows that the elastic behaviour of these beams lasted up to an applied static load of about 18,000 lb.

Another interesting observation is that the riveted beams, which were supposedly equivalent to the welded and rolled I-beams, were in fact about 13 per cent stronger statically. This is shown by a comparison, at a load of say 8,000 lb., of the strains on the flanges which measured about 450 micro-inches per inch in the welded and rolled sections, and only about 390 in the riveted section. This observation is all the more significant in view of the fact that the riveted beams, nevertheless, proved to be weakest under fatigue loading.

As described later, all fatigue tests were carried out with a maximum cyclic stress of ±26,000 p.s.i., corresponding to a strain variation in the extreme fibre of about 870 micro-inches per inch. The foregoing diagrams also indicate that a maximum cyclic load of 15,000 lbs. was necessary to induce these stresses in the welded and rolled beams and about 17,500 lbs. for the riveted

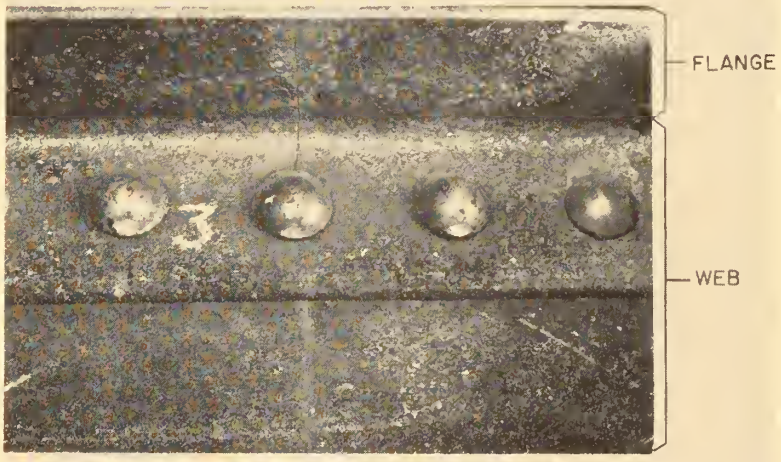
Fig. 11. (below) Fatigue fracture of rolled structural steel beam.



FRACTURE IN FLANGE

FRACTURE IN FLANGE AND WEB

FRACTURE IN FLANGE



FRACTURE IN FLANGE AND WEB
PASSING THROUGH RIVET HOLE

Fig. 12. Fatigue fracture of riveted structural steel beam.

beams. It will be remembered that the fatigue testing machine applies these loads twice in a cycle, and at a rate of 165 cycles per minute.

Fatigue Flexure Tests

The first few fatigue tests, both at +70°F and at −40°F, were carried out at various stress levels, to obtain basic information as to the fatigue life of these particular beams. Based on these preliminary results, a reversed cyclic stress on the flanges of ±26,000 p.s.i. was chosen as that which would produce fatigue failure after a few hundred thousand cycles.

All subsequent tests were then carried out at this stress level and the comparison of behaviour under fatigue of the different types of beams, at both temperatures of +70°F and −40°F, were made on the basis of fatigue life or number of cycles to failure. Failure was considered to have occurred when one flange cracked, ever so slightly, at which moment the resistance of the beam instantly decreased very appreciably.

In Figure 8, each tested beam is represented by a column, the height of which is proportional to the number of cycles to failure. The white columns are for beams tested at +70°F while the hatched columns are for beams tested at −40°F.

Conclusions

The first and most important observation is that the fatigue life of all beams tested, without exception, was greater at −40° Fahrenheit than at +70° Fahrenheit, the increase in life being the most striking in the case of the rolled beams which attained, on the average, a value of about 4 times the life, or number of cycles, of the same type of beam tested at room temperature. As a tentative explanation of this result it should be noted that the yield point of some steels increases as the temperature is lowered.

Therefore, it seems possible that the fatigue limit of these steels also increases as the temperature falls. This observation does not contradict the fact that, at the same time, energy absorption under impact is decreased, precisely because the more elastic behaviour is unfavorable to energy absorption. It is also seen in Fig. 8 that the average fatigue life of the rimmed and killed steels tested at both temperatures are not much different, although the killed steel shows somewhat more consistent results.

The welded beams, of both rimmed and killed steels, are seen to have, at +70°F, a much better fatigue life than the rolled beams but, although their life is increased at −40°F, it does not increase as much as that of the rolled beams. Nevertheless, it is seen that welded beams stand up exceedingly well under these conditions of low temperature.

Another notable result is that the riveted beams, either at +70°F or −40°F, have a much shorter life than the rolled or welded beams. This result is probably due to the well-known existence of high stress concentrations at the rivet holes, through which fractures in the test beams invariably passed.

It is also interesting to note that the fractures, at temperatures of both +70°F and −40°F, were of the same type for all beams. A typical fracture is shown for each type of beam in Figs. 9, 10, 11 and 12. These fractures had the following common characteristics. They all propagated at an angle of 45° to the planes of the web and flange plates, except in the immediate vicinity of the joint between flange and web, where the fractures were at 90° to these planes. In the riveted beams, this last type of fracture occurred in the corners of the angles.

Only occasional departures from this crack pattern occurred, and then in only one part of the fracture, so that the predominant behaviour can be considered as normal. A consequence of this observation is that in a welded beam the welded joint between web and flanges does not behave any differently than the same joint in a rolled beam, or than the corners of the angles in a riveted beam which are in a corresponding location. Consequently, this fracture at 90° seems to depend chiefly on the geometry of the I-beam itself and not on the presence of a weld or built up section of plate and angles.

Summary

If the Charpy Keyhole impact tests are acknowledged as a method for the determination of the transition temperature of metals, the foregoing tests on the fatigue resistance of welded beams, made of

(Continued on page 626)

Inclined Hangers as Bridge Stiffeners

by

E. M. Rensaa, M.E.I.C.,

Rensaa & Minsos,
Engineers & Architects,
Edmonton, Alta.

The Tacoma bridge failure spurred engineers to investigate the stability of suspension bridges and it also brought to light of day a considerable amount of work that had already been done in this and allied fields.

Most of this paper is devoted to a study of the analysis of the designs of arches with inclined hangers. Though infrequently seen on this continent, several such bridges have been built in Europe; they are cheap and unbelievably light and airy in appearance. By analogy it is argued that inclined hangers might be useful in the design of suspension bridges, but the author thinks that haste should be made slowly in this field, notwithstanding that one such bridge has recently been built in El Salvador.

The failure of the first Tacoma suspension bridge brought new interest to the old problem of designing such structures so that they would be safe for wind loading. The lessons learned by the failures of early suspension bridges had been more or less forgotten. It was still recognized that a suspension bridge had to be made safe against horizontal wind loading, but it was also believed that wind loading would not require much vertical strength beyond that required by traffic loads. For a long span suspension bridge, the cables are so heavy that traffic loads become a smaller proportion of total weight than for short spans. This condition appears to allow relatively more flexible stiffening girders for long spans than for shorter ones. The trend towards more flexible stiffening girders, combined with insufficient understanding of the dynamics of wind loading, at last brought on the Tacoma disaster. Since then much investigation of the action and effect of wind loading has been carried out and the results have been published (1). While the problem may not be fully solved, it appears that the general principles are now understood. This has enabled engineers to work out methods for strengthening old unstable bridges and to make safe designs for new structures.

It has been proposed to use diagonal hangers instead of the ordinary vertical ones to obtain vertical rigidity in suspension bridges. By creating a truss effect, the need for a rigid stiffening girder should to some extent be eliminated. Articles advocating the use of diagonal hangers have been published (2), (3). A five span suspension bridge, the San Marcos bridge, with a very extensive diagonal hanger system placed crosswise has recently been constructed in El Salvador, Central America (4).

The use of web members effective only in tension, but not in compression, was common in earlier days, but has been largely abandoned in modern bridge structures. Many engineers will remember the old pin-connected trusses with non-rigid tension diagonals tightened with turnbuckles. Near the center of span they were placed crosswise to take care of changed shear. Some diagonals would go out of action and might rattle loudly under heavy traffic, the vibration sometimes causing wear at the connecting points. It does not seem likely that the use of diagonals which will go out of action under ordinary live load conditions, including wind loading, would be acceptable now, even for a suspension bridge. The question is then, "Is it possible to design a hanger system in which every hanger will always carry some tension and not go out of action ?" This problem has been fully solved for through concrete arch bridges, but probably not completely for the more flexible suspension bridge. A considerable number of through concrete arch bridges with diagonal hangers have been built during the last 25 years by the Danish firm of Christiani & Nielsen, particularly in Sweden and in France. These bridges have proved to be rigid and are generally cheaper than arch bridges with vertical hangers.

The feasibility of using diagonal hangers for suspension bridges has been investigated to some extent both in America and in Europe. The old Brooklyn Bridge had an extensive system of cable stays in addition to an ordinary stiffening truss. The same is the case with the proposed Messina Strait Bridge in Italy. The Florianapolis Bridge has a stiffening truss system where the

cable forms the upper chord. The two bridges last mentioned have been designed by D. B. Steinman, M.E.I.C. Another and very interesting proposal was made by the late German engineer, Dr. Dischinger (5). He proposed a combination of suspension bridge and cantilever bridge and used the Quebec Bridge as an example of how such a structure would appear. The cable would carry all dead load, but only 10 to 20 per cent of the traffic loads. Most of the traffic load would be carried by the truss. The upper chord of this truss would follow the cable and be suspended from it, either for its complete length or past the quarter points. The system would be rigid and apparently cheap. The nearly constant cable tension and the decreased requirement of anchorage for the lightened cable load would evidently be of great advantage and allow a considerable saving in cost. It would appear, however, that web members, apart from stays, must be rigid in the systems proposed both by Dr. Steinman and by Dr. Dischinger. These members cannot therefore be classified as ordinary hangers. Stays cannot be said to create a true truss effect, but should be considered as guys or as intermediate supports, as the case may be.

A comprehensive study of the theory of structural systems containing members which might go out of action under certain load conditions was published in 1930 by the Danish engineer, Dr. O. F. Nielsen (6). Based on this work, the writer, in 1936, made a study of the theory of inclined hangers for a concrete bowstring arch bridge (7). Many of the theoretical conclusions reached would also apply to a suspension bridge, because this may be considered in many respects as an inverted arch. Some of the more important parts of the theory and of the considerations relative to the use of inclined hanger systems will now be discussed.

Some writers have stated that inclined hangers, together with the

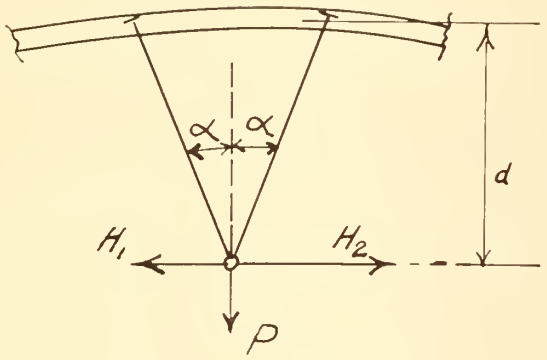


Fig. 1

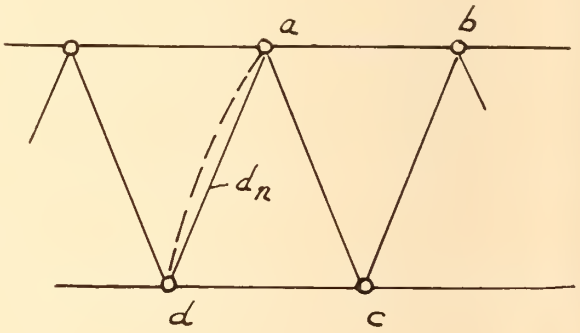


Fig. 2

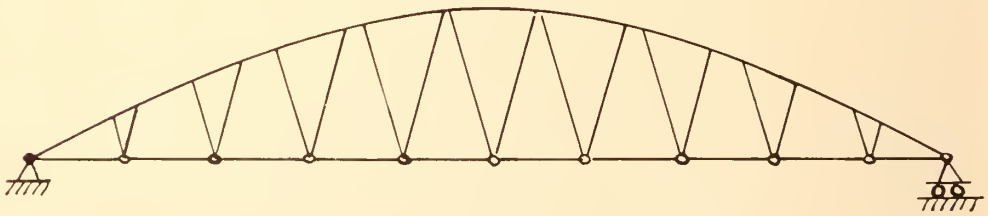


Fig. 3

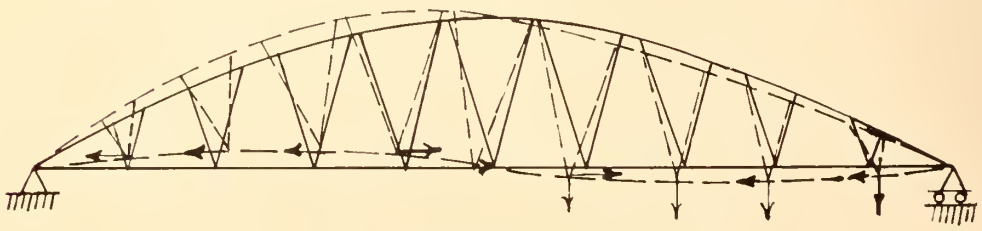


Fig. 4

arch (cable) and the suspended roadway, will make a truss. This may not be correct. One of a pair of web members meeting at a chord point in the interior of a truss is generally in tension and the other is in compression. With nonrigid hangers, there can be no compression in any of these members, as one will go out of action as soon as its initial tension, if any, is overcome. In a truss with a web system containing compression members, pretension may be induced in a diagonal, by the use of a turnbuckle, for instance. The adjacent compression member would then be precompressed to balance the pretension. Where there are no compression web members, it is clear that pretension can, in general, be created only by the weight of the roadway. Without such pretension, diagonal nonrigid hangers would evidently be useless as stiffening members.

The tension in a hanger depends both on the load it has to carry and on its angle with the vertical. As will be shown, it is the horizontal component of stress in a hanger which is of value for stabilizing the bridge. There is an upper limit to the horizontal differential component of load such a hanger pair, Fig. 1, may take, before one of the hangers will go out of action. This limit is:

$$T\max = H_2 - H_1 = P.\tan\alpha, \quad . \quad . \quad . \quad 1.$$

Below this limit the structure may be considered to act nearly as a truss.

The moment from the hanger pair will then be:

$$Ma = T.d = P.\tan\alpha\ .d \quad . \quad . \quad . \quad . \quad . \quad . \quad 2$$

Even if one of the hangers goes out of action, this moment is not lost, but it cannot exceed the limiting value. This is an important fact; inclined hangers are not completely useless, even if one or more go out of action.

If, in a pin-connected structure, a tension diagonal such as d_n goes out of action, the surrounding frame *a-b-c-d*, Fig. 2, becomes statically indeterminate. A truss or arch would, under such circumstances, be unstable and subject to collapse. A suspension bridge would not, but the structure might deform to an uncomfortable extent. When returning to its original position, the diagonal might come back suddenly. What that might cause was convincingly illustrated in the case of the centre guys on the Tacoma Bridge (p. 31, Part I, Bulletin 116 (1).) If one of the cords (arch or stiffening girder) were sufficiently rigid, such a member could supply the needed stability to the system, but this rigidity might not completely prevent shock from diagonals coming back into action. For the above reasons the writer thinks that a bridge should not be built where hangers will go out of action, except under the most unusual circumstances and where this condition would not be likely to cause much damage.

Let us consider a tied arch bridge as shown in Fig. 3. It is assumed that the tie is hinged at its points of intersection with the hangers and at its junction with the arch. This system is ten times statically indeterminate, provided all hangers are in action and have different stresses. Should one or more diagonals go out of action, there will be a corresponding decrease in the number of statically indeterminate redundant members. It is thus seen that such a system, even though stable, is subject to what may be called "changeability"; stresses calculated under the assumption that all members are active, may be considerably in error.

A new analysis omitting the diagonals which were found to be out of action, could then be made. The new calculation might show, however, that some of the omitted diagonals were now back in action and that other diagonals, which earlier were found to be active, were now out of action. An exact analysis involving a large number of redundants might then seem to be nearly impossible. A usable method of analysing such changeable structures has, however, been worked out (6). Since the author does not favor the use of a structure where a member will go out of action, the problem of such an analysis will not be discussed further.

If it be found by the first analysis that a hanger is out of action, it will then be necessary to redesign the structure in order to obtain an unchangeable system. This may be accomplished in several ways. The weight of roadway may be increased to create a greater initial hanger tension, too costly a method. A cheaper method might be to increase the angles of the hangers with the vertical, or, as an alternative, the arch rib could be stiffened.

Figure 4 will illustrate how the bridge is stiffened by means of the inclined hanger system. If it be assumed that the lower hanger joints are permitted to slide along the tie, the arch might deflect as indicated. Since such a sliding movement is not permitted, there will be created horizontal forces which will hold the arch rib nearly in its original position. In such a case the condition is about the same as with a truss. It has been found, however, that the system will be more unchangeable if the hangers do not intersect at the same point on the arch rib, but are spread apart about as indicated. If the rise of arch above the roadway is great, as may be the case with a long span bridge, it may be difficult to get a sufficient slope of the hangers without letting them cross each other. With crossing hangers, the structural analysis becomes more complicated and the appearance is not so pleasing. However, arch bridges of this type of as much as 470 ft. span have been constructed without crossing the diagonal hangers (8).

Tension will not be uniform throughout the length of the tie in a bowstring arch with inclined hangers, but the difference will not be great enough to affect the design of the tie materially.

In the analysis of such an arch as shown in Fig. 5 it will be most convenient to assume the principal system as being a curved beam held horizontally at one end and free to slide at the other. The bridge is statically determinate externally, but will contain ten internally redundant stresses. There are several choices as to what members to consider as redundants. One of the tie stresses and one hanger of each pair may be chosen as such. Another choice is one tie stress and the horizontal component of the reaction between each hanger pair and the tie. This has the advantage of giving explicit values for these reactions and of showing at once if they are within the allowable limits.

It is also possible to choose a different system of redundants by cutting the tie as shown in Fig. 5 by assuming the stresses in the cut ends as the redundants. The difference between the horizontal stresses in the tie on each side of a joint will then correspond to the horizontal reaction of the hanger pair. It will be seen from the bending moment diagrams for $X_a = -1$, etc., that the influence of such a unit force will extend over a comparatively short length of the residual beam, and that consequently the coefficients for all panels except the ones on each side of the point in question will be zero. The residual system of elastic equations will then be similar to those for a continuous beam. There will be two unknowns in the first and the last equations and three unknowns in the others. Such a system of equations is easily solved either analytically or graphically. That

part of the system of equations depending on structural dimensions is constant regardless of loading and may be solved once and for all, so that only the variable load terms need to be adjusted. This redundant system has the disadvantage of requiring accuracy in the numerical solution of equations, because the differential horizontal reaction of hangers is obtained by subtracting two comparatively large tie reactions. Should the calculation show that the differential reaction of a hanger pair is greater than the limiting value established by Equation 1, that will indicate that one hanger is out of action and that the structure will have to be redesigned.

The elastic equations for this choice of a redundant system will be:—

$$\delta a = 0 = \delta a^\circ - Xa.\delta aa - Xb.\delta ab$$

$$\delta b = 0 = \delta b^\circ - Xa.\delta ba - Xb.\delta bb - Xc.\delta bc$$

$$\delta c = 0 - Xb.\delta cd \qquad - Xc.\delta cc - Xd.\delta cd$$

— — — — —

$$\delta i = 0 = \delta i^\circ - Xb.\delta ih - Xi.\delta ii - Xj.\delta ij$$

$$\delta j = 0 = \delta j^\circ - Xi.\delta ji - Xj.\delta jj$$

Where

δa°, δb°, etc., are displacements of cut ends at points a, b, etc., in the principal system, due to dead and live loading acting on the curved beam.

δaa, δbb, etc., are displacements of cut ends at points a, b, etc., in the principal system, due to $X_a = -1$, $X_b = -1$, etc.

δab, δac, etc., are displacements of point a in the principal system at point a for a unit load $X_b = -1$, $X_c = -1$, etc.

It follows from Maxwell's law of reciprocal deflection that

$$\delta ab = \delta ba, \quad \text{etc.}$$

In the bending moment diagrams for unit loads, Fig. 5, it is seen that they overlap partially. The first of these diagrams from the left will represent the contribution from moment to δaa; the second, to δbb, etc.; while the first overlap or double shaded portion will represent δab and δba; the second, δbc and δcb, etc. No redundant outside the limits of the moment diagram for a certain displacement will, therefore, make any contribution to that displacement. Should the hangers cross each other there will evidently be more overlapping of unit moment diagrams, which again would indicate that each equation would contain two more unknowns than will be the case for the system shown in Fig. 5.

It is, of course, necessary to calculate the numerical values of the coefficients of the unknowns, as well as the load terms, before the above equations can be solved. This calculation involves rather more work than the actual solution of the equations. The following are the general equations for these coefficients and load terms applicable to Point a.

$$\delta a^\circ = \Sigma So.Sa \frac{La}{EA} + \int \frac{No.Na}{EA}\, ds + \int \frac{Mo\ Ma}{EI}\, ds$$

$$\delta aa = \Sigma Sa^2 \frac{La}{EA} + \int \frac{Na^2}{EA}\, ds + \int \frac{Ma^2}{EI}\, ds$$

$$\delta ab = \delta ba = \Sigma Sa.Sb \frac{La}{EA} + \int \frac{Na\,Nb}{EA}\, ds + \int \frac{Ma\ Mb}{EI}\, ds$$

So = direct stress in tie or diagonal due to external loading of the principal system.

La = length of member.

No = direct stress in arch rib due to external loading of the principal system.

Mo = bending moment in arch rib due to external loading of principal system.

Sa, Na, Ma = analogical stresses and bending moment in principal system for $X_a = -1$.

The correct modulus of elasticity E must, of course, be used, according to the material to be used in construction.

There will be no temperature stresses in this external statically determinate system, except for uneven temperature changes. These are certain to occur in a structure with unprotected steel hangers, but the calculation of stresses from this effect as well as from the shrinkage and plastic deformation of concrete does not constitute any special problem.

For the ordinary two and three hinged arches the maximum bending moments due to moving uniform load will be approximately $w\frac{L^2}{50}$ to $w\frac{L^2}{60}$. For arches with inclined hangers, maximum bending moments will be only from one-sixth to one-tenth of these values. Thus the bending moments are almost negligible and even less than the secondary stresses in steel trusses. Bridges of this type have been built with such slender concrete arches that they look unstable against buckling.

The vertical buckling length for two or three hinged arches may be assumed to be half the total arch length. If there were more restrained points along the arch, the vertical buckling lengths would, of course, be decreased the same as in a truss with a curved upper chord. That is exactly the case for an arch bridge with inclined hangers, but only when all hangers are acting. The security against hangers going out of action will therefore also influence the security against buckling. This is a condition which will have to be considered for each case.

Since the bending moments in the arch for live loads have been practically eliminated, the rigidity of the structure has been correspondingly increased. This fact has been thoroughly verified by carefully conducted test loadings of finished bridges of this type.

Most of the bridges with inclined hangers are of the three hinged concrete arch type, but both two-hinged and bowstring arch bridges with inclined hangers have been built. Some steel arch bridges with inclined hangers have also been constructed.

Suspension Bridges with Inclined Hangers

The theory of the action of inclined hangers in arch bridges will indicate what may be expected from such a system if applied to a suspension bridge. If this is of long span, it would certainly not be economical to make the roadway extra heavy in order to increase the prestress in the diagonal hangers. With a nonrigid cable it would hardly be possible to eliminate the stiffening girder or truss entirely, but this would probably not need to be as rigid as for a bridge with vertical hangers.

Analytical stress analysis would be feasible for a suspension bridge with one span and unloaded back stays, or for a system as proposed by Dr. Dischinger, but would be difficult if there were more than three spans. In such cases it would appear necessary to use model testing.

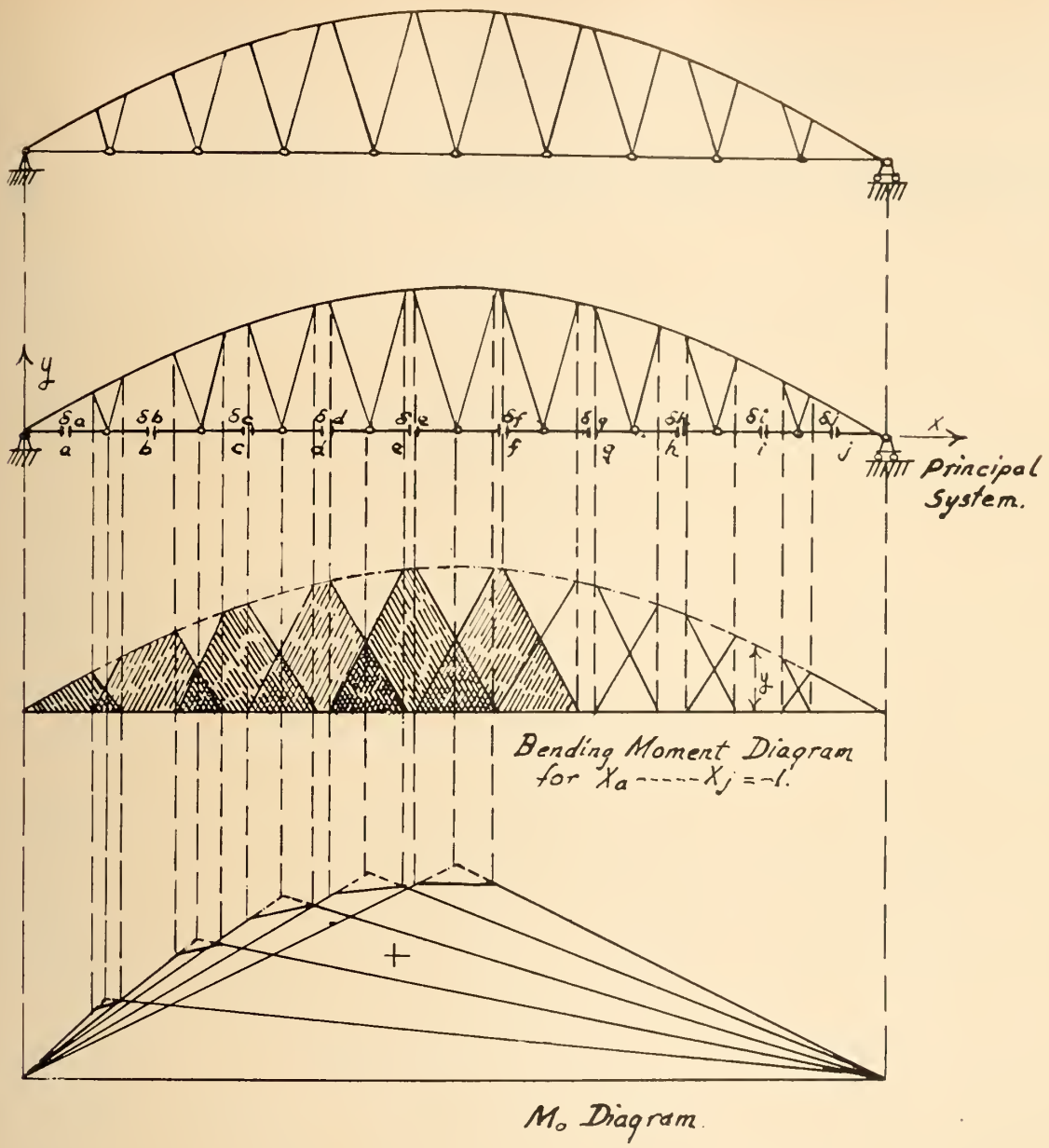


Fig. 5

Fixing the hangers securely to the cables will constitute a special problem in some of the proposed systems, because of the horizontal component of hanger pull, which will promote sliding. The average tensions in the hangers will be less than those for vertical hangers, and it will be difficult to even out the initial tensions. There is, under such circumstances, a danger that the hangers, even when in tension, might vibrate due to wind or to live loading. Such vibration may cause damage in time, as it did to the cables of a suspension bridge on the Alaska Highway, which did not have its cable strands sufficiently well clamped together.

A suspension bridge is generally more flexible than an arch bridge; it would seem to be much more difficult to make a practicable and economical design for a suspension bridge which would keep all inclined hangers in action under live load conditions. Taking all the above conditions into consideration, the author thinks it will pay to go slow in the use of nonrigid inclined hanger systems for suspension bridges, even though a major bridge of this type has already been constructed.

For medium length bridge spans of about 600 ft., a more rigid type than a suspension bridge with inclined hangers seems to be the self anchoring girder without cable, but with stays from the towers to both sides. This type was offered by a German firm in a recent competition for a bridge at Stromsund, Sweden, and was selected, because of better rigidity and economy than the ordinary suspension bridge originally proposed.

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Cost Calculations of Transports by Truck

by

Charles M. J. W. Kohler, M.E.I.C.

Consulting Civil Engineer, Ottawa, Ont.

Trucking and hauling problems enter into practically every construction operation. In this short paper the author gives a series of formulae by which the cost per ton mile may be readily determined, and explains them by giving a numerical example. Though trucks are referred to in the text, the formulae also apply for other types of transport vehicles.

If one desires to calculate the cost for transportation by truck, it is necessary to know the total number of complete round trips which can be made by a certain number of trucks during a certain time, say 8 hours.

For instance, if sand has to be transported by truck, the sand is loaded at one end of the trip and dumped at the other end. This means that if we have one loading facility for a certain number of trucks and the loading of a truck takes 4 minutes, the first truck leaves 4 minutes after the beginning of the shift, the second after 8 minutes, and so on.

If one complete round trip takes 40 minutes, the last round trip can start 40 minutes before the end of the shift. The trucks which return after less than 40 minutes before the end of the shift will not load again, unless one is prepared to pay overtime.

In this article is given a formula from which, for a certain period, the total number of complete round trips for a certain number of trucks can be found (formula 4).

Riding distance one way $= x$ miles.

Assume an average speed $= y'$ m.p.h.

loading time of truck = 4 minutes

time for driving out = $60\frac{x}{y'}$ minutes

time for dumping = 2 minutes

time for driving back = $60\frac{x}{y'}$ minutes

Time for one complete round trip = $6+120\frac{x}{y'}$ minutes . . . (1)

Number of trucks required for this = $\frac{6+120\frac{x}{y'}}{4}$ . . . . . (2)

in which 4 is the loading time in minutes.

Round off the required number of trucks from (2) to a whole number g, and calculate the actual average speed y in m.p.h., when using g trucks. The time required for one complete round trip (cycle) now becomes:

$$a = 6+120\frac{x}{y} \text{ minutes} \quad . \quad . \quad . \quad (3)$$

With this time a, we carry out our further calculations.

The total number n of complete round trips which these g trucks will do in 8 hours, or 480 minutes, is found as follows:

$480 = b \,.\, a+c$ minutes (in which b is a whole number)

$c = d \,.\, 4$ (loading time) + "rest value". (in which d is a whole number)

The "rest value" is usually 0 and if not, can be disregarded.

In this way we find the values for b and d.

The total number of complete round trips n, which the g trucks will do in 8 hours will be found from the following equation:

$$n = b\,(d+1)+[g-(d+1)]\,(b-1) \quad (4)$$

If the cost of the loading equipment, including depreciation, driver, fuel and maintenance is L dollars per day and the similar cost for one truck K dollars, the cost of one round trip amounts to:

$$\frac{g \,.\, K+L}{n} \text{ dollars} \quad . \quad . \quad . \quad (5)$$

If one truck loads q tons, this becomes:

$$\frac{g \,.\, K+L}{n \,.\, q} \text{ dollar per ton round trip} \quad . \quad . \quad . \quad (6)$$

or:

$$\frac{g \,.\, K+L}{2 \,.\, n \,.\, q \,.\, x} \text{ dollars per ton mile} \quad . \quad . \quad . \quad (7)$$

With an efficiency of $p\%$, the values for (5), (6) and (7) would be divided by p.

Example

The procedure will be clarified by taking the following example:—

$x = 4$ miles

Loading time = 5 minutes

$y' = 19$ m.p.h.

Time for driving out $60\frac{4}{19}$ = 12.63 minutes

Dumping time = 3 minutes

Time for driving back = 12.63 minutes

$8+25.26$ minutes (1)

Number of trucks required for this = $\frac{8+25.26}{5} = 6.65$ . . . (2)

Take the number of trucks used, g, as the nearest integral number, or 7. Then, $\frac{8+120\frac{4}{y}}{5} = 7$, from which we find $y = \frac{480}{27} = 17.8$ m.p.h.

One cycle a now becomes $a = 8+27 = 35$ minutes . . . (3)

$480 = 13.35+25 \qquad b = 13$

$25 = 5.5+0 \qquad d = 5$

Referring to (4), $n = 13\ (5+1)+[7-(5+1)]\ (13-1)$ which gives $n = 90$ (= total number of complete round trips).

With $L = \$100$ and $K = \$40$, the cost for one round trip is:

$$\frac{7\times\$40+\$100}{90} = \$4.22 \quad . \quad . \quad . \quad (5)$$

With a loading capacity of 4 ton per truck this becomes:

$\frac{\$4.22}{4} = \$1.06$ per ton round trip (6)

or: $\frac{\$1.06}{8} = \$0.13$ per ton mile . . . (7)

With an efficiency of 60%, (7) becomes: $\frac{0.13 \,.\, 100}{60} = \$0.22$ per ton mile.

The reader's attention is called to formula (4), which gives the number of complete round trips which a certain number of trucks will make during a certain time, without the owner having to pay overtime for part of the trips if these are not completed within, say, an eight hour day. The formulae may also be used for other types of vehicles.

Possibilities of Operating ATOMIC ELECTRIC POWER at Competitive Rates

by

W. B. Lewis

Vice-President, Research and Development
Atomic Energy of Canada Limited
Chalk River, Ont.

Canada's industrial productivity depends greatly on cheap hydro-electric power. Rising production already demands so much electric power that coal and oil are imported in some regions to supplement available water power. In the far north the cost of transporting even oil hinders development. Uranium, which Canada has in abundance, promises power not only with low transportation costs but eventually at a low total cost. The author of this paper, which was presented at the annual meeting in Toronto in May 1955, concludes that in large installations atomic power could even now be competitive.

Allowances for a Nuclear Power Plant to be Competitive with a Coal Plant

It is relatively easy to show that to compete with large scale commercial electric power in an industrialized country, consideration must be given to large units; in order to focus attention on a reasonable target, let this be a unit generating 100,000 kw. It will be compared with a commercial unit of similar size fuelled by coal and incorporating the best modern engineering practice. The costs for both stations may be broken down in such a way that the targets to be achieved in the separate stages and operations for the nuclear plant are made evident.

For the coal fired station assume a total capital cost of $140 per kilowatt of electrical installed capacity (kw_{EI}) of which the boilers and auxiliary plant cost $60/$kw_{EI}$. The turbines, generating plant and electrical equipment take the remaining $80/$kw_{EI}$. It must be remembered that these figures apply to a modern high efficiency, high temperature and pressure turbine, so this allowance may reasonably be higher than for equipment built to lower standards. Moreover, in assigning dollar costs, it is necessary only that all the figures should bear a reasonable relation to one another and the absolute values must be considered as dependent on local conditions and the purchasing power of the dollar.

A fuel cost of 30 cents per million B.t.u. will be assumed. This would be provided by coal of 13,000 B.t.u./lb costing $7.80 per short ton, or of 13,300 B.t.u./lb costing $8 per short ton.

At 90 per cent fuel to steam and 38 per cent steam to electrical efficiencies, 34.2 per cent overall, the fuel cost is 3.0 mill/kwh generated.

The load factor, or plant utilization factor, will be assumed as 80 per cent so that the annual output is 700 Mkwh.

Because public financing and private financing involve different interest and tax rates, which affect the comparison, costs will be evaluated for annual capital charges at both 8.5 per cent and 13 per cent.

The overall annual costs for the coal plant would then be as in Table I.

Comparable costs would be reached for a certain type of nuclear power station, which I propose to discuss in further detail, by making the following cost allowances.

Table I. Annual Costs for Coal Fired Electric Generating Plant

	Low Charges			High Charges		
	Rate	Amount	mill/kwh	Rate	Amount	mill/kwh
Generating plant ($8 millions)	8.5%	$ 680,000	0.97	13%	$1,040,000	1.49
Boilers and auxiliaries ($6 millions)	8.5	510,000	0.73	13	780,000	1.11
Coal consumption, 700 Mkwh at 3.0 mill/kwh		2,100,000	3.00		2,100,000	3.00
Fuel and ash handling		50,000	0.07		50,000	0.07
Other operating costs		250,000	0.36		250,000	0.36
TOTAL		$3,590,000	5.13		$4,220,000	6.03

Reactor cost, less fuel and moderator . . . $15,000,000 ($150 kw_{EI})
Heavy water, 80 tons at $30 lb 4,800,000
Uranium inventory, 66 tons at $20 lb . . 2,640,000
Uranium consumption at 3 per cent burn-up and 22 per cent thermal to electrical efficiency 4.55 tons year 182,000
Annual operating cost, excluding fuel processing 350,000
Fuel processing, 292 days at 455 Mw gives 133 kg. of fission products, at $3/gm. costs . . . 400,000

The overall annual costs would then be as in Table II.

Comparison of Reactor Types

The type of reactor under consideration may be described as:

Regenerative, meaning that it produces new fissile material re-

placing in some measure that consumed.

Solid fuelled; the fuel is natural uranium and the products obtained from its irradiation, significantly plutonium and uranium depleted in the U-235 isotope. The fuel is envisaged as being solid, either a metal or some sort of fire-brick. The fuel is likely to be processed after irradiation to dispose of fission products and to recover the plutonium and uranium for further use.

Thermal neutron; a large fraction of the neutrons released in fission are slowed down until in thermal equilibrium with the "moderator". The significance of this is that U-235 and the plutonium which contribute to the fuel cycle have very large ~ 1,000 barn cross-sections for thermal neutrons, making it possible to achieve

Table II. Annual Costs for Nuclear Power Plant

	Low Charges			High Charges		
	Rate	Amount	mill/ kwh	Rate	Amount	mill/ kwh
Generating plant ($8 million)	8.5%	$ 680,000	0.97	13%	$1,040,000	1.49
Reactor ($15 million)	8.5	1,275,000	1.82	13	1,950,000	2.78
Heavy water ($4.8 million)	5	240,000	.34	10	480,000	.69
Uranium inventory ($2.64 million)	3	79,200	.11	3	79,200	.11
Uranium consumption		182,000	.26		182,000	.26
Fuel processing		400,000	.57		400,000	.57
Operating		350,000	.50		350,000	.50
TOTAL		$3,206,200	4.58		$4,481,200	6.40

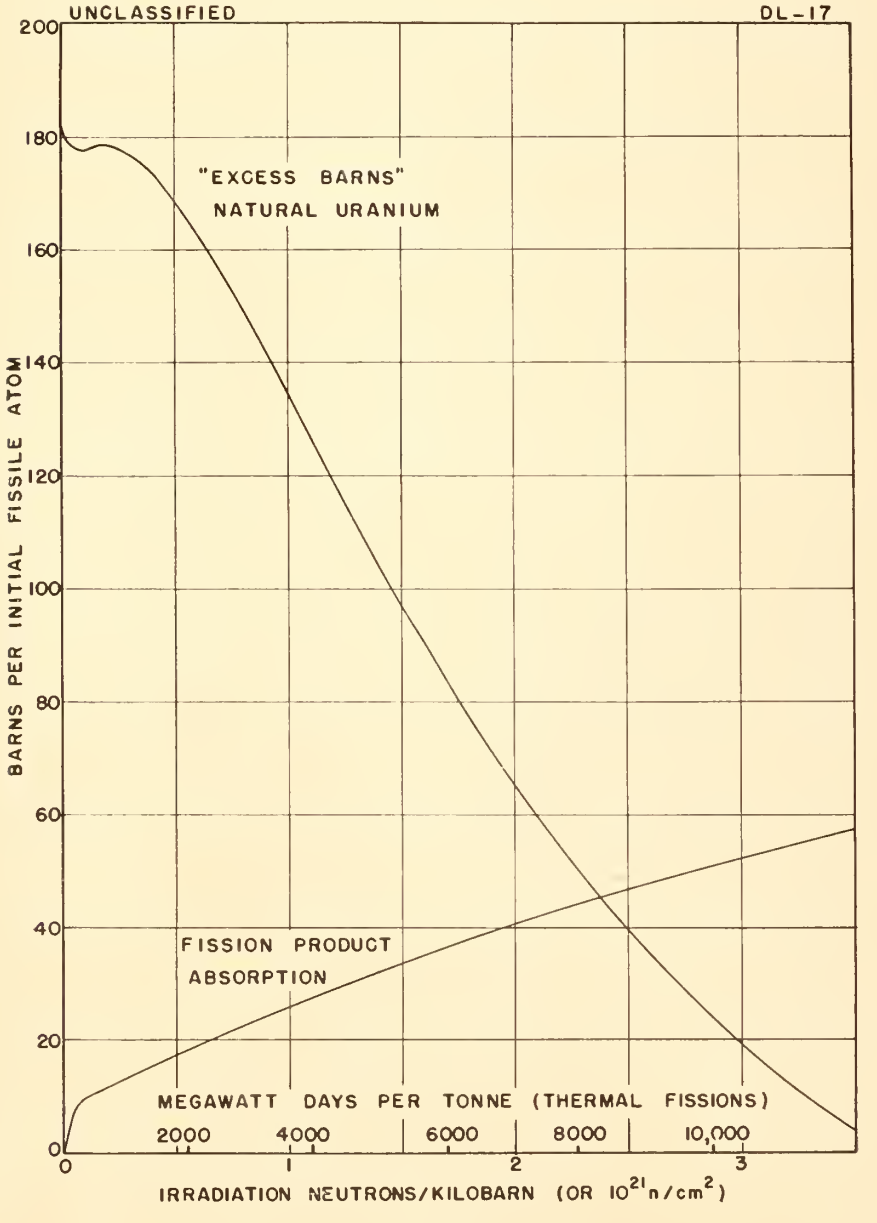

Fig. 1

a. very high specific rates of fission (—10 thermal Mw/kg.) and correspondingly low total content of fissile material in a reactor of given power rating;

b. low neutron wastage by competitive absorption in other materials in the reactor if these are well chosen.

Heavy water cooled and moderated; heavy water being little different in most properties from ordinary water, shares the same advantages and disadvantages as a coolant. A disadvantage is its low boiling point, making high pressures necessary in high temperature systems. Advantages are its high thermal capacity both as liquid and as steam and its low viscosity, making pumping power low. Chemically also it is like ordinary water and although somewhat reactive and corrosive, it is the principal product from the ready recombination of its elements.

It differs from ordinary water in having a much lower capture cross-section for neutrons, 0.0005 barn compared with 0.3 barn per hydrogen atom. This advantage has to be set against its price, which hitherto has been over $50/lb.

Other types of reactors which may be considered also as possibilities for competitive power generation, may be distinguished as:

Breeders; if the fissile material produced is greater than that consumed, the reactor is classed as a "breeder". In theory the operation of breeder reactors makes possible the utilization through fission of all uranium and thorium. In practice it has been considered that up to 30 to 60 per cent of the available amounts of these elements might economically be utilized. The fraction utilized is often referred to as the "burn-up". A regenerative non-breeder, but near breeder, may

Table III. Steam to Electrical Power Efficiencies

Steam Pressure psi.	Steam Temperature °C.	Steam Temperature °F.	Exhausting to Pressure psi.	Exhausting to Pressure in. Hg	Efficiency Rankine cycle	Efficiency Practical overall
1500	566	1050	0.735	1.5	43%	33%
422	232	450	1.0	2.04	33.5	~25
300 (sat.)	214	416	1.0	2.04	31.7	~23
240 (sat.)	203	397	1.0	2.04	30.6	~22
100 (sat.)	164.2	328	1.0	2.04	26.1	—
			0.735	1.5	~27	18
14.0 (sat.)	98.6	209.6	0.735	1.5	—	11

achieve a burn-up of several per cent.

Fluid fuelled; fabrication costs associated with solid fuel elements and their protective sheathing may be avoided by keeping the fuel fluid either as a solution, slurry (including liquid metal slurry), fused salt, gas or solid suspension. The main disadvantages are

a. The fluid fuel is likely to be more corrosive than a selected and controlled coolant.
b. Much of the radioactivity of the fission products is associated with volatile fission products of relatively short life. The requirements for containing these are not so easily met in fluid as in solid fuel systems.

One special advantage may be noted, namely that one of the xenon istotopes, Xe-135, a fission product, is a strong absorber of thermal neutrons, and is a significant poison affecting the operation of thermal neutron reactors. In certain fluid fuel systems it could be extracted in a time short compared with its half-life in the neutron flux, which may be about two hours. In most fluid fuel systems its concentration would be less and its delayed poisoning effects much reduced.

Fast neutron; if the reactor is designed so that the fission chain reaction is maintained without slowing the neutrons down to thermal energies, several advantages result.

a. The neutron yield per fissile atom destroyed is significantly higher, making breeding attainable.
b. A significant contribution may be obtained from uranium-238 and thorium which are directly fissile by fast neutrons.

The disadvantages are mainly

a. The need for a large initial charge of relatively pure fissile material (not less than about 100 kg. for a 100,000 kw generating station).
b. Technical difficulties of extracting heat from a core of very small volume surrounded by a thick "breeding blanket" of uranium or thorium, which must also be cooled.
c. The necessity for relatively frequent reprocessing of the fissile material. In a fluid fuel system, continuous processing may be possible, and the disad-

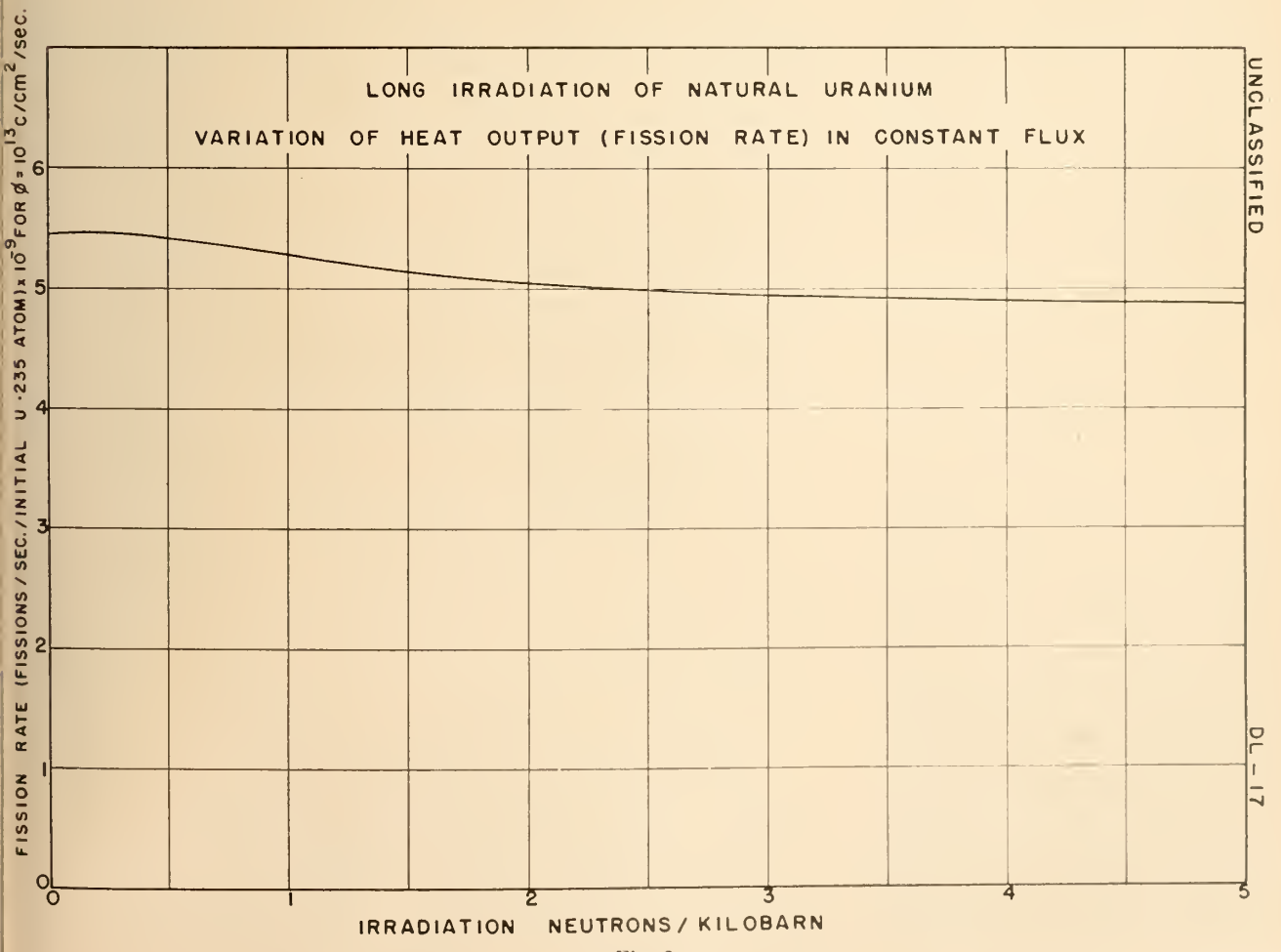

Fig. 2

vantage is that relatively large amounts of fissile material have to be processed for a reactor of given power.

Liquid metal cooled; this offers the advantage of high temperature operation. All satisfactory liquid metals, however, have higher thermal neutron absorption than heavy water. Corrosion and chemical activity problems are severe, but not insuperable. Sodium becomes intensely radioactive and requires much greater shielding precautions after reactor shutdown than water. Polonium produced in bismuth is a troublesome radioactive contaminant.

Ordinary water cooled; compared with heavy water the disadvantage of the higher neutron capture is to some extent offset by the smaller amount of ordinary water required to slow down neutrons.

Gas cooled; this offers the advantage of relatively high temperature operation, but this advantage is somewhat offset by the increased pumping power needed. Gas cooled reactors are relatively simple in design if allowed large amounts of uranium in a relatively cheap moderator; only graphite appears economic.

Alternative moderators; Beryllium and beryllia are good moderators with low neutron absorption, but are expensive. Graphite is a less effective moderator but is chosen for its low cost and good high temperature properties where bulk can be allowed.

Other contrasted classifications of reactors, for example homogeneous or heterogeneous, pressurized or boiling water, natural uranium or enriched, are not discussed, for, although to the engineer responsible for the design it may appear very distinct, any such reactor will be found to be classifiable from the economic viewpoint under the descriptive heads already discussed. For example, from the published information the Oak Ridge homogeneous reactor would be classed as a fluid fuel, regenerative or breeder, thermal neutron, heavy water cooled and moderated reactor. The economic questions raised by enrichment are all involved in regenerative and breeding fuel cycles. Increased fuel investment represented by increased enrichment may be balanced economically by increased regeneration or breeding, a lower initial capital cost for a reactor, or reduced fuel processing costs. The significant aspects of all these factors will be discussed.

Thermal to Electrical Conversion Efficiency

One of the first points engineers will notice in this paper is the assigned 38 per cent efficiency for conversion of the thermal energy of steam to electricity, but only 22 per cent for that from uranium. The relation of these figures to steam temperatures and pressures may be seen from Table III.

The steam temperature in the nuclear plant may be as low as 400° F. This low value has been chosen because of the fundamental point that it is costly to handle spilled radioactive material and it is therefore important from the economic viewpoint to keep away from the corrosion hazards associated with higher temperatures of the sheathing of fuel elements. Moreover, because the uranium fuel cost is so low, even at this low efficiency it contributes only one-third as much to the cost of power as the coal in its high efficiency plant.

Many nuclear engineers, particularly those with a steam engineering background rather than a radioactive chemical plant background, will be unhappy to allow such a low temperature. It will indeed be a happy day, when, by technical development, we achieve reliable operation at higher temperatures. The point is, however the double one that it is not essential to reach such conditions before atomic electric power is competitive with coal and that the advantage of slower corrosion at the lower temperature is considerable.

It is of interest to consider an example of how the total cost of power is affected by a change in the

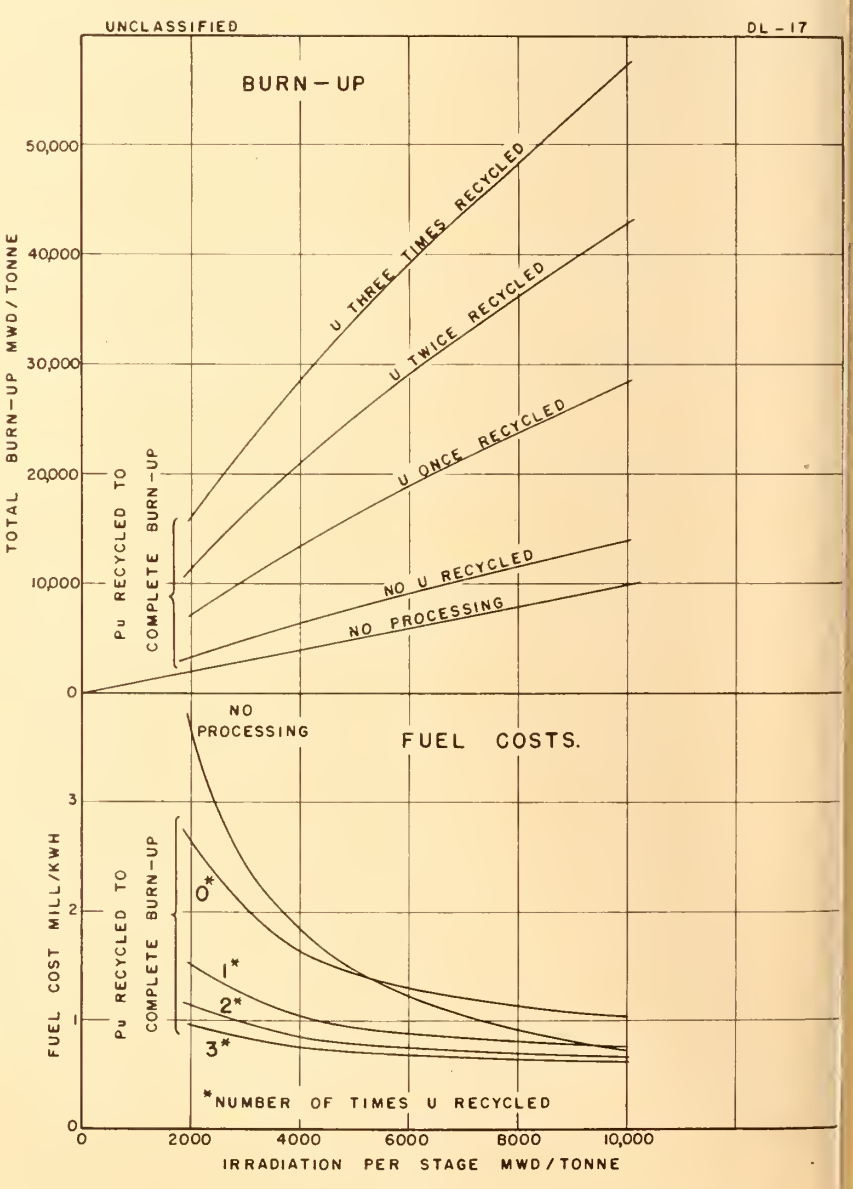

Fig. 3

thermal to electrical conversion efficiency. The contribution from uranium consumption and fuel processing is inversely proportional to this efficiency, so that by raising the efficiency from 22 to 33 per cent these contributions would fall from 0.83 to 0.55 mill/kwh. If the difference, 0.28 mill/kwh, were applied to the reactor cost, it would allow at the low charge rate an increase in this from $15 to $17.3 million, assuming no increase of operating cost other than fuel processing.

The Fuel Cycle

In the choice of a practical cycle for the fissile fuel, three requirements have to be satisfied in the reactor:

The reactivity necessary to sustain a chain reaction has to be provided.

Sufficient regeneration of fissile fuel must take place to allow a long enough irradiation of the fuel to make the fuel cycle economic.

The fuel has to be so arranged that the heat generated is removed by the coolant at as high a temperature as possible, while keeping the fuel at a low enough temperature to be stable, that is to say, not melting or passing through any significant phase change. For pure uranium metal this means keeping below 1,200° F. or 650° C.

In general, in a power reactor the disposition of fuel throughout the reactor will not be uniform; moreover considerable changes take place in the fuel under irradiation. As a result, the computation of the reactivity and its changes becomes very complex, and it may be doubted whether in practice any such computation will be justified. It is, however, possible to establish certain approximate relations applicable to small changes in reactivity, and these serve as guides to design and to forecast performance.

The reactivity of a reactor is commonly denoted by k and has the value $k = 1$ when in steady operation. In a thermal neutron reactor k would never be allowed to get as high as 1.01 for this would exceed the range in which control is slowed by the delayed neutrons from fission. At Chalk River it has been found convenient to assess small changes in reactivity in milli-k units.

For discussing changes in the fuel during irradiation, it is convenient to introduce another function related to reactivity which may be described as the excess cross-section and is conveniently expressed in "barns per initial fissile atom".

When a small absorber containing N atoms of neutron absorption cross-section σ is introduced into a reactor at a point where the neutron flux is ϕ, the change in reactivity may be written $\delta k = -C\phi^2 N\sigma$, where C is approximately constant for all positions in the reactor at a given power level.

This reactivity loss may be balanced by a yield of fission neutrons at the same point from N_f atoms of fissile material having an absorption cross-section σ_{fa} and yielding η fission neutrons per fissile atom destroyed, where N_f is given by $N_f\sigma_{fa}\ (\eta-1)\ \epsilon p/(1 + \kappa^2 L_s^2) = N\sigma$.

The factor $\epsilon p/(1 + \kappa^2 L_s^2)$ represents the fraction of fission neutrons becoming thermal in the same effective region of the reactor, and ϵ = fast fission factor, p = resonance escape probability, L_s^2 = slowing down area and κ^2 = Laplacian or buckling.

The "excess barns per fissile atom" in any region is given by the equation set in box above.

$$\frac{(\text{Total fission neutron yield}) \times \epsilon p/(1 + \kappa^2 L_s^2) - \text{Total neutron absorption}}{\text{Neutron absorption by fissile atoms}} \times \sigma_a$$

where σ_a = absorption cross-section of the fissile material.

When natural uranium is irradiated, the main changes in reactivity apart from the transient xenon poison already mentioned, are attributable to the build-up of (1) plutonium which produces an increase in reactivity due to its larger fission cross-section even if the regeneration is only about 0.8 atom of Pu-239 per atom of U-235 destroyed; (2) fission products which absorb neutrons.

The exact course of these changes depends on the velocity distribution of the neutron flux, the self-shielding due to the thickness of uranium, the ratio of resonance to thermal neutrons, and the amount of fast fission in U-238. The known nuclear data are not accurate enough to make an exact estimate even if the neutron velocity distribution were known, which is not the case. With all these reservations in mind, it is nevertheless possible to assess the general form of the changes to be expected. A typical curve is shown in Fig. 1. In the same figure is shown the absorption attributed to the fission products. This serves as an indication of what might be regained by processing the fuel to remove fission products at any stage.

In contrast to this fall of reactivity, the heat output in a constant neutron flux is well maintained to long irradiations, Fig. 2.

Setting a cost of $20 lb. for uranium as supplied to the reactor and making also the processing allowance of 0.5 mill kwh set above, the resultant contributions to the power cost from the fuel costs for a number of types of fuel cycle are shown in Fig. 3.

Not all these fuel cycles are attainable—the processing allowance may be insufficient, the average reactivity may be too low, or the fuel may break up before the full irradiation is achieved. In the long term, when many reactors are operating, the availability of uranium at the price suggested in the amount required might also rule against cycles with a total burn-up of less than, say, 2 per cent. However, as possibilities for early application, I would direct attention to two particular cycles; first, the very simple one involving no processing and setting no value on the discharged fuel—the limit to the irradiation is set by the reactivity drop and the physical stability of the fuel. For natural uranium metal 4,000 MWD ton might be attainable in both respects. This, however, leads to a rather high fuel cost of 1.84 mill kwh from Fig. 3 which is drawn for 25 per cent thermal to electrical conversion efficiency, so this would be 2.09 mill kwh at 22 per cent.

It might prove practicable to extend this to higher irradiations. The difficulty caused by the drop in reactivity might be overcome by moving the fuel after some irradiation out from the high flux regions of the reactor where new fuel would contribute more to the reactivity, and finishing the irradiation in a lower flux position.

For a longer term program on a larger scale, recycling of the uranium two or three times appears more attractive. Consider in particular an irradiation limit set at 4,000 MWD tonne and recycling the uranium three times. It is envisaged that the reactor would settle to an equilibrium in which it contains fuel at all stages of burn-up and recycling.

It is very important to the prospect of achieving fuel economy that the plutonium should not be left in the uranium or returned to it after processing, as the fission products from the plutonium would necessitate earlier reprocessing.

The processing allowance was set at 0.5 mill kwh electrical or $12 - MWD or $12 × 0.22 = $2.64 - thermal MWD at 22 per cent efficiency. This works out to about

$15/kg. for each extraction, which includes refabrication of the fuel for the reactor and disposal of the fission products.

Conducted on a large enough scale, for example, servicing a power plant of 1 million kilowatts, such a cost allowance does not appear unreasonable. We have no experience of conducting operations on such a scale, but judging from the experience we have on a smaller scale, it does not seem unattainable. It is, however, to be noted that if this is not achieved, then each extra dollar/kg. for each uranium reprocessing adds 0.02 mill/kwh to the power cost, while an extra dollar/gm. of plutonium reprocessing adds 0.1 mill/kwh.

For the same overall fuel costs a greater processing allowance can be made, since this allowance is almost proportional to the irradiation per stage and could, for example, be increased by 40 per cent if the irradiation per stage were extended to 6,000 MWD/tonne.

The Reactor and Heavy Water Costs

At the present time it is difficult to assess whether the $15 million allowance for the reactor cost (less moderator, coolant and fuel but including the building) and $4.8 million for heavy water, would be adequate. We have embarked on the design of a smaller power reactor and expect the experience gained will be most valuable in assessing the validity of estimates.

For the heavy water, pressurized type of reactor with metal fuel elements clad in zirconium, we can set minimum requirements for the amounts of heavy water and zirconium. Experience exists for heat transfer rates to water of 600,000 B.t.u./hr./ft.^{2} (190 watts/cm.^{2}). Suppose the design can attain an average of one-quarter of this, or say 50 watts/cm.^{2}, then for $100/0.22 = 454$ Mw heat output, the sheathing area would be 9.08×10^6 cm.^{2} and if 1 mm. thick of density 6.5 the sheathing would have a mass of 5.9 tonnes, and at $50/lb. in fabricated form would cost $650,000.

This item of zirconium is possibly worth considering further, for its cost per pound may fall. One U.S.A.E.C. contract calls for the billet metal at $13.5/lb., but possibly this low figure has not been met. Zirconium is very reactive, particularly with nitrogen, and metal may be spoiled by exposure to air at high temperatures; it is not easy to patch or weld so that a considerable wastage is to be expected, until all fabrication is achieved by simple, well developed processes.

For heavy water an allowance of 80 tons at $30/lb. was set. Estimates of the amount required, based on reactor experience and established heat exchanger designs, range between 60 and 100 tons. On the question of price, Selak and Finke in *Chemical Engineering Progress*, Vol. 50, p. 221, 1954, concluded "The production of heavy water at less than $40/lb., including amortization is in the opinion of the authors within the realm of possibility." In discussion Mr. Selak stated this was intended to include the high taxation rates applied to private industry in the United States. From this and other basic information, the figure of $30/lb. is not considered unattainable.

The pumps, pressure system and controls for the reactor represent the greatest uncertainty. It is probably necessary to spend several million dollars on development work, but if this is not charged against the reactor the following breakdown may be suggested. This will at least serve to indicate where estimates are liable to be in error.

	Millions of dollars
Building	2.75
Reactor structure	2.9
Auxiliary power equipment	1.75
Control equipment	1.5
Crane and rod handling	0.6
Auxiliary plant	1.0
Miscellaneous	0.1
Site development	0.2
	10.8
+25 per cent engineering	2.7
+20 per cent contingencies	2.2
Total	15.7

Conclusion

In concluding, I would suggest that the nuclear power plant has not yet arrived at the stage where accurate cost estimates are available because the extrapolation from previous experience is too great. Moreover, the whole technology of operating in the presence of the large amounts of radioactive materials involved is of such recent growth that the pattern of operations is not well established. Certain features exist which seem likely to stay, such as the handling of irradiated fuel elements in water trenches to provide shielding while allowing visual inspection; others, such as the plunging control rods, will not be so general.

By building reactors which are small but not of insignificant capacity and by facing the problems of their operation as they arise, we shall gain the experience necessary to give backing to forecast estimates.

We now have reasonable assurance of low fuel costs for thermal reactors and expect to show that the reactor costs can be brought to a level at which nuclear power generation is economically competitive. √

FATIGUE LIFE OF STEEL I-BEAMS AT NORMAL AND SUB-ZERO TEMPERATURES

(*Continued from page 614*)

rimmed and killed steels show that the temperature of −40°F still lies above the transition temperature of these two steels. The results of these fatigue tests show that resistance to fatigue of structural rimmed and killed steels of moderate thickness, is substantially greater at a temperature of −40°F than at +70°F.

The welded beams of rimmed and killed steels showed, at +70°F, a better fatigue resistance than the rolled structural steel beams whereas, at −40°F, the fatigue resistance of the rolled beams appreciably surpassed that of the welded beams. The riveted beams, at both temperatures, had the lowest fatigue resistance of all types of beams tested. The fracture characteristics were the same for all types of beams. This indicates that the welded beams behaved in exactly the same manner as the rolled beams, and that welding did not introduce any adverse effect.

In evaluating the results of the foregoing fatigue tests, it should also be appreciated that they were, of necessity, limited in scope, both as to the number and range of specimen tested. It would therefore be improper to draw too definite conclusions as to the relative merits of rolled, welded and riveted I-beam sections, beyond the range tested, especially regarding thickness or size of beams.

The results so far obtained do, however, point up the desirability of further research on similar but larger sections involving thicker material. Such a program would of course necessitate the construction of testing equipment much larger and more expensive than that described. It is hoped that in the not too remote future, further exploration along these lines may be made possible. √

Where are we Heading in Higher Education in Canada at the Present Time?

by

N. A. M. MacKenzie

President,
University of British Columbia, Vancouver, B.C.

This is an address delivered by Dr. MacKenzie before a meeting of the alumni of the University of British Columbia on November 30 last. Though he was not particularly concerned with engineering education, many of his remarks can be taken to heart by engineers, especially by that section of the profession which believes that the elevation of the engineer's status is more dependent upon raising the status of the individual than it is upon any mass effort.

I thought this evening I would talk to you about higher education in Canada, for that seems to be an appropriate topic for the alumni of a great university.

The first thing I would like to do is to state what I believe to be the purpose, the function or the goal of higher education. My own view is that we should strive to produce educated men and women in the broadest and best senses of the term "educated." But this in return requires a definition of education, and I should, myself, describe an educated man or woman as one with some knowledge and understanding of human history and human development. He should also have some understanding of our contemporary society and of himself as a human being in the physical, physiological and psychological senses; or, putting it another way, some understanding of the physical, mental and emotional factors or elements in his nature. He should also know something about the physical world around him, and about the importance of science in respect of that physical world and of his own life and society. Because all of us are likely at one time or another to be dependent upon ourselves for the making of a living, our educated man should have acquired certain skills and information which he can turn to practical use. More important than these in many ways as the mark of the educated man is his acquisition of wisdom and of judgment and balance, of standards of value, and of a capacity or ability to discriminate and to make right and wise choices. I suspect that all of you would agree with me that these are desirable objectives of higher education.

There are, of course, many others, including a capacity to understand and enjoy what we loosely describe as our "cultural heritage" — the arts and letters, music, painting, literature and the rest. Education should also include an understanding of one's emotional nature and the capacity to subject one's self to self-discipline. But granted all this, the problem remains of how to impart these desirable qualities and characteristics to the young people who come to us, to see that all of them acquire these qualities and are encouraged and persuaded to develop themselves to the maximum.

Our success is largely dependent upon what has happened to these young people before they enroll as university students, but this is in a sense pushing a problem and a responsibility back on the parents and the home, upon society and the local environment, upon the church and the schools, for not only are the young people who come to us conditioned before they reach us, but they are as well, throughout the whole of their university careers, subject to a great many persuasive and powerful influences which have nothing to do with the university.

Within the university the most important educational factors or influences are: the teaching staff; other members of the student body; the medium of instruction e.g., the humanities, science, arts, or a professional course; facilities available in the form of libraries, laboratories and extra-curricular activities; and the general philosophy of and atmosphere which surrounds the university itself. By this I mean its attitude towards freedom and responsibility, its interest in intellectual matters, and the emphasis which it attaches to things of the mind and to the place and the importance of social activities and of athletics on the campus. Even the physical surroundings of the university campus will have some effect upon the interests and character of students there.

But again, having described some of the agents or media of education, we are still without an answer to the question, "How do we ensure that our young people get the most and the best out of their university experience and out of the opportunities offered them?" Here we come close to the heart of the continuing controversy about contemporary education, its defects and limitations. A goodly number claim that the answer to our problem can be found in a return to or an emphasis

upon the teaching of the humanities. Others state that what is lacking is discipline; still others suggest that if we had smaller classes — more personal contacts between teachers and students — it would solve our problems. Still others decry and criticize the introduction of what they describe as vocational and technical courses, which they claim have no place on the university campus. Among these, they would list physical education, home economics, pharmacy and dentistry. Those who do this forget that in many respects university education has always been vocational, and that, while the ancient universities were communities of scholars, they were also places in which the clerks, the lawyers and the clergy learned their trades or professions.

Quite frankly, I have no complete or satisfactory answer to the question, "How do we produce educated men and women in our Canadian universities?" The most and the best that I can do is to suggest one or two things that are important. The first is that I believe that the teacher is far more important than the subject. A good teacher, if he is himself an educated man, can impart to his students most of the desirable qualities and ideas that I have described above, regardless of whether his subject is physics, mathematics or Greek literature. A poor teacher can take any subject, not excluding the best and the most exciting, and make and keep it as dry and uninteresting as the dust which collects on the shelves of libraries that are never used. So, I would rank first in importance a good teacher who is himself an educated person. If he has imagination, a breadth of vision and understanding, and a capacity to arouse the curiosity of young people and to stimulate them into the pursuit of knowledge on their own initiative, then I would count him as a jewel beyond price.

I also believe in the importance and necessity of discipline — self-discipline if possible, but, failing that or where necessary, imposed discipline. Our young people are in process of becoming mature adults. They must learn and acquire an attitude towards responsibility and about work and about doing things that are boring and unattractive. One of my concerns about modern society is the lack of discipline and the degree of irresponsibility which prevails in it among old and young alike. Here we at the university can do something through our insistence upon academic standards and reasonable behaviour. But we are, in a sense, waging a losing battle, unless the community in which our young people live is concerned about these matters and doing something about them as well, I believe very strongly in the importance of arousing young people's curiosity and in stimulating them to find out things for themselves. This can be done, and we try to do it, in a variety of ways through teaching, through research in laboratories, through libraries, through extra-curricular activities, through association with other students, through public lectures, through student self-government and in an endless variety of other ways. Through all of this, I keep coming back to the importance of the teacher and of the example which he sets to those who sit under him. I come back, too, to a statement I made earlier about the importance of the influences to which our students have been subjected before they come to us. Some of these we have limited, if any, influence upon. There is one, however, which is very much to the fore at the present time, and in which I believe that we of the universities could do more than we have done in the past and are now doing; and that is in the training of teachers, or as I would prefer, the educating of teachers for our schools, and the encouraging of more of the best of our young people to choose teaching as their life work. The staffing of our schools has been, for many years, a haphazard makeshift business. By this, I mean that a great many of our schools, particularly in the country districts across Canada are staffed by young girls with limited experience, education and training. The majority of these do not expect or intend to make teaching a profession. Most of them hope and intend to get married as soon as possible. Fortunately for the many of us who are men, they are successful.

This state of affairs in respect of the teaching profession is not the fault or responsibility of anyone or any particular group. It is the joint responsibility of all of us. It grows out of the difficulty in finding enough teachers and enough money to look after all of our children in a country where education is compulsory, and, despite all of our discussion and all of our efforts, we may not be able to change this materially, though I do believe there are some things of a constructive and positive kind that can be done. The first is to give some practical evidence of our belief in the importance of education, in other ways than by talking about it and by criticizing the teachers, the schools and the departments of education. This can be done in two ways: the first, by a public recognition of the importance of teaching and by attaching the same kind of prestige to this profession that we do to medicine, to law and to business. Another practical contribution is our advising, encouraging and persuading more of the best of our young men and women to go into teaching as careers. I do not believe many of us are doing this, and I doubt if many of those of you who are parents intend or expect your children to become school teachers. I do not know what the answer to this one is, but I do know that, if we hope or expect to get many of the best and ablest of our young men and women into the teaching profession, we shall have to provide more incentives than presently seem to exist in that profession.

This brings me to the question of university responsibility for or participation in the training and education of teachers. Personally, I have always felt and stated that education is a continuing process, and that the schools and the universities are important and related parts or phases of that process. Certainly we in the universities are, or should be, greatly interested in and concerned about our schools and about the qualities and abilities of the teachers in them, for it is from the schools that we get our students. Further, I believe that university education and experience are interesting, useful and important to everyone who can benefit from them. In particular, I believe that we have an important contribution to make to the education and training of school teachers. For these and other reasons, I would like to see every school teacher spend some time at the university or, if you will, have the university assume responsibility for a part of all teacher training. This will not be easy to bring about, but I believe it is a goal we can set and strive after.

You will note that I have, throughout, distinguished between "training" and "education". I have done so intentionally because, although they are in some respects synonymous, I am using them in somewhat different senses. Training I think of as the acquisition of skills in a profession or vocation, in this case teaching and meaning "how to teach": the techniques, methods, devices, — whatever you may call them — which young people are

(Continued on page 634)

Accidental Air in Concrete

by

M. F. Macnaughton, M.E.I.C.
Vice-President,
Mount Royal Paving and Supplies, Ltd.,
Montreal

and

John B. Herbich, M.E.I.C.
Research Fellow,
St. Anthony Falls Hydraulic Laboratory,
University of Minnesota, Minneapolis

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This paper deals with the peculiar air-entrainment properties of some sands found in our Laurentian Shield, which make it difficult to produce high grade concrete from them, and it tells how these difficulties may be overcome.

With the prospect of increased construction activity in our north country, we consider this paper of such importance that we have reprinted it with little condensation.

This paper presents a special problem in regard to "accidental" air entrainment in concrete mixtures. "Accidental air" is a new term in concrete technology. It may be defined as air accidentally entrapped or incorporated into a concrete mix either mechanically or by any other means. It may be unstable in nature and vary in size from microscopic to ¼ in. or larger air bubbles. The term "accidental air" should not be confused with the term "entrained air" which is generally used to describe the air introduced to the concrete mix in the form of microscopic air bubbles by addition of various air-entraining agents.

The first indication of the existence of such a situation arose when a report was made on a sample of gravel aggregate from St. Johnsbury, Vt., for the Canadian Pacific Railway Co. in 1937. The gravel was suitably graded for use as concrete aggregate and the organic matter content was apparently low. A trial mixture prepared with this gravel showed low density, with a unit weight of 137 lb. per cu. ft. and a compressive strength of only about 50 per cent of what was expected from the water-cement ratio used. A direct quotation from the report on this subject is made here:

> "For some reason which we could not determine the sand has, when surface dried, the peculiar property of holding a film of absorbed air so tenaciously that it is not readily displaced by water and the surface of the material wetted. As a result of this characteristic, if the sand is at all dry, a great deal of air is incorporated into the concrete mixture in which it is used and no amount of mixing seems to be effective in displacing these air films. The concrete is light in weight, is filled with air bubbles, and, for the cement content used, has a very low compressive strength."

The conclusions in respect to this gravel were, as it was later discovered, partly wrong, but basically correct. Air was being entrained, though nothing was known about air entrainment in those days, and the excessive amount of air entrainment, as indicated by the low weight of the resultant concrete, is today a perfectly reasonable explanation for the low strength obtained from this trial mixture.

The next recorded contact with such a situation came in 1947, when some tests were carried out for the Great Lakes Power Co., Ltd. In this case the designing engineers in the United States had specified the use of an air-entraining agent to entrain 3-5 per cent of air in the concrete mixture. Trial mixtures with the aggregates submitted for test showed that plain mixtures, without the addition of an air-entraining agent, entrapped about 6 per cent of air. Aggregate was obtained from another source which showed no evidence of abnormal amounts of entrained air in plain mixtures.

Nothing more developed until, in 1949, the Shawinigan Engineering Co., Ltd., employed Milton Hersey Co., Ltd., as concrete consultants on the work on the power dam on the St. Maurice River at La Trenche. Here it was found that the only fine aggregate available within reasonable distance of the work had the power of attracting accidental air into the concrete in the amount of 2.0 to 3.5 per cent. In this particular case, since the coarse aggregate was high in specific gravity (2.90 average) and the loss in weight, from a point of view of stability, was of no consequence, it was recommended that a small amount of an air-entraining agent be added to the mix to introduce some stable air which would be resistant to freezing effects, and the specifications were changed to permit an air content in the exposed concrete of 5-7 per cent in the aggregate fraction below 1½ in.

During the next two years a number of cases were encountered where natural aggregates yielded mixtures with excessive amounts of air, but it was possible to dispose of them by utilizing aggregates from other sources, or, in the case of structural concrete, where comparatively slight variation in weight is not an important factor in design, by adding a small amount of an air-entraining agent to provide some stable air content.

Peribonka Projects

Early in 1951 the Aluminum Company of Canada, Ltd., called on the services of Milton Hersey Co., Ltd., as inspectors on the concrete work on their two projects on the Peribonka River, involving a total of approximately 800,000 cu. yd. of concrete. Sand in that area is abundant. The first tests of sand, from a deposit located about a mile from Chute du Diable, indicated that the natural sand possessed an abnormal capacity for entraining air in plain mixtures, in some cases as high as 9 per cent. It should perhaps be mentioned here that the air content was measured on the $-1\frac{1}{2}$-in. fraction of the concrete. In the case of a concrete sample with maximum size of aggregate of 6 in., the stone above $1\frac{1}{2}$ in. was removed by hand and the remaining sample tested in an air meter by the approved method.

Before the investigation was completed, all deposits accessible by road within a radius of 30 miles were sampled and tested, as well as a number of deposits beyond that radius. Some 2,600 tests holes were put down and the final conclusion was that all of the sand in the area had the same characteristic, in greater or lesser degree, of attracting air into the mixture. The characteristics of the sands were as follows:

Coarse sand: Average value from Sept 1, 1951, to May 31, 1952.
Fineness modulus: 2.61.
Organic matter content (by sodium hydroxide color test): 100 parts per million.
Grading:

Retained on No.	8 mesh	4.0 per cent
No.	16	19.1
No.	30	53.5
No.	50	88.1
No.	100	96.5

To supplement the deficiency in fine fractions, a blending sand was added to the coarse sand.

Fine sand: Average value from Sept. 1, 1951, to May 31, 1952.
Fineness modulus: 0.88
Organic matter content: Nil.
Grading:

Retained on No.	8 mesh	0.2 per cent
No.	16	0.7
No.	30	2.4
No.	50	14.3
No.	100	69.9

The grading of the average blended sand was 90 per cent coarse and 10 per cent fine sand.

Organic Matter

An investigation at McGill University by Dr. H. W. Lucien showed that the air-entraining properties of this sand were due to the presence of a considerable proportion of organic matter in the sand. This organic matter seems to be derived from the decomposition in clay beds underlying the sand deposits. Some of the volatile products of the organic decomposition have been recondensed on the surfaces of the sand grains overlying the clay deposits and have imparted special properties to the sand, as far as its use in concrete mixtures is concerned.

Dr. Lucien was able to separate the organic matter present in the sand into three main groups. The first of these, which was a nonvolatile brown crystalline solid, possessed foaming properties when used in concrete mixtures. The second, which consisted of a liquid with a high vapor pressure, exhibited foaming properties to an even more marked degree. The third constituent consisted of methane gas which apparently was absorbed on the surface of the sand particles, or, possibly, dissolved in the second constituent mentioned above.

All could be removed by cold solution in ethyl ether. By distillation of the solution at 0°C, and reduced pressure, the ether was removed along with the methane. The extract remaining consisted of a mixture of Components 1 and 2, and by heating on a steam bath Component 2 was volatilized, leaving a residue of the brown crystalline solid.

The extracted sand possessed no air-entraining or foaming properties, but re-introduction of the extracted components resulted in renewal of the foaming effects.

Long continued aeration of the sand apparently results in virtual elimination of Components 2 and 3, with appreciable reduction in foaming or air-entraining properties, but does not eliminate Component 1, which is comparatively nonvolatile. Heating to 212°F, such as occurs in heating aggregate with live steam in winter operations, assists in eliminating the volatile constituents, but is only partially effective, due to the difficulty of eliminating the volatile constituents from a comparatively large mass of sand in a stockpile. Heating to still higher temperature in a drier would effectively remove the greater part of the surface-activating materials, but such a procedure, apart from the cost, would present serious problems in mass concreting operations because of the necessity of after-cooling.

These organic products, derived from the anoxemic decomposition of organic matter, behave quite differently from normal organic materials which contaminate sand as a result of the decomposition of organic matter at the surface in the presence of air. The ordinary sodium hydroxide color test is useless, as a concentration of as high as 500 parts per million may show a color corresponding to No. 1 on the color chart. At or near the surface, where aeration and oxidation have occurred, the sand has little or no air-entraining property; the effect increases with depth, as might be expected. The effect varies widely with sand from different parts of the same deposit. In the first trial mixtures accidental air contents of 5-9 per cent in plain mixtures were obtained. Later even higher air contents were observed and, in one instance, when an investigation was underway to determine why there was unusual difficulty in controlling the air content of the concrete, a trial mixture of plain concrete was prepared in the laboratory with sand which was then being used in the plant, which contained 23 per cent of accidental air. This concrete weighed 118 lb. per cu. ft. and had a consistency like that of whipped cream.

Laboratory Tests

Once the problem was understood the remedy was fairly simple. Since the air inclusion resulted from the presence of a foaming agent in the sand the obvious remedy was to eliminate this excess air by the addition of a foam control agent. At the same time, since a certain amount of properly entrained air is desirable in concrete to afford protection against freezing effects, the foam control agent should be not too drastic in its effect and should leave a residue of stable air in the mix.

By investigation on a laboratory basis, prior to the start of the actual construction, several agents were found which functioned in a satisfactory manner. Most of the satisfactory foam control agents belonged to the higher alcohol group and some of these could be used commercially in concrete mixtures at no great cost.

Preliminary Field Experience

The first approach to the problem was to use the foam control agent to reduce the air in the mixture, as discharged from the mixer, to the desired amount. It was found that this approach did not give adequate control, since variations in air-entraining characteristics of the sand were quite marked — and it was difficult, in plant control, to keep pace with such changes. From the start of concrete operations on these projects, mortar samples, including all aggregate below the $\frac{1}{2}$-in. screen size, were prepared and subjected to freezing resistance tests. Some of the early tests indicated that even 5

per cent of air retained in the $-1\frac{1}{2}$-in. fraction under such conditions did not give complete protection against the effects of 150 cycles of the freezing test. It appeared that not all of this residual air was effective in providing protection against freezing effects. This was supported by results of laboratory tests which indicated that, in some cases, from 7 to 9 per cent of accidental air was necessary to obtain adequate protection against freezing effects.

A further difficulty was that the accidental air introduced by the organic matter in the sand was comparatively unstable, and the resultant foam broke down rapidly. As a result, concrete might be discharged from the mixer to a transport vehicle in a perfectly workable condition and by the time it arrived at the point of placement so much air had been lost that at the delivery point the concrete was harsh and unworkable, and, incidentally, contained insufficient air to protect it against freezing effects.

Pumped Concrete Operations

This loss of air was particularly objectionable in pumped concrete operations, where satisfactory performance depends entirely on the use of a mixture which will not segregate in the line. With an unstable air content, sufficient loss of air to the top of the line will result in an open air channel along the top of the line and a mechanical freeze of the main bulk of the concrete in the line. In such a case it becomes necessary to stop operations and empty the line. With a line 1000 ft. long this means possibly a four-hour delay and the loss of 10 cu. yd. of concrete in the line, plus what is in transit to the pumping machine from the mixer plant.

Before the concrete work had proceeded far along these lines it was realized that, regardless of all else, concrete discharged from the mixer had to have a residual content of stable entrained air. This was achieved by adding an excess of air-entraining agent to the mixture to introduce an excess of stable air into the mixture, and then adding a sufficient amount of the foam control agent to eliminate excess air and reduce the air content, on discharge from the mixer, to be the desired amount. It was felt that by doing this the residual air in the mixture would be fairly stable and would remain reasonably constant in amount from discharge from the mixer to the point of final placement in the forms.

This was found to be so, and it was possible to discharge concrete from the mixer with an average air content of 5-7 per cent, haul it 3 miles in trucks, put it through a Pumpcrete machine, pump it 800 ft. and discharge it from the end of the line with an average air content of 3.5-5.5 per cent in the $-1\frac{1}{2}$-in. fraction of the mix.

Table I. Concrete Observations, June 15, 1951

At the mixer			At the forms		
Time	Slump, in.	Air content, per cent	Time	Slump, in.	Air content, per cent
P.M.			P.M.		
3:00	1	6.0	3:00	$1\frac{1}{2}$	4.5
3:10	1	7.6			
			3:15	$\frac{1}{2}$	4.5
			3:30	1	4.9
3:45	$2\frac{1}{2}$	7.5	3:45	$1\frac{1}{4}$	4.0
			4:00	1	3.8
4:05	$2\frac{1}{2}$	6.0			
			4:15	$1\frac{1}{2}$	4.9
4:30	$2\frac{1}{2}$	7.0			
			4:35	$1\frac{1}{4}$	3.9
			4:45	1	4.7
5:00	$1\frac{1}{4}$	6.4	5:00	1	4.9
			5:15	1	4.0
5:17	$1\frac{1}{2}$	5.2			
			5:30	$\frac{3}{4}$	4.7
5:45	5	7.5	5:45	1	4.8
6:00	$2\frac{1}{2}$	5.8			
			6:10	4	4.5
6:25	—	6.4	6:45	$1\frac{1}{2}$	3.7
Maximum	5	7.6	Maximum	4	4.9
Minimum	1	5.2	Minimum	$\frac{1}{2}$	3.7
Average	$2\frac{1}{4}$	6.5	Average	$1\frac{1}{4}$	4.4

Admixtures: air-entraining agent + foam control agent.
About 20 min. elapsed between the time when concrete left the mixing plant and was placed in the forms.

Table II. Resistance to 150 Cycles of Free-Thaw Test

Degree of scaling	0	1	2	3	4	5
Per cent of air: 2	1					
3	3					
4	5	3		1		
5	5	1				
6	1					
7	1					
Total number of tests	16	4	0	1	0	0
Percentage of the total number of tests	76.2	19.0	0	4.8	0	0

Degree of scaling ranges from 0 to 5, where 0 indicates no scaling and 5 complete disintegration.

Field Control

No great extra cost was involved in this operation. Air-entraining agents are comparatively cheap, and, with a sand such as described, the amount required to introduce an extraordinary amount of air is comparatively small. Foam control agents are more expensive, but the amount required is extremely small. The amount used varied from 1 to 15 cc. per cu. yd. of concrete, the maximum being used when, for a short period, the sand supplied to the mixing plant yielded 23 per cent of air in a plain mixture.

Adequate air control under such conditions calls for the continual presence of an inspector who does nothing but run air tests on the concrete discharged from the mixers. From the results of these tests the amount of foam control admixture is varied to insure a constant content of stable air in the concrete.

After establishing this practice it was possible to obtain much more satisfactory results from the test samples submitted periodically for

Table III. Concrete Observations, Apr. 7, 1952

At the mixer			At the forms		
Time	Slump, in.	Air content, per cent	Time	Slump, in.	Air content, per cent
A.M.			A.M.		
10:05	3	5.0			
10:15	3	5.0	10:15	3	5.5
10:30	2¾	4.9	10:30	3	5.3
10:45	2¾	5.1	10:45	3	5.2
11:00	3	5.6	11:00	3	4.9
11:15	3	4.8	11:15	2½	4.0
11:30	3	5.9			
P.M.			P.M.		
2:15	2½	4.5			
2:30	3	5.5	2:30	3	4.3
2:40	3	5.0	2:45	3	4.3
2:55	3	5.5			
			3:00	3	6.4
3:10	3	4.0			
			3:15	3	4.5
3:25	3½	6.4			
			3:30	2½	5.0
3:40	3	5.3			
			3:45	3	5.0
3:55	3	5.0			
			4:00	2½	4.4
4:05	3	5.0			
4:15	3	5.0	4:15	3	4.5
4:30	3	5.5	4:30	3	4.6
4:40	3	5.7			
			4:45	2½	4.1
4:50	3	6.0			
			5:00	3	4.9
5:05	3	5.0			
5:15	3	4.9	5:15	3	5.9
5:30	3	4.9			
Maximum	3½	6.4	Maximum	3	6.4
Minimum	2½	4.0	Minimum	2½	4.0
Average	3	5.2	Average	3	4.9

Admixtures: air-entraining agent + foam control agent.

freezing and thawing tests. Of the last batch of 50 samples, covering an operational period of approximately 2 months, not one showed any damage as a result of 150 cycles of the freezing test.

In the first approach to this problem, in June, 1951, little was known about it; the difference between the behavior of accidental and entrained air in concrete was not fully recognized. At that time it was felt that if between 3 and 6 per cent of air was obtained in the final concrete, the specifications were satisfied as far as frost resistance was concerned.

On June 5, 1951, the observations shown in Table I were made by the inspectors on discharge of the concrete from the mixers and on final delivery at the forms from the Pumpcrete machine. At this time the 8-in diameter Pumperete line was about 800 ft. long.

Final air control seemed to be fairly satisfactory and within normal limits, but freezing resistance test results on samples taken from similar concrete within the next week or two showed some variations from the properties desired.

Table I shows the behavior of 21 specimens of concrete taken during this period. While 16 of the 21 show no visible damage after 150 cycles of the freezing resistance test, four show slight scaling and one shows severe damage. All of the damaged specimens were from concrete mixtures containing from 4 to 5 per cent air in the $-1\frac{1}{2}$-in. portion of the mixture and should have been resistant to the freezing test.

Up to this time the amount of residual air in the concrete was controlled by simply adding enough foam control agent to lower the final air content, on discharge from the mixer, to about 2 per cent above the air content that was desired in place, without regard to the quality of the air in resisting freezing effects.

When the freezing test results were obtained on the first lots of test specimens, it was felt that something more than total air content of the mix was involved, and that perhaps the quality of the entrained air in the mixture was a factor. It was noted early that the accidental air had a tendency to leave the mixture readily, whereas, with normal aggregates, the entrained air is strongly retained.

The conclusion was that the proper method of handling such an aggregate was to add a large excess of a foaming agent, to increase the air content far beyond any reasonable amount, and add a controlled amount of an anti-foaming agent to reduce the final air content to the amount required in the mixture as discharged from the mixer. Theoretically, in such a procedure, the foaming agent will add stable air to the mixture, and the anti-foaming agent, provided that it is properly selected for the work, will eliminate the more unstable air fractions from the mix, and leave behind only those air fractions which will properly resist freezing effects. This presumes, of course, that the more stable air contents are also those which give greatest resistance to freeze-thaw exposure.

The experience, after a year of tests on concrete from this project, indicates that this may be correct. Table III presents the results of tests made on April 7, 1952, on concrete delivered to the work.

This presents a much better picture of air control than the record of June 5, 1951. Of greater importance, perhaps, is the fact that all samples of concrete sent in for freezing resistance tests during the period April-May, 1952, some 50 in all, came through 150 cycles of the freeze-thaw test without showing any visual evidence of damage.

Special Investigations

The observations, both in the laboratory and in the field, indicated that these sands, in addition to the fact that they possessed the property of accidentally entraining air, were extremely susceptible to the addition of further amounts of air-entraining agents. Addition of even a comparatively small amount of any of the normal air-entraining agents would result in an abnormal increase in the air content of the mix.

It was found also that with sands of this type, time of mixing is a pronounced factor in the amount of air entrained. A considerable part of the concrete on these projects was mixed in transit-mix trucks, where mixing time was liable to much greater variation than in central plant mixing operations. It was felt that some further information in regard to these effects would be desirable.

Long Mixing Time

Some difficulty was experienced at the start of operations in controlling the uniformity of concrete weighed at the batching plant and mixed in transit mixers. At that time the normal procedure was to insure a minimum mixing time of 10 min., but no maximum limit was specified, as the concrete was usually discharged shortly after the completion of the 10-min. mixing period. It was found that the air content would increase on longer mixing time and laboratory and field tests were carried out to determine the effect of long mixing time on air content.

Laboratory tests were carried out in a small 2.5-cu. ft. mixer operating at 22 r.p.m. The general procedure was to mix the batch until maximum air content was reached and then eliminate the excess air with an anti-foaming agent. Results of tests on two batches of plain concrete are given in Tables IV and V.

It appears that the air content in these plain mixtures builds up to a practical maximum in 15-20 min. of mixing time and, without foam control, in excessive amount. Addition of the foam control agent at the start of the mixing operation reduces total air as well as limiting the effect of excessive mixing time. Table VI shows the characteristics of a mixture in which the foam control agent was added at the start of the mixing operation.

In the above test it is noted that the air content builds up to a practical maximum after about 20 min. of mixing. With further mixing the air begins to reduce in amount, and after 50 min. of mixing it is eliminated fairly rapidly. Similar conditions were observed in the concrete discharged from the 2- and 4-cu. yd. central plant mixers, and it was found necessary, to obtain effective control of air content, to limit mixing time to a maximum as well as a minimum, and to adjust the amount of foam control agent added to that which would give the desired air content after the specified period of mixing.

Similar results were obtained from mixtures prepared in transit-mix trucks, although in these mixers the mixing period required to increase air to a maximum was appreciably greater than in the case of the small laboratory mixer. Results of observations on a batch of plain concrete mixed in a 3-cu. yd. transit mixer are shown in Table VII.

Here again it was found necessary to limit mixing time to a maximum to avoid excessive air entrainment

Table IV. Mixing Time Tests of Plain Concrete

Mixing time, min.	3	8	13	18	23	28*	30*	33
Air content, per cent.	6.0	14.0	17.3	20.0	21.0	23.0	12.5	6.4
Unit weight, lb.	142.8	130.0	125.2	122.0	120.2	118.6	128.8	146.8
Slump, in.	7	8	8	8	8	8	5	2

*Anti-foaming agent added after 28 and again after 30 min.

Table V. Mixing Time Tests of Plain Concrete

Mixing time, min.	3	8	13	18	23	28*	33
Air content, per cent.	3.8	11.7	13.5	14.4	15.5	15.5	7.2
Unit weight, lb.	151.0	136.8	134.2	134.0	132.0	131.2	146.2
Slump, in.	2	7	8	8	8	8	3

*Anti-foaming agent added after 28 min.

Table VI. Mixing Time Tests

Mixing time, min.	3	8	13	18	23	53	68
Air content, per cent.	2.3	3.5	6.2	6.7	6.9	5.6	3.7
Unit weight, lb.	152.8	151.0	145.8	143.8	142.6	145.0	150.2
Slump, in.	5	6½	7	7	8	2	½

Foam control agent added at start of mixing.

Table VII. Plain Concrete Mixed in 3-cu. yd. Transit Mixer

Mixing time, min.	10	20	40	60	80	100	110	120
Air content, per cent.	4.0	9.8	12.5	13.4	13.1	11.5	10.1	7.6
Unit weight, lb.	151.8	143.2	137.6	136.4	136.6	139.2	141.4	145.2
Slump, in.	1½	6	5	4¾	4¾	2½	2¼	1½
Compressive strength, 28 days, psi.	4685	3270	2340	2260	2220	2565	3090	3540

Table VIII. Effect of Excess Dosage of Foam Control Agent

Mix	85a	85b	85c	85d	85e	85f	85g
Cement, lb.	470	471	472	466	469	466	454
Sand, lb.	1330	1408	1411	1392	1403	1393	1357
Coarse aggregate, lb	1841	1947	1951	1926	1940	1927	1876
Water, lb.	269	298	298	295	291	285	256
Foam control agent	nil	1.25 oz	5.0 oz	1.25 lb	5 lb	20 lb	80 lb
Weight per cu. yd., lb.	3910	4124	4132	4079	4108	4091	4023
W/C	0.57	0.63	0.63	0.63	0.62	0.61	0.56
Slump, in.	3	2½	2½	2½	2½	2½	3
Air, per cent	7.1	1.9	1.8	1.7	1.5	1.6	1.0
Compressive strength, p.s.i.							
3 days	1920	2185	2210	2180	2135	2275	1690
7 days	2890	2985	3170	3320	2960	3100	2750
28 days	3750	3830	4050	4205	3830	3975	3525
Degree of scaling	0	1	1	1	2	2	2

as a result of long-continued mixing. Mixing time for transit mixers was set at 15 min. and rigidly controlled to that time. As in the case of the central mixing plant operations, the amount of foam control agent was adjusted to give the desired amount of air in the concrete on discharge from the mixer.

Effect on Foam Control Agent on Concrete

A series of tests was made to determine the effect of the foam control agent on the properties of the concrete, particularly on its compressive strength and resistance to freezing effects. In carrying out this series the amount of foam control agent was varied from nil to a maximum of 80 lb. per cu. yd. Mix proportions and results of compressive strength tests are shown in Table VIII.

In actual field application it was found that the amount required for satisfactory control of air content varied from 1 to 15 cc. per cu. yd., so that Mix 85b of Table VIII contains somewhat more than twice as much of the foam control agent as was ever used in practice, and Mix 85g contains about 2500 times as much. Mix 85b shows somewhat higher strength than Mix 85a, probably as a result of the elimination of the greater part of the air. The compressive strengths of Mixes 85c, 85d, 85e, and 85f vary somewhat, but the differences are not significant. Mix 85g does, however, show a decided drop in compressive strength, perhaps because such a volume of foam control agent in the mixture impedes the hydration of the cement.

Conclusions

1. In the past four or five years, fine aggregates possessing similar characteristics, though generally in lesser degree, have been encountered in numerous locations, among them the following: (1) Sault Ste. Marie, Ont.; (2) Greenwood, N.S.; (3) La Trenche, Que.; (4) Morin Heights, Que.; (5) Baie Comeau, Que.; (6) Cape Ray, Newfoundland; (7) Chalk River, Ont.; and (8) Sudbury, Ont. All of these aggregates occur in the area covered by the Laurentian shield, and all of them are glacial in origin. Since this paper was compiled the authors have recorded a number of additional cases where similar conditions have occurred.

This may explain, in part at least, the varying behavior of concrete in some of the structures in our northern areas which have been exposed to winter conditions. A typical example occurs in the case of the concrete works in connection with the power development at Shipshaw, near Arvida, Que. These structures, built 12 years ago without the use of air-entraining agents, are in excellent condition today except for certain localized areas where segregation in placing apparently resulted in concrete of high water-cement rates and poor quality. The bulk of the work shows no sign of damage as a result of exposure to freezing effects. Tests of the sand from the deposit used as a source of fine aggregate for this concrete indicate that it has the property of occluding air into the mixture to the extent of 3 to 6 per cent, and this may account for the excellent performance of this concrete to date.

2. A satisfactory degree of control of air content and consistency can be achieved by adding a surplus of an air-entraining agent to the mix and then eliminating the more unstable air fractions by the addition of a foam control agent in amount sufficient to leave the desired quantity of residual air in the concrete. In actual practice, both the foaming agent and the anti-foaming agent are added at the same time.

3. With sands possessing these characteristics it is necessary to set maximum as well as minimum limits for length of mixing time, both for central mixing and for transit-mix operations.

4. The outlined methods of control of air content in concrete when sands of the type mentioned are encountered yield mixtures which are highly resistant to freezing effects without, so far as has been established, any detriment to the other properties of the concrete.

5. In the majority of cases where this problem is encountered it would seem that the solution is to obtain aggregates which behave in normal fashion. If material of normal behavior is obtainable within economic distance it should be used. If such material is not available within economic hauling distance, then the information presented above may be of assistance in using the local aggregates to advantage.

Acknowledgment

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Where are we Heading in Higher Education in Canada at the Present Time?

(*Continued from page 628*)

supposed to acquire before they enter the school rooms as teachers. Education I have been using in a more general sense, — "the content" or "the what to teach", as contrasted with "the how". But that is the smaller and less important meaning or use of "education" for my present purposes. For I would like to think of our school teachers not only as being competent to teach but as being educated men and women in the broadest and best senses of that term. That is why I would like all our teachers to spend a considerable time on the campus with the rest of our student body as our lawyers and doctors do, and why I would like them to take courses in the Faculty of Arts and Science under good university teachers, so that they may learn something about the content of the courses they may later teach, but in addition may become educated in the other senses in which I have been using that word.

This raises the question of summer schools and extra-mural courses for teachers, and of the normal schools as well. All of these are important and have made valuable contributions to the training and education of teachers. I would like to say a special word of appreciation for the work done by the normal schools. But, I should point out that of necessity, due to the limits of time and their special responsibilities, their main concern is with teacher training, with the "how to teach". I would hope that if our teachers could spend a longer time in training and could do this at the university in association with other students, they would benefit from this more extended and varied experience and be better educated citizens and better teachers as a result of this experience.

Newer Types of MAGNETIC AMPLIFIERS

by

R. R. Jackson, M.E.I.C.

Assistant Research Officer,
Radio and Electrical Engineering Division,
National Research Council, Ottawa, Ont.

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The power range and field of application of "transductors", or magnetic amplifiers, have been widely extended during the past few years. Here the author reviews the fundamental principles of the magnetic amplifier and cites a number of examples of new uses recently developed for it in various fields.

Readers of the *Engineering Journal* will recall a paper, "The Transductor, or Magnetic Amplifier", by W. J. M. Moore in the February 1950 issue. In it, an excellent description of the basic principles and operation of magnetic amplifiers was given and a clear picture of the state of the field at that time presented. Since then, much work has been done, and it is felt that a new look at the subject is in order.

Many advances have been made in circuitry, and these in turn have often been made possible by improved components — primarily rectifiers and core materials. We propose to discuss briefly some of these developments, in the hope that it may be of use to those who do not have time to follow in detail various specialized aspects of electrical engineering. To do this adequately, it is necessary to review briefly the fundamental principles of operation of the magnetic amplifier.

Elementary Theory

We will deal in this presentation only with so-called "square loop" core materials. These are alloys having a flux density vs. magnetomotive force characteristic similar to that shown in Fig. 1b. This sketch represents conditions of the circuit of Fig. 1a, in which a sinusoidal voltage e is applied to a winding of N turns linking a toroid of the material in question. In Fig. 1b, H represents the magnetomotive force, proportional to the ampere turns Ni linking the material, and inversely proportional to the length of the magnetic path. The ordinate B is the flux density in the material.

Let us assume that conditions are initially described by point a of Fig. 1b. That is, the flux is at negative saturation and the magnetomotive force is negative. Now let the magnetomotive force vary towards positive values. The flux density B will change only a small amount until point b is reached. Then, over a very small change in H, B will increase until positive saturation is reached at c. Further increases in H will increase B only slightly. Upon reversing the direction of change in H, the path d-e-f-a will be followed.

The hysteresis loop so traced in actual practice is not as precisely regular as shown in Fig. 1b, but it does approximate the figure quite closely for a number of materials in common use today. Further, no material has only one hysteresis loop. The frequency at which the loop is traced, and the wave shape of the voltage e have effects on its outline.

It is possible to analyse the behaviour of some amplifiers quite adequately by means of the B-H characteristic depicted in Fig. 1c. This neglects the width of the loop — i.e. it neglects the magnetizing currents — but in some cases this is of little importance.

In his paper, Mr. Moore drew attention to a very useful method of analysis. This utilizes the relationship

$$e = N\frac{d\phi}{dt} \qquad \ldots\ldots\ldots 1.$$

where e and N are as shown in Fig. 1(a) and ϕ is the total flux linking the N turns. ϕ is given by B times the cross-sectional area of the magnetic path. In writing equation (1), we have assumed the B-H characteristic of Fig. 1c.

Integrating equation 1, we obtain

$$\int_{t_1}^{t_2} e\, dt = N\,(\phi_2 - \phi_1) \qquad \ldots\ldots\ldots 2$$

where ϕ_1 is the flux level at time t_1 and ϕ_2 that at time t_2.

It is now possible to show how the flow of current in a load is controlled by the majority of magnetic amplifiers. Fig. 2(a) is similar to Fig. 1(a) except for the addition of a load. Let $e = V \sin \omega t$ where V is the peak voltage, and w is equal to $2\pi f$, and f is the frequency of voltage alternation. Further, assume that at $t = 0$, i.e. when $e = 0$, the flux density in the core material is at the point ϕ_p of Fig. 2b. Note that the ordinate of Fig. 2b is flux ϕ rather than flux density B.

As the voltage $V \sin \omega t$ rises in the beginning of the cycle, ϕ will also increase (eq. 1). During this period,

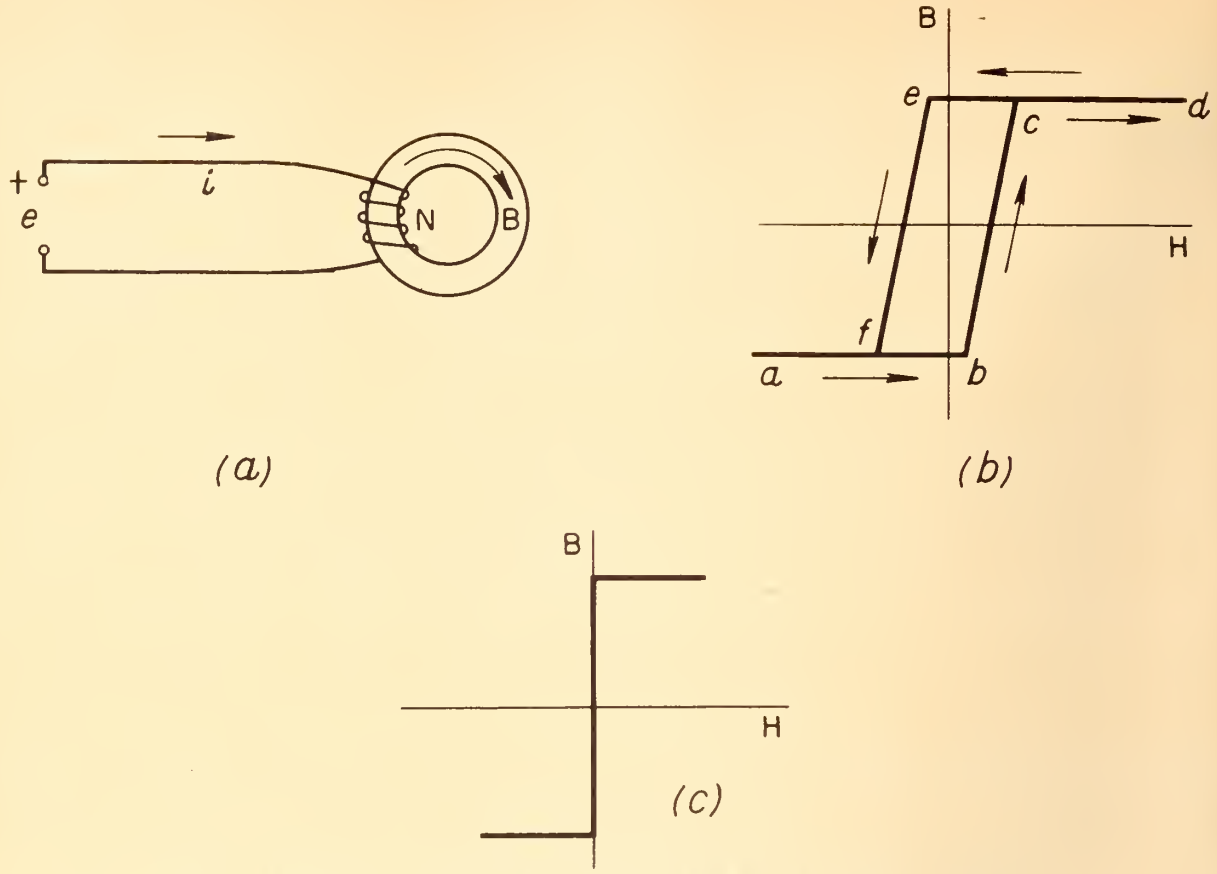

Fig. 1. Magnetomotive force vs. flux relationships in "square-loop" material.

the supply voltage is balanced by the rate of change of flux linking the N turns. Assuming the idealized loop of Fig. 2b, no current flows in the circuit during this period.

When ϕ reaches the value $+\phi sat$, it can increase no further. $\frac{d\phi}{dt}$ becomes zero and the core can no longer absorb volt-time integral. Thus, at this point, the voltage is transferred abruptly to the load. Of course, the circuit shown would function in this manner for only one half cycle, as there is no means of setting the flux at ϕ_p for the next "firing".

However, this serves to show that with core materials of the type described, there is possible a sort of switching, or thyratron action. If means are available to "preset" the flux ϕ_p each cycle, to any desired level, it is then possible to divide the volt-time integral between the core and the load, so as to achieve control of the load voltage, and hence of the load current.

Conventional Amplifiers

The primary differences in modern magnetic amplifiers exist in the means for controlling the value of ϕ_p. The methods of operation of more conventional types are discussed in Mr. Moore's paper, and others (Ref. 1, 2, 3, 4). It is only necessary to draw attention at this point to the relatively slow response of high gain magnetic amplifiers, a disadvantage in some applications. In general higher gains bring about longer response times (Ref. 5). It is possible

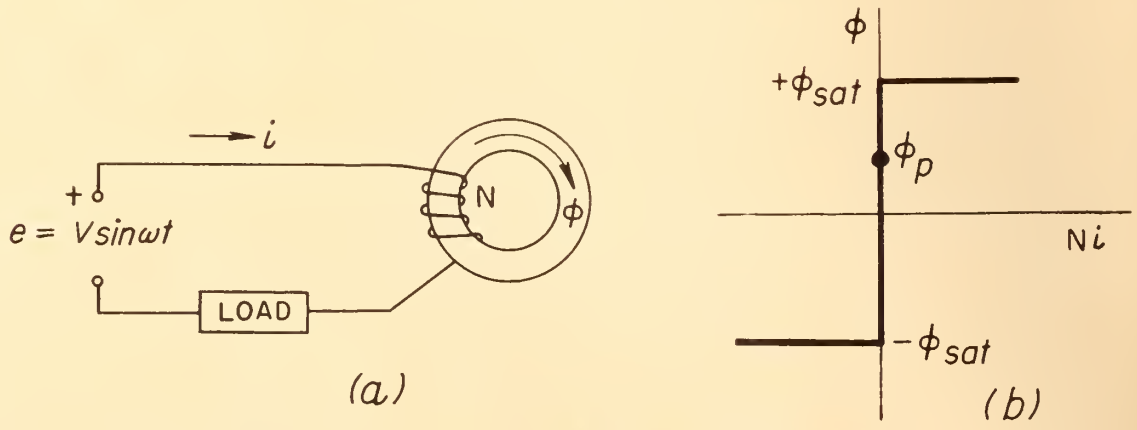

Fig. 2. Control of load voltage by "volt-time" division.

to improve upon this condition somewhat by obtaining the desired high gain through the use of several stages rather than one only, but it is a definite limitation in applications requiring fast response.

A Half-wave, Half-cycle Response Circuit

Fig. 3 shows a circuit in which it is possible to control the presetting of the flux level, and which responds fully to changes in control in one half cycle of the supply frequency.

For purposes of analysis, assume the following:

1. The load is resistive, of resistance R, and the resistance of all other parts of the circuit is negligible.
2. The B-H characteristic of the material is ideal, as shown in Fig. 1c.
3. The rectifiers are ideal, — that is, they have zero resistance in the forward direction and infinite reverse resistance.
4. e_c, the control voltage, is a half-wave rectified sinusoid, and its pulses coincide with negative half-cycles of e_g, the supply voltage.
5. The supply voltage, $e_g = V_g \sin \omega t$, is of such a magnitude that, acting alone on the winding, it would swing the core flux between positive and negative saturation.

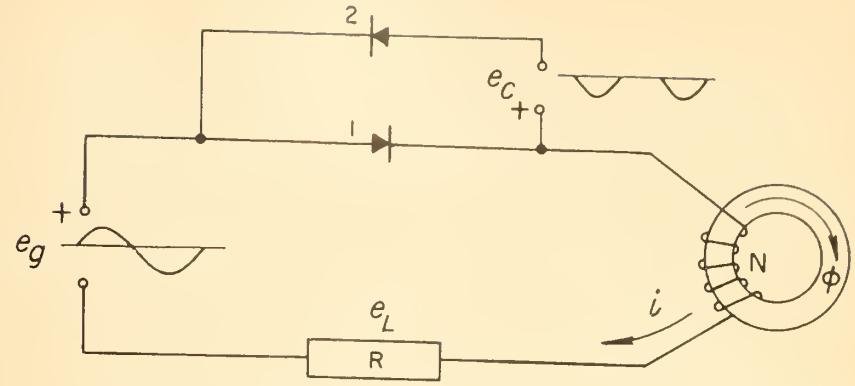

Fig. 3. Half-wave amplifier.

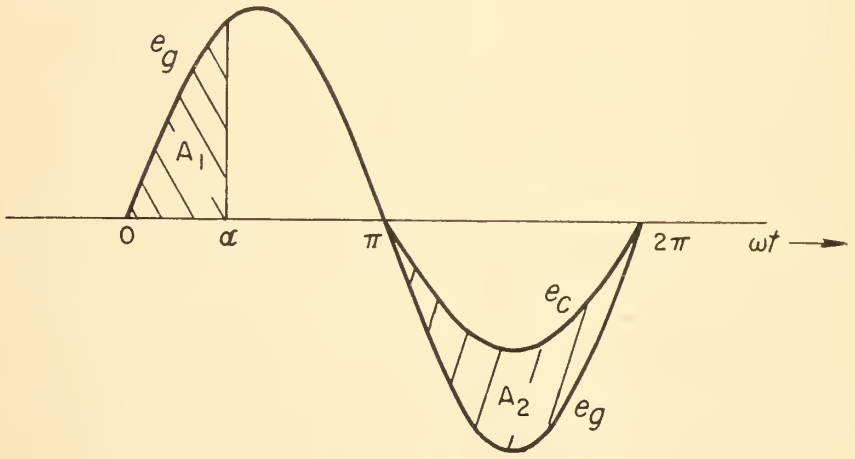

Fig. 4. Operation of amplifier of Fig. 3.

Now suppose that the amplifier is in steady state operation, and that at $t=0$, the core flux is at ϕ_p, as shown in Fig. 2b. For the first part of the voltage cycle, the course of events is that described earlier. The change of core flux balances the voltage e_g until saturation occurs, at which time the supply voltage is applied to the load, and for the remainder of the positive half-cycle a current $i = e_g/R$ flows in the circuit via rectifier 1. At $\omega t = \pi$, the voltage e_g, and consequently the current i, become zero.

The direction of the supply voltage now reverses, tending to cause i to flow in the other direction via rectifier 2. At this point, the flux is still at positive saturation and there is zero magnetomotive force applied to the core. Again the rate of flux change balances the voltage applied to the core, but this voltage is now $e_g - e_c$, rather than e_g alone. Thus the flux change occurs at a slower rate than in the "firing" half cycle, and in fact, since steady state operation was assumed, must change at such a rate as to be equal to ϕ_p at the end of the negative half cycle.

Figure 4 shows this situation graphically. A_1 is the volt time area (the time integral of e_g) absorbed by the core between $\omega t = 0$ and $\omega t = \alpha$, the "firing angle". A_2 is the volt-time area absorbed by the core on the negative half-cycle, — that is, it is the difference between e_g and e_c integrated from $\omega t = \pi$ to $\omega t = 2\pi$. In steady state, A_1 and A_2 are equal in magnitude.

A brief look at limiting cases may help. If the control voltage is zero, the flux will swing all the way from positive to negative saturation on the negative half cycle, in view of assumption 5. No "firing" can occur on the next half cycle, because the core is now able to absorb all of the positive voltage swing. If the peak value of e_c is equal to the peak of supply voltage, there will be no voltage applied to the core, and hence no flux resetting, in the negative half-cycle.

Thus the core remains saturated and e_g is applied to the load continuously throughout the positive half cycle. That is, "firing" occurs at the beginning of the positive half cycle. Further increases in e_c have no effect, and the output remains constant. The output characteristics of the amplifier, in terms of load voltage E_L vs. control voltage E_C, are shown in Fig. 5. E_L and E_C are half-cyclic rectified values of e_L and e_C respectively.

Transient Response of the Half Wave Amplifier

It will be seen that any change in e_C, occurring in a firing half cycle, will be immediately effective in controlling the flux reset during the succeeding negative half cycle, and no further change in amount of flux reset can occur without an additional change in e_C. Thus the amplifier responds completely to this change in signal within one half cycle of the supply frequency.

A change in e_C occurring during a reset half cycle will be only partially effective for the next firing, and complete response will thus occur in the following cycle. The maximum time required for complete response of the load voltage to changes in control voltage is thus

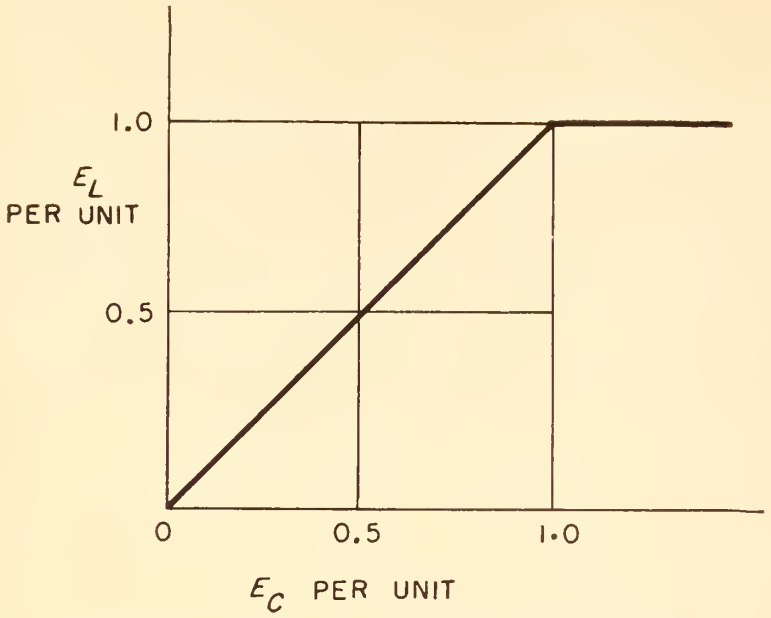

Fig. 5. Transfer characteristic of amplifier of Fig. 3.
Note:—At E_C = 1.0 per unit, e_C peak = e_L peak = e_g peak.

one and one-half cycles of the supply frequency.

Effect of Actual Core Characteristic

In actual practice, the core characteristic is more like that shown in Fig. 1b than that of Fig. 1c. This means that during flux swinging periods, a small magnetizing current will flow in the load. In firing half cycles this makes no great difference to the analysis, but it has an important effect on the operation in resetting half cycles.

If the *B-H* loop were that of Fig. 1c, no current would flow in the signal source, and hence the signal source impedance could be made as large as desired. This would make possible power gains of any magnitude, though the voltage gain for the circuit of Fig. 3 is always 1. The non-zero width of the loop, however, means that current must flow in the winding to produce a flux change, and this current must neeessarily flow in the signal source during resetting half eycles. The voltage drop thus produced in the signal souree acts in a manner similar to the control voltage, so that the impedance of the control source provides a limit to the sensitivity of the amplifier to small signals.

For example, if the impedance of the signal source were high enough to limit the reset current to a value less than that neeessary to produce a flux change, no resetting could occur and full output would result at all times. It is in fact possible to control this amplifier by means of a variable resistor in place of e_c.

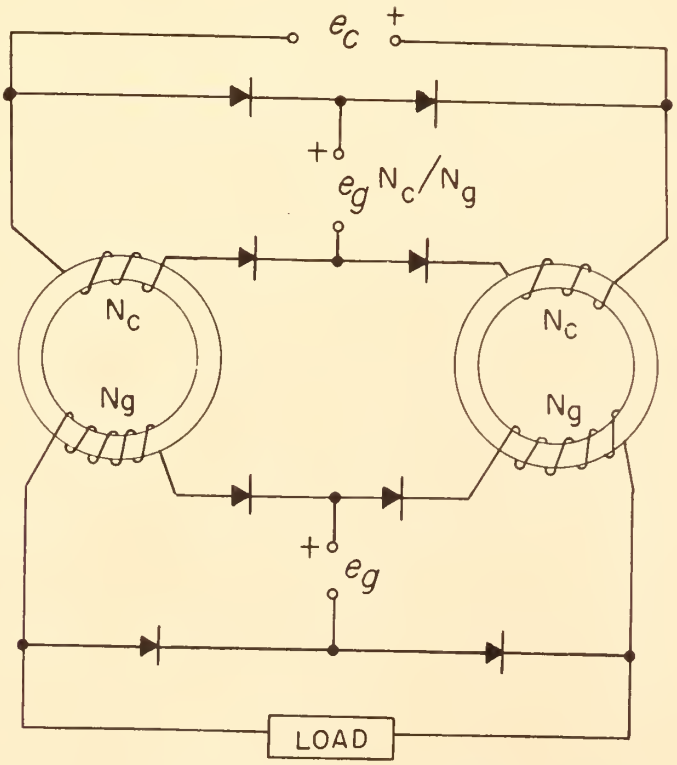

Fig. 6. Double bridge self-saturating magnetic amplifier.

Other Half Cycle Response Circuits

A full wave circuit operating on the principles outlined above, is shown in Fig. 6 (Ref. 6). There are many such circuits (Ref. 6, 7, 8) and these have found a wide application, particularly in the servo-mechanisms field. If a supply frequency of 400 cycles per second is used, amplifiers with response times of 2 or 3 milliseconds result.

Recent Developments

Without going further into details of operation, it is interesting to note how the power range and field of application of magnetic amplifiers have increased. A recent paper (Ref. 9) describes an amplifier with a zero drift of 10^{-16} watt, using several stages to raise output to the micro-watt level. An amplifier on a somewhat different scale having an output of 160,000 amperes at 14 volts (2240 kw.) has been in successful operation for some time (Ref. 10). This device involves the use of 20,000 pounds of copper, 4 tons of grain oriented steel and 8,000 gallons of oil. In its selenium rectifiers are nearly 8,000 plates each of 45 square inches. It is controlled by less than one half ampere.

Even the audio field has been invaded. An all-magnetic audio amplifier (Ref. 11) has been built and successfully operated. Compact, rugged, and requiring no warm-up time, it has a useful band-width (3 *db* down) of 0 to 3000 cycles. It utilizes a modulated carrier, and the carrier itself is generated from the

power source by means of magnetic circuits which multiply frequency.

A further illustration of the wide application of the magnetic amplifier is its use as an analogue computor component (Ref. 12). In military computors, where a mean life of at least 6 months between failures with operation under unfavorable conditions is desirable, extreme reliability of individual components is important. Here this is achieved by the combination of dry rectifiers, precision resistors and magnetic amplifiers.

Finally, it is of interest to note recent work (Ref. 13) in the development of circuits using transistors in conjunction with saturable cores. The combination is apparently a happy one, and has given rise to a number of interesting circuits. It has opened up a new field of development of which much will doubtless be heard in the future.

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Power Reactor

The following is an excerpt from the statement made in the House of Commons, Thursday, March 24, 1955 by the Rt. Hon. C. D. Howe, Hon.M.E.I.C.:

"On February 17, 1953 in the course of a brief report . . . . . on the atomic energy program, I stated that the time had come to undertake the development of atomic power in this country. I stated further that, since the production of power is the concern of the various commissions and power companies which distribute power in Canada, it seemed desirable that arrangements should be made whereby the power producers might participate in the future development work. Shortly after this announcement, the Hydro-Electric Power Commission of Ontario indicated its interest in participating in the program, and discussions began as to how this might be carried out most effectively. These discussions resulted in a decision to undertake a feasibility study which would have as its object the determination of an outline specification for a power reactor. The arrangement, which was announced on November 12, 1953 provided that Atomic Energy of Canada Limited would make available technical information and experimental facilities and that Ontario Hydro would supply the personnel for the study. Ontario Hydro also stated its intention to expend on the study up to $100,000 a year over a two-year period. Subsequently several other utilities contributed personnel to the study group.

During the debate on the amendments to the Atomic Energy Control Act last June, I advised the House that it had been decided to set up an Advisory Committee on Atomic Power, consisting of representatives of all the power commissions and the power companies in Canada. The purpose of the Committee was to provide a medium whereby power producers in all parts of Canada might be kept fully informed of developments in the atomic power field. . . .

Late in 1954 the feasibility study had advanced to the point where it was possible to consider the next step — the design, engineering and construction of a demonstration power reactor. Atomic Energy of Canada Limited has now recommended that such a reactor should be built, and the Government has accepted this recommendation. The reactor will be designed to produce 20,000 kilowatts electric. Its nuclear specifications will be based, in the main, on the heavy water technology which has been developed at Chalk River in connection with the operation of the NRX reactor. While the reactor is not expected to produce power at costs competitive with hydro plants or large thermal stations, it will provide the kind of operating and cost experience which will make possible a scale-up to a large and economic power reactor.

Bearing in mind that atomic power will be used by the utilities and that the manufacturing industry will be responsible for producing the equipment and components for power reactors, it seemed desirable that arrangements should be made for the participation in the project of a utility and, further, that the detailed design, engineering and construction of the reactor should be contracted to a manufacturer.

Two utilities, the Hydro-Electric Power Commission of Ontario and the Nova Scotia Light and Power Company Limited, have made specific proposals for participation in the project, and two utilities, the Nova Scotia Power Commission and the New Brunswick Power Commission have indicated some interest. Atomic Energy of Canada Limited has now recommended that the proposal of the Hydro-Electric Power Commission of Ontario be accepted, and the Government has approved this recommendation. The arrangement will provide that Atomic Energy of Canada Limited will assume responsibility for the specifications and the cost of the reactor and that the Hydro-Electric Power Commission of Ontario will assume responsibility for the specifications and cost of the conventional part of the plant, including the cost of the building to house the entire plant and the cost of its site. Ontario Hydro will operate the plant as a part of its power system and for that purpose will purchase steam at a price equivalent to the cost of steam produced in the emergency plant erected at Scarborough, Ontario some years ago.

The decision to accept the proposal of Ontario Hydro is based on several factors. First, as the reactor is to be used for demonstration purposes it is essential that it be operated in a power system which is sufficiently large to cope with interrupted operation or operation at a low load factor. Second, it is considered desirable that the first power

(Continued on page 659)

Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

A LONG STEEL HIGH PRESSURE PIPE LINE

Guy R. Scott, *Journal—American Water Works Association*, v. 46, n. 7, July, 1954, pp. 627-628.

This line is a unit in the program to increase the water supply for Colorado Springs, Colo.

The 30-in. steel line, when completed, will transport water by gravity from the Continental Divide near Alma, Colo., to the present limit of the city's system on the north slope of Pike's Peak, a distance of about 72 miles. Owing to the character of the terrain and the necessity of crossing from one major drainage basin into another, the entire length of the line is an inverted siphon, with operating heads exceeding 1,000 ft. over much of the distance and reaching a maximum of 1,900 ft. The capacity of the line will be 18 mgd. The eastern 16.6 miles of the line were completed in 1953, along with some 14- and 16-in. lines that, with two pumping stations, enable the city to obtain a supply from the South Platte River near Lake George until the gravity line can be completed.

The welded steel pipe is lined with shop-applied coal-tar enamel and is coated with coal-tar enamel and white-wash. The manufacturers were requested to furnish their most economical 16- and 30-in. pipe for each internal working pressure classification, the thicknesses to be obtained from the formula $T = \frac{PD}{2S}$, in which P is the working pressure (p.s.i.), S is the unit stress (p.s.i.), T is the pipe wall thickness (in.), and D is the outside diameter (in.). In applying the formula, the maximum unit stress allowed in pipe design was 50 per cent of the minimum yield point of the steel. The minimum wall thickness permitted for the 16- and 30-in. pipe was 0.25 in., while that for the 14-in. pipe was 0.1875 in.

Wall thicknesses for the 30-in. pipe as furnished varied from 0.25 in. for the 240-p.s.i. classification (minimum allowable) to 0.47 in. for the 750-p.s.i. classification, the latter being based upon steel of 50,000-p.s.i. minimum yield point. Pipe was furnished in nine different classes, or working pressures, including the two limiting pressures. All 30-in. pipe was furnished in 40-ft. lengths, and 14- and 16-in .pipe in double random lengths up to 40 ft.

The use of coal-tar enamel lining and coating made necessary the following construction procedure. Because of the difficulty anticipated in making repairs and inspecting the inside lining at pipe joints, an all-welded pipe, feasible when unlined, was impossible in the 14- and 16-in. sizes and was considered impracticable in the 30-in. size. Therefore, the method specified for the 30-in. size consisted of joining, by butt welding, three 40-ft. lengths on the trench bank and then coupling the resulting 120-ft. lengths mechanically in the trench. This procedure permitted easy access to and repair of the inside lining at welded joints and eliminated the need for pass holes in the pipe, as well as problems in ventilation that would have accompanied all-welded construction. Pipes 14- and 16-in. in diameter were connected by mechanical couplings, and welding was prohibited except for special bends or installation of fittings.

The total cost of the project, including the diversion dam, the two pumping stations, and the pipeline, was $2,176,240. About 5,200 tons of steel was required for the fabrication of the pipe.

SURVEY OF A GROWING PROBLEM: FOREMAN-MANAGEMENT RELATIONS

E. B. Lindsay, *Advanced Management*, v. XIX, n. 9, September, 1954, pp. 25-28.

Management is increasingly aware of a serious foremen problem. It is encouraging to note that top executives in almost every progressive firm and industry are actively pursuing a program of promising attacks aimed towards alleviating the situation.

The foreman's nose is out of joint: His interests have been short-circuited. Many of his prerogatives have been taken away. His authority has been reduced. His margin of financial compensation is less pronounced. He is denied the privilege of sharing, in the true sense, management's problems. He is begrudged the right to unionize. And yet he is still shouldering the prime responsibility of getting out, as economically as possible, an established quality and quantity of goods in a given time.

It is small wonder that tradesmen or workers are often reluctant to accept the promotion to foremen, recognizing it as a promotion to a tougher, poorly-compensated, complicated, red-tape-infested and grievance-ridden job.

Foremen Earns Less Than Many Workers They Boss

The postwar period produced a production boom of commercial goods in America. The high overtime pay of the production man continued to be as substantial as it had been during war time, and yet the foreman's weekly pay cheque made no allowance for his many extra hours of work, so that in many cases, because of the wage freeze, the foreman was actually earning less than good production workers. Then too, paid vacations and paid sick leave are no longer exclusive benefits to foremen and neither are pensions or old-age security policies.

Some management experts now refer to the foreman of today as "The underpaid, under-privileged, uninformed, confused, insecure

member of management". Here is how leading industrial concerns are meeting and solving the issues.

Compensation

A number of companies have discovered that a large portion of the rank and file workers are unwilling to become foremen because the pay increment is not enough greater to be attractive. Consequently some companies are maintaining differentials up to 30 or ever 35 per cent.

Some firms pay incentive bonuses to foremen along with other management and staff people. Other companies are paying their supervisors for overtime hours, as well as an adequate basic pay differential. Progressive corporations recognize that compensation in the pay envelope is only one segment of compensation in the true sense. Genuine recognition in the form of sincere praise for a job well done means more to the soul of average man be he president, manager, foreman or worker than any other one thing.

Three Steps Are Needed

True compensation takes still other forms. Little privileges, even a little paternalism, go a long way towards raising the status and the morale of the supervisors. Such things as a foreman's office, conference, lunch and coat rooms, desks or tables, a distinctive foreman's jacket, being put on the mailing list of the technical and management publications and having access to a company library are all steps which are being taken by progressive managements in an effort to elevate the status of the foreman. Please note that this elevation by compensation is largely superficial and is only the first of the three steps of (1) compensation; (2) communication and (3) management team building.

Communication

Communication is a two way street. Top executives are only now beginning to realize that it is just as important to be understood as it is to understand. The emphasis today in management is on two-way multilateral communication.

There are two separate phases to the new type of industrial management communication. The first phase is the job problems and planning discussion and conference with all members of the management team. The second is informational communication—the supervisors telling executive and staff management how the production job is going; staff people telling the supervisory management and executive management the results of their studies, surveys and programs; executive management in its turn keeping the staff and supervisory people informed on the progress and status of the business enterprise and on high level company policy.

Advantages of Conference Method

The conference method of job discussion is rapidly gaining in popularity. It has two main advantages; first is the pooling of brain power and industrial experience of all levels of the enterprise's management, and second is the elevating of the status of lower echelons of management. The chief disadvantage which companies have found with these conferences is that they tend to become long-winded.

The methods of informal communication vary somewhat from company to company.

In the older and more dictatorial organizations the method frequently used is what might be referred to as the "Factory Manager's Weekly Review" where supervisors come one by one and review with the factory manager and sometimes one or two selected others the progress over the past week. The advantages of this method are that the factory manager keeps up to date on events, progress and problems and little time is wasted by any of the participants. There are disadvantages, chief of which is the fact that communication tends to become one-way with top executives soaking up information but giving none out. Another disadvantage is that only a selected few are present and much valuable information becomes pigeon-holed. There is a tendency in these discussions for the selected few to become fewer and fewer and for the few to pass along less and less of the information.

Approaches to End One-Way Communication

A number of businesses have attempted to overcome the tendency of one-way communication from supervisors to top executives by opening up another parallel avenue for the transfer of information in the opposite direction. Here are some of the approaches being used: a president's newsletter or a management newsletter, a summary of financial or business progress (whether or not it be encouraging), news conferences for business and industry news only, posters and pamphlets in the staff or management dining rooms, annual reports, training or educational refresher courses with all of management in attendance and participating.

Another communicational approach which is favoured by some companies is the weekly written report summary. The foreman writes a summary report to his department head. The department head writes a summary report to the factory manager. The upper echelon of management reciprocates with its business summary. The beauty of this method of communication is that with careful distribution only those to whom the information is useful will get it, the report writer can plan and budget his time so that the report will be written during slack periods in the day, and similarly the report can be read by recipients when the time is available; the report, because it is written, will be concise and definite and it will form a permanent record and a stimulant to improve performance, which will serve as a reminder and can be referred to at any future time, and it builds clear thinking top management men for the future. The weaknesses of the weekly report summary are that it eliminates spontaneous co-operative solution to current problems, it takes away the desirable element of personal contact, many people find it tedious and difficult to express their views in writing and some even fear possible criticism, and it takes considerably longer to write about a situation than tell it verbally.

The solution to the problem of inter-organizational communication which seems to have been the most successful, is a combination and compromise between the weekly summary report and the job conference.

Building the Management Team

Finally we come to the last step in the solution to the foremen problem, that of making these supervisors management conscious and concious of being a part of the management team. It is surprising and startling to discover that this last important phase of organizational integration has been both neglected and conscientiously avoided in some instances, by even the most progressive of managements. When asked the reason for this neglect the answer most often given seemed to be either that the top men were too busy, or it would be mollycoddling and paternalism, or that they couldn't see how it would pay for the effort involved or do the company any good.

How to Train Supervisors to be Management Conscious

Obviously every company is in business to make money. To be

cognizant of his important role of controlling and supervising the workers, the supervisor must be management conscious. And making these foremen a part of the management team is the most important step to ensure a loyal, robust, happy and financially secure business enterprise. Furthermore, it is probably the best way known to build future department heads, factory managers and other top executives.

The best management consultants in America seem to agree that the most important step in building a management team is for top executives to share with lower echelons of supervision and administration their problems and headaches.

This whole idea of sharing problems is a philosophy of consultive administration and supervision which puts emphasis on human dignity. The purpose is the encouragement of increased productivity and ultimately the personal gain of all participants. The object is to create in every last member of the management team a healthy motivation and a want to do that extra bit that so often means so much towards success.

It has been indicated by many studies that the average individual's output is somewhat less than 65 per cent of what is considered a reasonable standard. It is believed by those who are regarded as leaders in "consultive supervision" such as General Foods Corporation that in order to close the gap, one of the most important steps is to create a genuine feeling of greater participation on the part of every employee. The individual will give more if he feels that he is "in the act" and "a member of the team" rather than simply one of the cogs in the business machine.

Basic Rules

Companies which practise consultive supervision generally accept and follow these basic rules:

1. The president, general manager and production manager must accept and practise consultive supervision methods remembering that subordinates are likely to deal with those they supervise as they themselves have been dealt with.
2. Subordinates must feel free to say so when they see some arrangement which they believe is not the best one. They should be encouraged to work out a more satisfactory solution but should be discouraged from making destructive criticism.
3. Every leader should review this or that problem from time to time with those who report to him, and occasionally take along a subordinate to meetings with other supervisors,—particularly if the individual is interested in or affected by the question to be discussed.
4. "One-man shows" should be frowned upon while the development of subordinates who have the ability to think and contribute ideas should be encouraged.
5. All management should be convinced that when asked a question to which they do not have the precise answer it is better to say "I don't know. But I can and will get the right answer for you."
6. The factory and staff offices should be visited occasionally and members of management should chat informally with employees, asking their ideas and opinions on matters of interest to them.
7. And every sensible executive recognizes that the foremen must have both authority and responsibility in significant matters. Authority must parallel responsibility.

Another method that is being used to encourage the induction of the foremen into the management team is by allocating to them certain definite extra responsibilities. The usual approach is to form committees to handle management tasks such as a guard committee to take precautions against sabotage, safety committee, fire protection committee, plant inspection committee, grounds committee, inter-communications committee, suggestions committee, public relation committee and training committee. The members of these committees tend to become plant and management conscious. Furthermore, such groups help to ease the load of some staff or executive function and at the same time prepare themselves for advancement up the management ladder.

AUTOMATIC TRAIN ANNOUNCEMENT SYSTEM

The Engineer, v. 198, n. 5151, October 15, 1954, pp. 519-20.

Particulars have been received of a new system of train announcement which has been installed at Stratford Station by British Railways. This system came into operation on Monday, October 11th and with it platform announcements for down trains on the Eastern Region lines from Liverpool Street to the Eastern Counties are automatically initiated by the individual trains themselves. This system, which is the first of its kind in this country, has been developed by The General Electric Company, Ltd., to the specifications and requirements of the signal and telecommunications engineer, Eastern Region, British Railways.

With the new equipment the announcements for the various trains are recorded on a continuous loop of magnetic tape, 3 in. wide, and having a capacity for twenty-five recorded tracks. The "train approaching" and "train standing" portions of each announcement are recorded on separate tracks. The appropriate announcement for any given train is selected by an operator in the signal-box and the selection is stored electrically until the train operates the track circuit connected with the signalling system. Thereupon, the play-back head is moved to the pre-selected track on the magnetic tape, which is set in motion at the same time. The tape reproducer, which is linked to the station loud-speaker system through an amplifier, then starts announcing; "The train approaching No. — platform will call at . . .".

When the train passes into the platform track it operates an adjustable delay relay. This allows a suitable lapse of time, before the doors open. The reproducer then broadcasts; "The train standing at No. . . . platform will call at . . .". During peak or abnormal periods, when the interval between trains does not allow sufficient time for the "approaching" announcement to be broadcast, this is automatically omitted, and the "standing" announcement only is broadcast.

Pre-Selection Principle

The announcements are pre-selected and up to four pre-selections can be made and electrically stored in each platform group, an illuminated lamp indicating the announcement number of each stored selection. When the announcement for a train is started, a red lamp is illuminated adjacent to the respective storage indication and both lamps are extinguished when the train concerned leaves the platform.

Selections are made in the order that trains will arrive at the platform, irrespective of the order of entering the controlling track circuit sections or routing to the platform. Non-stopping trains and other traffic

for which no announcement is necessary are included in the selection by operating the "no announcement" key. In the event of an alteration, or incorrect selection, the stored selections can be cancelled and fresh selections made.

An audible and visual warning is given if a train for which no selection has been made, enters the controlling section. A selection can then be made at any time prior to the arrival of the train at the platform, but if sufficient time is not available for the broadcasting of the "train approaching" portion, this is automatically omitted.

The Control Apparatus

The control apparatus consists of telephone relays and uniselectors fitted in a metal cabinet. On the receipt of a start signal from the control apparatus, a uniselector rotates and is stopped at its appropriate contact, thus positioning the reproducing head on the required track. The tape motor is then started and, simultaneously, all high-tension circuits are completed, via relays, on the amplifier rack associated with the particular reproducer and the announcement is broadcast. The ends of the loop of tape are joined by a metal foil strip. This strip completes a circuit for the stop relay at the end of the operation and the reproducer and amplifiers are returned to the condition of awaiting the next start signal.

Three racks of amplifier equipment are provided, two for the recorded announcements and one for microphone announcements.

AND THE OTHER PAGES

New Zealand Engineering, v. 9, n. 7, July 15, 1954, p. 217.

A particular method of approach to a recurring happening will, if continued for a long enough period, turn into a habit, and a habit will, in due course, turn into a custom. This custom may be a national one, or it may be local, or confined within larger or smaller limits. In its ultimate application, the habit becomes purely a personal one. Thus, an individual may have one or more habits personal to himself, which serve to pinpoint him amongst his acquaintances. If his ancestors had presented a similar peculiarity, his present name would likely contain a reference to it. In modern times we are taught to be more polite, though it is still a fact that the child possessed of no inhibitions and therefore most likely to come out with the truth, will take one glance at another child, note its peculiarities, and give it at once a nickname which will endure through life. These same faculties of observation, classification and truth have been granted to the savage. The civilized child loses the faculty as it reaches its full understanding. It becomes too engrossed in forming other habits, and helping to establish other customs. Though probably unaware of it, it may be qualifying for membership of the *felo-de-se* club.

The very subject of habits and customs, good or bad, national or individual, is an exciting and fascinating one. Consider, for instance, the habit of eating and the many personal peculiarities which arise from this necessary and satisfying occupation. There is the anticipatory effect on the diner, the approach to the table, the selection from the menu, the gamble which centres round the unseen carver, the artistry of the cook, the frills, the music, the service, the surroundings —all these can contribute towards the meal and the fullness thereof. Whether they actually do so contribute is a circumstance which will depend on the habits of the individual diner. If he can assess and appreciate all the things which contribute towards the enjoyment of a good meal, he is to be envied; if he cannot do so, he is to be pitied. If he realizes his deficiencies, he is wise if he corrects them. If he fails to recognize them, he may still be brought to a state of grace.

Different Type of Meal

From a contemplation of him who eats—however fascinating it may be in its horror—we may turn to a like analysis of him who reads, truly a different type of meal, but just as necessary if balance is to be maintained, and the troy-weight of the brain is not to be dwarfed by the *avoirdupois* of the abdomen. Just as there are fashions in eating, so are there fashions in reading. Both meals can be subject to good or bad habits, but as the eater in public is a more frequent sight than the reader in public, the former will have some regard for his companions, and will not in general deliberately offend. The reader, however, enclosed physically and mentally in the privacy of his castle, is in reality less secure than he imagines himself to be. The diner can normally be expected to do justice to a good meal, but the reader does not, to the same extent, do justice to a good book.

He is less inclined still to do justice to a good technical journal; yet there are in its make-up all the items which contribute towards a fascinating bill of fare. Just as the chef aims to offer something attractive to every type of eater, be he in habit epicurean or porcine, so does the technical journal, and this one in particular, strive to cater catholically. Our diner does not fancy beef? Very good! Let him not despair; a smaller and smoother-grained animal has been specially slaughtered for him. Our reader does not fancy the precise and ever-repeating clank of the mechanical robot? As an alternative he may drift peacefully downstream with the hydraulic engineer. This diner searches his menu quickly for plum pudding; that one will be satisfied with nothing but an ice. This reader hungers for the arithmetical treatise; the next one feels that he can digest no more than the leading article. Both feel that they have wrung from the journal all that is of interest to them. Both are wrong.

They have had no regard for the dining-room and its architecture; for the table linen, the china and the cutlery; for the hors d'oeuvre, the sorbet and the savoury; and, least of all, for the service. They have disregarded those exhibits which have been so carefully prepared, so discriminatingly assembled, and so artistically presented, and without which the meal itself would not be possible.

Plea for Recognition

Yes, our plea is for some greater recognition of the fairness of the handmaiden—so readily forthcoming in other walks of life—some greater appreciation of her art, some practical indication of the excellence of her service, some encouragement for its continuance. It is a plea for the forming of a habit of reading the advertisements within these covers.

Those who cannot find time to do so can be likened to a ploughman who drives ever along the same straight line. Gradually his furrow deepens and gradully his V-shaped share builds up on either side a rampart which obscures his vision, and deprives him of any appreciation of the beauties which surround him. For there can be beauty in advertisement, and the art of its presentation is no less intricate than is the art of presenting a technical paper. It is, moreover, a medium through which even the harried engineer can keep himself reasonably up to date, and this alone might well induce the literary diner to give his attention to all parts of the menu.

Month To Month

JAN. FEB. MARCH APRIL **MAY** JUNE JULY AUG. SEPT. OCT. NOV. DEC.

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Co-operation with A.S.C.E.

Recently the Board of Direction of the American Society of Civil Engineers has put into writing certain terms of co-operation between the Society and the Institute which have existed many years but without any official recording.

By a recent resolution the Board of Direction has approved the following statement:

"For the purpose of furthering the cordial relations long existing between the Engineering Institute of Canada and the American Society of Civil Engineers, it was proposed that the Board of Direction restate present policy concerning members of E.I.C. with reference to A.S.C.E conventions and publications, as follows:

(a) Members of E.I.C. are cordially invited to attend all conventions or other meetings of A.S.C.E., and when attending, they shall be entitled to participate in such meetings on the same basis as members of A.S.C.E. When a registration fee is required of A.S.C.E. members attending A.S.C.E. conventions or other meetings, members of E.I.C. attending shall be charged no greater registration fee than members of A.S.C.E.

(b) Members of E.I.C. shall be entitled to purchase or to subscribe for the publications of A.S.C.E. on the same basis as members of A.S.C.E."

This is the second of the leading American societies with which the Institute has a co-operative agreement. The other is the American Society of Mechanical Engineers. The real significance of agreements of this kind is the declaration of the desire for co-operation. It is a great thing for every member of both organizations to know that there is so clear and so friendly an understanding between leading organizations in different countries.

By means of the Conference of Commonwealth Engineering Institutions the Institute also has co-operative agreements with the institutions in Great Britain, South Africa, Rhodesia, India, Australia and New Zealand. Through this chain of contacts members of the Institute have available to them services in many parts of the world which otherwise would not be theirs to enjoy. These things are a dividend on their membership in the Engineering Institute.

It is hoped that members who will be visiting or moving to any of these places will avail themselves of these services.

Graham Clark Lecture

E. Graham Clark, C.B.E., M.C., M.Sc., was on the staff of the Institution of Civil Engineers in London, England, for forty years, the last seventeen of which saw him as secretary. He died on April 23, 1954.

One of Mr. Clark's fondest wishes was that an annual lecture should be established dealing with a subject of common interest to the members of the Institution of Civil Engineers, the Institution of Mechanical Engineers, and the Institution of Electrical Engineers. Recently the Councils of the three Institutions have accepted the proposal which Mr. Clark made in his lifetime and have decided to name the lecture after Mr. Clark.

This is indeed a splendid memorial to a man who for so many years served faithfully and intelligently the profession of engineering.

Mr. Clark was one of the principal promoters of the Conference of Commonwealth Engineering Institutions, of which the Engineering Institute of Canada is a member. This is but further proof of the fitness of establishing a memorial lecture supported by the three leading British Institutions.

The first lecture in the series was given on May 4, 1955, at the Institution of Civil Engineers. The speaker was Brigadier General Sir Harold Hartley, and his subject "The engineer's contribution to the conservation of natural resources".

Cover Picture

The cover picture shows one of the two identical reactors being built at Britain's first atomic power station.

The article "World Race for Atomic Energy" on page 647 gives some details of the construction.

Photograph courtesy of Taylor Woodrow.

A Message from The President

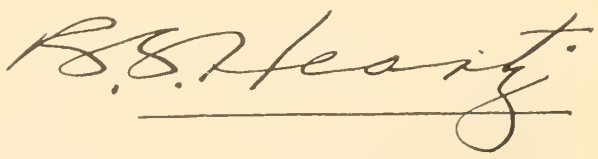
MY first message to the Members of The Engineering Institute of Canada is one of thanks and appreciation for the honour they have conferred upon me.

Since its inception, almost 70 years ago, the Institute has made many adjustments to meet changing conditions. Perhaps the greatest of these, Confederation, is still to be achieved. The proposal to bring together into one common organization all the engineers of Canada is one which must be carried to a successful conclusion. The privilege of participating in official discussions towards this end is in the nature of a trusteeship.

Those who have been selected by the Council of the Institute to study these matters have accepted their responsibility in all seriousness, as have, also, those representing Dominion Council. The Institute Committee has made its first report to Council. Its studies indicate clearly that it should be possible to find a solution acceptable to all, as there is evidence of wide approval for some form of Confederation.

To complete an agreement satisfactory to everyone will not be easy; time, patience, wisdom and understanding will be required for the task, but I am hopeful of the outcome.

Following the tradition and example of those who have preceded me in this office and, with your co-operation and understanding, I shall do my utmost to make this another memorable year in the history of the Institute.



R. E. HEARTZ, M.E.I.C.,
President.

Three Generations of Membership

Recently Headquarters received an application for student membership from a student at the Nova Scotia Technical College.

The particular significance of this application is that it marks the third generation in this family to be members of the Institute. The first member was Lieutenant Colonel F. W. W. Doane who joined the Institute in 1887. He was made a Life Member in 1931 and an Honorary Member in 1952.

The next member of the family to join was his son Harvey W. L. Doane who came in as an Associate Member in 1919 and who qualified for Life Membership in 1955. And now we have his son Harvey William Doane joining as a Student in 1955.

There may be other instances of three generations in one family all at the same time supporting the Institute but if such is the case they are not known to anyone at Headquarters. It seems safe to say that this is a unique occurrence. It does do something to indicate the long span of Institute usefulness. With the first membership beginning in 1887 the year of the Institute's incorporation, the last one coming in this year, we have an unusual continuity of interest and support from one family.

It is interesting to note that the two senior members of the Doane family have been active in Institute affairs. At the present moment, Mr. Harvey Doane, is a member of the Institute Committee on Confederation. He has been active in many other posts as well within the Halifax Branch.

Doubtless with the further passing of time there will be more family memberships like this but it is nice to be able to acknowledge this one which appears to be the first of what it is hoped will be a long series. Long live the Doanes!

Distinguished Visitors

Recently the Institute had the pleasure of entertaining Professor R. W. Parson, president-elect of the Institution of Engineers of Australia. On the left R. E. Heartz, president-elect of the Institute and on the right, past president James A. Vance.

At a reception for Sir Hugh Beaver, M.E.I.C., visiting Montreal on March 17, left to right: Dr. Arthur Surveyer, past president of the Institute; Sir Hugh Beaver; Vice-President I. R. Tait; Past-President J. B. Stirling.

Correspondence

As the Life Members See It

Dear Mr. Editor:

I wish to thank you for your very kind letter announcing my Life Membership in the Institute.

It was 50 years ago when I landed in Montreal from Scotland seeking employment and the first job I got was an appointment as rodman with the C.P.R. on the Toronto Sudbury line when Mr. W. F. Tye was chief engineer of the company —$45 per month and board. I spent three or four years on survey and construction and transferred to the Algoma Central as resident engineer. I think four or five years in the North Country a better training to become Canadian than twice that length of time in a city office. I then took up contracting with surprising suc

cess. I was married in the West when the War started. Then four years in the Army with Pioneers, Engineers and Railway troops.

It was when I returned from overseas that I realized that construction camps and family life did not mix so I went into business; forming the firm of Wood, Fleming & Co., and I have come to the conclusion that of all training, engineering is the most useful for a man in general business, as we are in insurance, building management and real estate. We also have a wholly owned subsidiary—the Cloke Construction Co. of which my son, J. P. Fleming, is assistant manager. He is a graduate (mechanical) of Toronto University.

I did not mean to write a history of my life, but I think that "once an engineer always an engineer" is a truism. I have a horizontal mind as against the vertical mind of a financier, or in other words, I can read a profile easier than a balance sheet. Thanking you again,

ROBERT FLEMING,
Wood, Fleming & Company Limited,
Toronto,
December, 1954.

Open Competition for Building Designs

The architects associations throughout the country have made an important contribution to their professional reputation and standards by promoting and encouraging open competition for building designs on various large projects.

This method of selecting architectural service is commendable from many points of view.

(a) Tends to raise professional standards.

(b) Encourages architects to co-operate for various efforts.

(c) Fairest method of selecting services for government projects.

Consulting engineers and engineering associations would do well to publicize this method for selecting professional engineering services. The advantages that could be realized by the consulting engineers would generally coincide with those already realized by the architects.

N. GANS, M.E.I.C.,
Montreal,
February, 1955

World Race for Atomic Energy

British Progress at Calder Hall, Cumberland, England
(From a Correspondent)

At Calder Hall, Britain's first electric power station to be driven by atomic energy is now in an advanced stage of construction. Most of the early work at the site was in the hands of the civil engineering contractors, Taylor Woodrow, Ltd.

There is every reason to believe that Atomic Power Station No. 1 will be generating electricity in 1956. Its capacity is likely to be in excess of 50,000 kilowatts — no official figure has yet been given — part of which will be used by the plutonium factory at Windscale nearby, the rest being fed into the national electricity grid system. Thus atomic energy will be serving British industry and the homes of the people much sooner than many dared to hope.

The Calder Hall power station is only an experimental installation. Engineers will gain operational experience, and out of it will come new designs for the further development of atomic power stations which will be produced by British industry. In fact, so great is British confidence in atomic power that plans have been authorized by Parliament for twelve stations with a total capacity equal to that which could be derived from five or six million tons of coal.

The novelty of Calder Hall atomic power station rests on the method of heat extraction from a nuclear reactor or pile, which serves as an "atomic furnace", since steam is still the working medium for the turbines which drive the alternators. For this first installation the development of the necessary steam producing equipment was entrusted to Babcock & Wilcox, Ltd. Two atomic furnaces will be used at Calder Hall, each working with four steam-raising towers about 80 feet high. Heat generated in the graphite-moderated uranium reactors will be carried to the steam plant by carbon dioxide under high pressure, the hot gas giving up its heat to preheating, evaporating and superheating sections of the steam plant. After passing through the steam-raising towers, the cooled carbon dioxide gas will be recirculated by blowers to the reactors, where the heating cycle is repeated.

One of the most interesting features from the technical point of view is the use of a double-pressure steam cycle in order to obtain maximum efficiency from the comparatively low temperature, about 400° C., of the gas entering the steam towers. Each tower contains, in effect, two sets of steam-raising equipment, there being separate high-pressure and low-pressure economiser, evaporator and superheater sections. Special care has been taken to keep the coolant gas and the steam or water apart because of the danger of contamination. C. A. Parsons & Co., Ltd., are supplying the turbo-alternator plant, the circulating gas blowers and the piping.

There are a turbine hall, two cooling towers, an administration block and ancillary and temporary works. The thermal reactors are constructed with very thick walls and of high density concrete, the great thickness being needed to provide shielding against high energy radiation.

The turbine hall houses four alternator sets of 22 kva. capacity each. The condenser water cooling towers with hyperbolic concrete shells, each 300 ft. high and 200 ft. in diameter at the base, are also of normal design. There is a two-story administration block and the ancillary works include roads, drainage, fencing, ducts, etc.

Calder Hall is now beginning to look like the power station of the future. Two reactor buildings, each 120 ft. high, are in an advanced stage of construction; between them will stand the generator hall, which already has foundations down for the turbo-alternators. The reactors, "burning" natural uranium, are the responsibility of the Atomic Energy Authority, which has designed and is building them. These reactors and the coolant will be contained in pressure vessels or outer shells, made by Whessoe, Ltd., the whole being encased in biological shields forming the reactor buildings which are already the dominant features at Calder Hall, the world's first atomic power station.

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

In round figures, the combined power and navigation features of the Seaway excluding dredging in the Upper Lakes by the United States, and excluding works for the development of power by the province of Quebec, will cost in the neighbourhood of $900 million, divided into three parts.

A third of the total will be spent by the Ontario Hydro-Electric Power Commission. Another third will be spent by the New York State Power Authority, and the remaining third for navigation facilities. Of the latter, some $200 million will be expenditure by Canada's Seaway Authority, with $100 million by the St. Lawrence Seaway Development Corporation for locks etc. on the American side of the river.

With the advent of warmer weather during early April, the tempo of construction on the various power aspects of the Seaway was being stepped up. At mid-April roughly 1,000 men were employed in the International Rapids section, most of them on the Canadian side, compared with a possible maximum of some three or four thousand Canadian workers during the coming summer.

Completion of the first sections at both ends of the powerhouse cofferdam, originally planned to be ready for pumping out by early April, was at that time six weeks behind schedule due to mud, ice and high water, while similar difficulties had beset cofferdam construction by the New York State Power Authority on the Long Sault control dam.

Though work on the navigation aspects by the Canadian Seaway Authority has been at a virtual standstill all winter, within the near future as the ice moves out of the river and from Lakes St. Francis and St. Louis, work on dredging in the Lachine Section, awarded last fall, will be resumed and dredging recently let by contract on these two lakes will be started. Work has already commenced on excavation for the Iroquois Canal and Lock.

Early Start on Power Development

Contracts are already awarded for the 16 hydraulic turbines and 16 electric generators for the Canadian half of the dual powerhouse at Barnhart Island, some three miles west of Cornwall, as well as for the supply of concrete aggregates for the powerhouse structure, as already noted in previous issues of the *Journal*. Orders have also been placed for turbines and generators for the U.S. end of the powerhouse by the N.Y. State Power Authority.

On March 27 the N.Y.S.P.A. opened tenders for the entire structure on the Long Sault Dam between Barnhart Island and the U.S. mainland. Two lowest bids were from a Kaiser-Mannix-Pacific Bridge-Miron Frères group at $25,998,000 and from a Morrison Knudson-Walsh-Perini-Kiewit-Utah group at $26,019,000.

Hydro has also called for tenders on the Canadian half of the powerhouse structure. Bids opened on May 10. Sufficient work must be completed by June 1, 1958, to permit initial powerhouse operation, while completion of the entire structure is called for by September 1, 1960.

This half structure will be 1,500 ft. long, 170 feet in height from base to roof, and 190 feet wide. The intake structure, which will also serve as a dam across the north channel of the river between the Canadian shore and Barnhart Island, will be integral with the powerhouse. The superstructure will be equipped with three gantry cranes; one of 90 ton capacity for lifting the gates, one of 400 ton capacity for erecting and handling the generators and turbines, and a third of 30 ton capacity for lifting and lowering the tailrace gates on the downstream side.

Nearing completion by Ontario Hydro are two 400 ft. traffic tunnels under the existing 14 ft. draft navigation canal just west of Cornwall. These tunnels, one of 16½ ft. diameter and the other of 10 ft., plus a sliding bridge over the canal for heavy equipment too large for the tunnels, will provide access from Highway No. 2 to the powerhouse. Nearing completion also is Hydro's million dollar Administration Centre with offices, staff house, hospital and testing laboratory on the north side of the highway.

Thus of the $300 million, more or less, total to be spent by the Ontario Hydro, contracts awarded to date amount to around $25 million. Following the award to be announced in May for the Canadian half of the powerhouse structure,—largest single contract on which bids have been asked to date,—the next tender call for a major component of the Canadian power development may be for Canada's half of the dam at Iroquois, some 40 miles upstream from Cornwall. Bids on this may run as high as $17 million, while expenditure by the New York State Power Authority may amount to another $11½ million.

Winter Delays Work on Ship Channels

For the navigation features of the project, some 70 contracts will be awarded during the life of the job by Canada's Seaway Authority, at a total cost of about $200 million. These contracts are divided as follows: 20 in the Lachine Section, 10 in the Soulanges Section, 5 in the St. Francis Section, 10 in the International Rapids Section, 10 in the Welland Section and 20 miscellaneous. A total of some $120 million will be spent for navigation in the Lachine Section, while $50 million will be spent in the Soulanges.

Already awarded last fall in the Lachine Section were contracts for 10 miles of channel dredging between the Caughnawaga Bridge and Montreal Harbour, and for removal and re-erection of a bridge, and in January in the International Rapids Section for the lock and canal at Iroquois. In March four dredging contracts were awarded for channels in Lakes St. Louis and St. Francis at a cost of $14 million. Thus so far only some twelve per cent of total expenditure has actually been committed by Canada's Seaway Authority out of the $200 odd million total mentioned above.

Contracts yet to be awarded in the Lachine Section include those for elevating the south ends of the Jacques Cartier (Harbour) and the Honoré Mercier highway bridges, and for opening of a new traffic lane on the Jacques Cartier Bridge on an unused tramway right of way. Bids will be invited for installing movable bridge spans over the new navigation channel on the Victoria (C.N.R.) and the Caughnawaga (C.P.R.) railway bridges, for providing uninterrupted highway traffic on Victoria Bridge with a second lane on the east side replacing Southern County railway tracks. The Seaway Authority will build cloverleaf road approaches at the South Shore entrances to Jacques Cartier and Victoria Bridges. Besides these, contracts will be awarded for three turning basins on the old 14 ft. draft canals.

While no major work has yet been commenced in the Cornwall area by Canada's Seaway Authority, work is under way on demolition of the old Cornwall post office to make way for a permanent administration building, while a large 6-storey staff headquarters is going up at Pitt and Second Streets. Forty miles further west at Iroquois Point, heavy grading equipment is going to work on removing the 4 million yards of excavation involved in the 50/80 ft. deep Seaway canal which will contain the Iroquois lock.

Similar operations are being carried out on the U.S. side of the river by the U.S. Seaway Development Corporation. Work on the new lock in the Grasse River area was commenced in mid-April.

The Flooded Areas

Some 20,000 acres of Canadian land will be flooded with 18/22 ft. of water, and some 6,500 residents will be re-established in new communities. Ontario Hydro is continuing negotiations regarding location and layouts of new townsites and compensation to residents. With settlement regarding the moving of the town of Iroquois now completed, attention is focussed on negotiations with towns and villages in Cornwall and Osnabrook Townships, such as Aultsville, Farran's Point, Moulinette, part of Morrisburg, Wales and Dickinson Landing. There are tentative plans made here for two complete new townsites to replace these small communities, and the new sites are pretty well agreed upon.

Though flooding will not take place before late 1957 or early 1958, there is much to be done. Expenditure in preparation for flooding on the Canadian side may run to $70 or $75 million, while flooding on the American side will cost perhaps $20 million. The total cost of rehabilitation on both sides of the river will be pooled and shared equally between the Hydro and the New York State Power Authority.

Some thirty five miles of the C.N.R. double track main line have to be relocated, and already work has commenced on clearing. Traffic will be rerouted late in 1957. Besides this, Ontario's Department of Highways will reroute some 26 miles of highway No. 2 between Cornwall and Cardinal, locating it where possible on the abandoned C.N.R. right of way and partly on dykes to be built west of Cornwall to confine the flooded area. The first seven miles of this work between Cornwall and Moulinette was commenced last year.

Later, a scenic highway connecting a number of islands left in the flooded area is envisioned. Ontario is also surveying and planning extension of the new through 4-lane highway 401 right through to the Quebec boundary, north of the Seaway communities. This 4-lane throughway, however, is independent of Seaway development and work will be spread over a 10 year period.

Misgivings at Montreal

Provincial Authorities at Quebec City and City Authorities at Montreal are expressing concern at what they feel is an unsympathetic attitude on the part of Seaway Authority officials towards local problems arising from Seaway construction. Probably the most pressing of these is the traffic problem between Montreal and its suburbs on the south shore, where congestion is already serious.

Actually the traffic congestion problem has been given a lot of study. It is said that the proposed new lane on Victoria Bridge will double that bridge's capacity for auto traffic, while opening another lane on the Jacques Cartier bridge will triple the number of autos that can be handled there. A far more pressing problem appears to be the capacity of the approaches over certain Montreal streets.

Fear is being voiced, too, of a considerable drop in property values over large residential areas along the south shore such as St. Lambert and Préville, once the view of the river is blocked by high Seaway walls. What provision, residents ask, is to be made for water and sewer services with the water in the ship channel high above the street levels?

Though compensation will no doubt be provided for those affected by higher waterlevels, residents fear damage to social and community life will far exceed rates of compensation set by government claims adjustors. New homes with the necessary services and community buildings will have to be provided for many residents who must move. These problems, it is contended, should all be taken into consideration by the Seaway Authority.

Pointing out that the improved river channel above the Lachine Canal will be narrower than at present, thus increasing the velocity of flow in the river materially, critics claim the channel will never freeze over in winter, and the formation of frost will be encouraged on power lines and electrical installations, thus reducing their potential. Admittedly, however, some of these drawbacks are necessary evils that cannot be avoided.

Harbour Development on Great Lakes

While little has been heard in Canada so far respecting harbour development at Canadian Great Lakes ports in anticipation of greater traffic once the Seaway is open, ports on the U.S. side are not letting the grass grow under their feet. Many of these cities have already set up "Seaway Committees".

As an example, Cleveland is planning a $25 million "Trade Mart", similar to the one in New Orleans. The City proposes to build a $15 million breakwall along the entire waterfront to serve as an erosion barrier, and to provide additional berthing space for lake and ocean vessels plying the Seaway. Cleveland is also boosting for a World's Fair in that City to coincide with the opening of the Seaway.

The Hon. Alexander Wiley, speaking before the U.S. Senate on March 15 this year, reported that the Chicago Regional Port Authority will commence a $22½ million project of harbour and terminal improvement this year. Milwaukee plans a $4-7 million harbour improvement. Toledo plans to spent $21 million on docks. Buffalo will spend $2-3 million on deepening its harbour. Ashtabula will spend $5 million on its harbour. Manitowoc and Erie are considering port development. Toronto is planning a million dollar terminal. Besides this there are $109 million worth of Federal channel improvements under way or planned in the Upper Great Lakes. One U.S. army engineer, he said estimated at least $500 million may be invested in the Great Lakes area in the next 10 years by federal, state, city and private agencies for harbour and channel improvements.

Canadian ports are planning too. Sept Isles seeks an all year ocean port. Quebec will improve its elevators and cold storage and dredge St. Charles Estuary. Trois Rivières proposes more wharf space, sidings and sheds. Montreal is getting a 10,-700 sq. ft. transit shed from the Harbours Board. Kingston will spend $4 million on dredging and construction. Toronto is opening a new marine terminal and will add 3,300 feet of docks. Hamilton will extend its docks and terminal buildings this summer. Windsor plans to spend $3 million on dock facilities.

Benefits to Canadian Economy

The Hon. Lionel Chevrier, president of the St. Lawrence Seaway Authority, in an address at Toronto in April, predicted a potential Seaway traffic of 31 million tons for the 1959 season and the five to ten years following—lower than the 1950 traffic estimate of 44½ million tons due to conditions having changed somewhat over the past five years. The new Seaway locks, he pointed out, would be of the same dimensions as those of the Welland canal. In 1953, traffic through the Welland was 19½ million tons—17 million down-bound and 2½ up-bound. This imbalance has resulted in a great proportion of upbound vessels being light. Seventy three percent of the vessel passages were by "canalers" and small vessels, yet 56 per cent of cargo tonnage carried had been by large upper lake vessels.

"It is apparent", he said "that even with present facilities and present dispatching methods, the Welland has never operated to anything like its full capacity. The capacity could be greatly increased by twinning Lock No. 2, the only lock where vessels are dispatched up- and down-bound into an adjacent single lock, and by providing additional tie-up space. It should be borne in mind, too, that the capacity of the Welland is greater than that of the Seaway from Montreal to Lake Ontario will be, because of the greater length of the season of navigation —260 days for the Welland as against 230 days for the Seaway".

Mr. Chevrier estimated the savings to the Canadian economy due to large and economic vessels moving through the Seaway without trans-shipment, and through greater economy in the use of vessels, would amount to $30 millions annually. Careful surveys of the advantages from the Seaway project such as alleviation of Ontario's power shortage, further industrialization of the Great Lakes-St. Lawrence area, better access by foreign trade to the great inland and riverside market and better movement of products to market from the western grain growing regions, brought the conclusion that the project would benefit the Canadian economy to the extent of somewhere around $100 millions annually.

Pure Air to Come

Mankind appears to wish to live on this earth in an environment approaching the celestial as nearly as possible. For years we have been trying to clean up our waters to the point where they will cease to be dangerous to health or offensive to the eye and nose. At least, we now know how to do it and progress in this respect depends mostly on how much money we are willing to spend. Of late, the atmosphere has been getting some consideration.

Smoke and dust prevention and abatement are not new. They are such obvious kinds of atmospheric pollution that they first caught the public eye, but we know very well that there are invisible pollutants of equal, if no greater, importance. The "pure" air of the country in Great Britain deposits an estimated 60 to 120 tons of solids per square mile per year, while in Pittsburgh the figure for 1953 was 600 tons. There are no comparative figures for gaseous pollution, but in this day of automobiles and diesel locomotives it must be large.

These remarks are prompted by a reading of the 1954 report of Toronto's Air Pollution Advisory Board, of which the chairman is Prof. E. A. Allcut, M.E.I.C. The Board estimates that Toronto citizens are being penalized to the tune of at least $10 million a year by smoke and dust, yet its request to the city for $20,000 for expanding its activities was reduced to $7,100. This estimate of loss includes no allowance for sickness, premature deaths and the general loss of amenity due to air pollution. The four-day "smog" of December, 1952, in London ran that city's deaths to about 4,000 above the normal.

This Toronto report would indicate that progress is being made there in spite of many handicaps. Last year there were 14,407 inspections of which 635 were unsatisfactory. Court proceedings were instituted against 129 violators and 111 of these were convicted and fined, 12 were given suspended sentences or withdrawn. 4 were dismissed and 2 postponed to 1955. Evidently, it does not pay to violate Toronto's by-law.

These accomplishments would perhaps make one think that Toronto's air pollution problem is well on the way to solution, but really there is a long way to go yet. The question of how far the jurisdiction of the city over the railways extends has to be settled, as does the similar question of its jurisdiction over steamships. Competent personnel is hard to find. Public opinion seems not yet to have reached the point where it will sanction financing the establishment of an adequate number of permanent air sampling stations, as necessary to detect air pollution as police are to detect crime.

Perhaps we in Canada are too

complacent. We have no London, Pittsburgh nor Los Angeles and our climate is perhaps less conducive to atmospheric conditions such as have occurred in those cities, but we are becoming more and more industrialized and so air pollution is on the increase. The sensible way to deal with it is by way of prevention rather than by cure. Toronto, Montreal, Hamilton and some other cities have made a start. If others follow, the title of this note may prove a proper one.

Congress on Air Pollution

The first international congress on air pollution was held in New York on March 1 - 2, 1955. This was arranged by the Committee on Air Pollution Controls of the American Society of Mechanical Engineers, and Professor E. A. Allcut, M.E.I.C., attended it both as a member of that committee and also to represent the City of Toronto, whose first report on air pollution was published recently. There was a very large attendance at all sessions and papers were read from Canada, United States, Great Britain, France, Holland, Italy, and Portugal. They covered the legal, biological, physiological, meteorological, chemical, mechanical and research aspects of the problem and indicated the extreme complexity of the subject.

The highlight of the meeting was the Calvin Rice Lecture on "Air Pollution; the growth of public opinion" by Sir Hugh E. C. Beaver, M.E.I.C., who was chairman of the Government Committee of Enquiry into the Nature, Causes and Effects of Air Pollution (United Kingdom). The report of this Committee, popularly known as the "Beaver" report, has recently been published and it is probable that it will be implemented by governmental legislation by the British Parliament, within the next few months.

Sir Hugh Beaver was then made an honorary member of the A.S.M.E.

After the banquet on March 1, G. Edward Pendray (Pendray & Company, New York) gave an address on "Management Aspects of Air Pollution".

Several Canadians participated in the conference. The Federal Government sent a delegation of four, including Dr. E A. Watkinson and Dr. Morris Katz, M.E.I.C. The City of Toronto, the Ontario Research Foundation and the Ontario Department of Health were also represented.

The two Canadian papers on the program were those of Dr. Watkinson, "Air Pollution Control: associated health implications", and of Mr. Newbury, Ontario Research Foundation, "The Sarnia Survey: action without compulsion". Dr. Katz acted as chairman of one of the sessions.

A Visit to Westinghouse Plant

President D. M. Stephens visited the Hamilton plant of Canadian Westinghouse Company Ltd., prior to his meeting with the Hamilton Branch in February, and was received by the chairman of the board of Canadian Westinghouse, H. A. Cooch, M.E.I.C., the president, H. H. Rogge, and several Westinghouse engineering managers.

Front row, left to right: L. Austin Wright, general secretary; H. A. Cooch, President Stephens; H. H. Rogge. Back row: W. J. McNicol, Jr. E.I.C., A. A. Moline, M.E.I.C., W. Hindle, M.E.I.C., C. P. Haltalin, M.E.I.C., of Winnipeg Electric Company; and E. E. Orlando, M.E.I.C.

A Serious Situation

In the United States it appears that the subject of physics is being so neglected in the high schools that there is a likelihood of its being dropped entirely from the curricula.

W. C. Kelly, of the department of physics, University of Pittsburgh, discusses this question in an article in *The Science Counselor* for September. The following is quoted from that article:

> When we consider the status of physics in the secondary schools of this country, we confront a paradox. The importance of physics in our national life increases daily, but the interest of high school pupils in the subject, as judged by enrolments, drops toward the vanishing point. Physics has completely changed our pattern of military defense, created whole new industries, explored nebulae and probed nuclei, and has worked a fundamental change in our thinking about the great world and the small. Yet in 1948, a representative year, less than 6 percent of our high school pupils were engaged in the study of this truly basic science.

The News letter of the Engineering Manpower Commission of En-

gineers Joint Council commented on the subject in the November issue.

Statistics, based on data taken from NEA reports, illustrate the trend in physics enrolments:

Percentage National Enrolment in Physics

1895	22.8%	1922	8.9%
1900	19.0	1928	6.8
1905	15.7	1934	6.3
1910	14.6	1948	5.8%
1915	14.2%		

Even when the national percentage enrolment of 5.8 per cent for 1948 is multiplied by 4 to take into account the fact that physics is usually studied only by seniors, the percentage still falls, or at least is stationary at a low level. Over 75 per cent of our high school population has no contact with physics, and school boards and high school administrators find themselves neither willing nor able to continue elective courses in which few students show interest.

Physics can contribute much to the education of any pupil, whatever his future vocation. We need not only an understanding of our physical environment, we must know how to control it. In a technological world, practically everyone requires some knowledge of machines, and physics is immensely helpful to those who will study for the engineering and scientific professions.

Dr. Kelly points out some of the reasons why it has been hard to arouse student interest in physics and what he thinks can be done about it:

1) Most people do not know what physics is about. We need pamphlets, movies, and popular lectures to explain physics to the public.

2) Physics is regarded as impossibly difficult. We must convince our pupils that anyone of moderate ability, who has studied algebra and plane geometry, can master a high school course in physics.

3) We should form "fast" and "slow" classes wherever possible, to serve both average and gifted pupils.

4) The supply of well-trained teachers of physics is far short of our needs. The influence of the teacher on the attitude of the pupil toward physics is usually decisive.

5) Thorough revision of high school physics courses is needed, in the direction of more intensive content.

6) Demonstration experiments and student laboratory work, though expensive and time-consuming, are essential if class interest is to be kept at a high level, and they should be restored to introductory physics courses.

This is indeed a serious situation. Imagine what will happen in this modern world if the high schools cease to teach physics. Without the basic training in this vital subject in high school, there can be no engineers, no scientists, no physicists.

Looking at it from a distance it would seem that the answer to the question is to make physics a compulsory subject rather than "an elective course".

It will be interesting to discover what the conditions are in Canada, and an effort will be made to get this information. However, Mr. Kelly's observations and his facts are so important that the *Journal* is presenting them to the membership immediately without taking the time to see what the story is in Canada.

Engineering Manpower

(Contributed)

Reports have appeared in the press lately to the effect that Russia's annual crop of graduate engineers is substantially greater than that of the United States and Canada combined. From the standpoint of national defense, these reports are disturbing. If Russia were to use her alleged advantages in this respect for the amelioration of the lot of her own people, the West could only say, "Good luck", but it appears that overwhelming military might is her only goal.

The comparative estimates we have seen make no mention of contributions to the West's engineering manpower by graduates from Commonwealth countries other than Canada, nor of those from the NATO countries. Commonwealth graduates, except perhaps those of India, Ceylon and, we hesitate to write it, South Africa, should be counted among our resources. Most of the NATO nations should be counted in, though the political instability of France and the uncertainty of West Germany's future make their contributions a matter of question. And we should not forget the annual crop of engineering graduates from the majority of the Latin American republics, most of whom are as anti-communist as we are.

Nobody can predict how the nations of the world would line up in a future world war — which God forbid—but it is possible to make a shrewd guess. We would like to see a comparison, say for 1954, of the total number of graduates in engineering and science from those nations which are known to be communistic and from those which are known not to be, leaving out all with neutralist leanings. The figure would be interesting, if not heartening.

While one cannot guess the number of engineers and scientists the West could use in some future conflict, it is sure that the number would be large. Some slight clue to the answer can be found by considering the increase in demand for such graduates year by year in the United States, a large part of whose industry is already engaged in defense work.

The trend there is indicated in a recent report of Dr. Frank S. Endicott, Director of Placement, Northwestern University, Evanston, Ill. According to his figures, gathered by canvassing 152 of the larger employers, the demand for engineers, chemists and physicists will be up about 19 per cent in 1955. The only decreases in demand shown are among civil engineers, metallurgists and "others" and these are small. Chemical engineering shows the greatest increase, 62 per cent. The increase in the demand for non-engineering university graduates is small, a mere 2 per cent.

These figures indicate that the United States is not getting as many engineers and scientists as it could use, for certainly 1955's graduating class will not be 19 per cent larger than 1954's. Some of the trouble in the United States could be overcome if Selective Service did not take so many young graduates, many of whom the armed forces cannot, or do not, use in work for which they have been trained.

The two principal ways in which

the shortage of engineers and scientists can be overcome — and these apply to Canada, too—are, first, to see that all such people already employed are, so far as possible, used where their talents are of the most value, and, second, to so arrange matters that boys — and the occasional girl — who have the required abilities and inclinations may take the technical and scientific courses offered by our universities, no matter what their economic status. And similar provisions should be made for young people who are better fitted for work as technicians than as engineers or scientists.

The first remedy lies entirely in the hands of employers, the second partly in the hands of employers, who can support the universities more generously, and partly in the hands of the universities, which must prepare to train an increased enrollment. They are already preparing; substantially increased enrollment is expected no matter what steps may be taken to boost the output of engineering and scientific graduates. These preparations largely boil down to matters of finance.

Academic Performance

Comparison of Academic Performance of Undergraduates of the Pre-War and Post-War Periods, 1910-1948

This study was made by McGill University, Faculty of Engineering in April, 1954. An article on the American situation will appear in our next issue.

An analysis has recently been made of the records of students in the Faculty of Engineering and the results are shown in the tables below.

The figures in the tables were prepared with a view to obtaining a comparison between the academic performance of engineering students of the present day and those of some years ago. Only two groups of students have been analyzed, so that the figures are in the nature of a spot check. It is believed, however, that they constitute a reasonable sampling of the two groups.

Considerable care was exercised in obtaining the figures, and as noted in the tables, they have been obtained by tracing through our records the names of the individual students. In all cases the percentages shown are based on the number of students in the original entering class, and it is believed that the figures are correct within a possible error in the counts of not more than two or three students. We cannot say that they are absolutely correct, as it has proved rather difficult in some cases to analyze the records so as to obtain an exact count, but there is no doubt that the figures as shown indicate very closely the general picture.

The older of these groups entered the faculty in 1910, so the normal completion of their course was entirely before the first Great War. There would probably be some minor effects in the figures due to that war, but only to the extent of the relatively few students who had not completed their course and who did not return from the war. The recent group entered the faculty after practically all of the veterans had completed their course, so that it is reasonably representative of the almost purely civilian entry which we get today. The two classes are roughly comparable in size.

Certain interesting features appear in the figures. The percentage of the entry group which eventually graduated was almost the same in the case of the four year men, being 53.7 per cent and 56.6 per cent respectively. It may be noted that in the case of the later class, a larger percentage completed the work in the minimum time, but this is almost certainly due to the fact that our existing rules of standing and promotion differ materially from those in effect in 1910. In particular, we do not now permit a student actually to take courses in any but the year in which he is registered. If he has any deficiencies he must make these good by his own efforts and without course instruction. In the older days we permitted a student to "straddle",

Students Taking Last Four Years of Course at McGill

Year of entry	1910		1948	
Number entering	214		260	
	Numbers	Percent	Numbers	Percent
Graduated in minimum time, namely, 1914 and 1952	61	28.5	120	46.2
Graduated later	54	25.2	27	10.4
Never had to pass a supplemental examination		9.8		14.2
Total graduates	115	53.7	147	56.6
Attended only first session	52	24.3	57	21.9
Repeated first session, then withdrew	21	9.9	20	7.7
Repeated first session, took next year, then withdrew	5	2.3	8	3.1
Completed only first two sessions, then withdrew	9	4.2	9	3.4
Completed only first three sessions, then withdrew	12	5.6	19	7.3
Totals who did not graduate	99	46.3	113	43.4

Entering With Advanced Standing
Students Taking Only Last Two Years of Course at McGill

Year of entry	1912		1959	
Number entering	54		63	
	Numbers	Percent	Numbers	Percent
Graduated in minimum time, namely, 1914 and 1952	24	44.4	44	70.0
Graduated later	13	24.2	8	12.7
Never had to pass a supplemental examination		16.7		30.0
Total graduates	37	68.6	52	82.7
Totals who did not graduate	17	31.4	11	17.3

NOTE: In all cases, the above figures have been obtained by tracing through our records the names of the individual students. The numbers shown above in the various categories, therefore, do not include any overlappings or duplications. The numbers include only those individuals of the original entry groups whose names appear in the various categories.

and in the extreme ease, it was possible for a man to be registered in courses in three successive years at the same time. It is believed that the larger number now graduating in minimum time is due to this tightening of our rules rather than to any change in the general average performance, and this eonelusion is borne out by the fact that the total percentages graduating are to all intents and purposes the same.

So far as the matter can be assessed, we do not believe that there has been any reduction in the difficulty of our courses or in the standards demanded of students. In fact, members of the staff who have had experience throughout the period consider that if anything, our courses and standards today are a bit more demanding than they were in 1910. It therefore seems to be a fair conclusion that the performance of our students today is at least as good as that of their predecessors of more than a generation ago. In this regard it is also interesting to note that nowadays we ean expect about fourteen pereent of the entry group to proceed through their course without ever failing an examination, which is a considerable improvement over the roughly ten per cent of students who aceomplished this feat in 1910.

The foregoing remarks apply in the main also to the students who enter with advanced standing and take only the last two years of their course in our faculty. These students come from schools whieh provide instruction only up to the level at which the student transfers to McGill. During the period under review, this group of "feeder" schools has changed considerably, the principal change having been the addition of several new ones. The performance of these advanced standing students of today is appreciably better in all respects than that of their predecessors.

The figures of the four year men include a breakdown of the "casualty" group. Approximately one-quarter of the entering elass attends only the first session; another ten per cent, having failed the work of this first session, repeat the year and then withdraw; and so on through the course. The casualty list is higher in all cases immediately after the first session than it is in the later years. It is important to realize that not all of these easualties are due to academic incompetence. Many of them are voluntary withdrawals by reason of either health, finances, or change in personal circumstances.

The reeords show that of the roughly thirty per eent who disappear after attempting the work of the first session, approximately two-thirds are withdrawals foreed by academie diffieulties and the remaining one-third are for personal reasons uneonnected with aeademic work. It is entirely probable that of the twenty per eent who retire at this level due to academic failure, at least one-half have not really worked on the job, having decided for themselves that for one reason or another they have got into the wrong niehe. Thus it would appear that roughly twenty per eent of the entering elass became easualties by the end of the work of the first session beeause of academic incompetenee, this condition being about the same today as in the elasses of thirty-five years ago.

R. E. Jamieson,
Dean of the Faculty
of Engineering.

A recent meeting of district officers of the Department of Public Works brought together headquarters and field officers for discussions on Departmental activity. Front row, left to right: W. W. Ryan, M.E.I.C., engineering staff, Toronto; W. J. Johnston, M.E.I.C., superintending engineer, Ottawa; Lt. Col. A. A. Anderson, chief engineer, Ottawa; G. H. Thurber and J. E. Gagnon, superintending engineers, Ottawa; J. A. Brown, M.E.I.C., engineering staff, Fort William. Back row, left to right: District Engineers C. F. P. Faulkner, M.E.I.C., New Westminster; G. T. Clarke, Halifax; W. C. Ewing, Edmonton; G. Millar, St. Johns, Nfld.; J. M. Vogin, Ottawa; A. Michaud, Rimouski; J. F. Mellish, M.E.I.C., Winnipeg; C. W. Currie, M.E.I.C., Charlottetown; A. A. St. Laurent, Montreal; R. P. Henderson, M.E.I.C., Saint John, N.B.; L. McLaren, M.E.I.C., Quebec; J. W. Borghner, London. Absent, C. W. Morgan, Toronto; and G. B. Anderson, M.E.I.C., Fort William.

The Angus L. Macdonald Bridge

A long-cherished vision became a reality on April 2, when a great bridge reaching across the harbour of Halifax to link the city with the town of Dartmouth was formally opened.

The Angus L. Macdonald Bridge, built at a cost of more than ten million dollars, was officially opened by the widow of the late premier of Nova Scotia, Mrs. Angus L. Macdonald.

Apart from the obvious and immediate benefits that the bridge will give as a means of transportation over one of the finest natural harbours in the world, the Angus L. Macdonald Bridge has a larger significance in its role as a silent herald for a new phase of industrial and civic progress. It is the first completed project in a program designed to reinforce the economy of Nova Scotia.

The Province is demonstrating the rising expansion of Maritime industrial works with the building of the Canso Causeway, the Bar Harbor-Yarmouth Ferry, and an industrial investment of 15 per cent, second largest in Canada.

The Angus L. Macdonald Bridge is the second-longest suspension bridge in the British Commonwealth. It has a total length, including approaches of 5,290 feet, compared with 5,978 for the Lions Gate Bridge. The centre span at Halifax is 1,447 feet in length, while that of the Lions Gate is 1,550.

In an impressive ceremony celebrating the occasion, Mrs. Macdonald was presented with a lifetime pass, the only one that will ever be given for the bridge. The Royal Canadian Air Force and Royal Canadian Navy staged a dramatic aerial fly-past in salute while three H.M.C. ships, the Algonquin, Nootka and Penetang passed under the bridge in review. The bridge was dedicated by the Hon. Henry D. Hicks, premier of the Province, after which the official party crossed the bridge for an official reception at H.M.C.S. Stadacona.

For the town of Dartmouth, it will provide a new era of expanded building and self-determination. The city of Halifax, now tightly compressed within its natural boundaries, will find an outlet for its many peoples and growing industries. In the larger sense, the economy of Canada is advanced another step with the completion of a structure which will serve the needs of an important commercial area.

Unusual Features

In building the Halifax-Dartmouth Bridge provision was made for it to carry a 30-inch water main. Existing water supplies of the city are not capable of further great expansion and at a future date it may be necessary to carry water over the bridge from sources on the Dartmouth side of the harbour.

In providing lighting for the bridge, consideration had to be given to coast conditions. Atlantic fog often rolls up Halifax harbour in season.

The lighting selected is sodium vapor, which is effective in fog and at the same time economical.

Light standards are also designed to carry trolley wires, to accommodate the crossing of electric coaches.

Each of the three suspended spans of the bridge is equipped with a "travelling bridge" which moves along beneath the spans to facilitate inspection and maintenance.

Main Statistics

While the Journal will treat this project in more detail at a later date, the following details, will be of interest at this time:

Overall length, abutment to abutment, 4,410 feet

Length of main span between towers, 1,447 feet 2 inches

Height of towers, 309 feet

Minimum clearance under main span, 165 feet

Total weight of steel in bridge, 8,227 tons

Length of main cables, 3,140 feet

Diameter of each of main cables, 13.5 inches

Number of strands in each cable, 61

Diameter of each individual strand, $1\frac{1}{2}$ inches

Width of roadway, 27 feet

Width of sidewalk, 5 feet

Cost of bridge, $10,750,000 (approximately).

The ASME Boiler Code

Interpretations

The Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

The following revisions were formulated at the meeting of January 21,1955.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.

Power Boilers, 1952

Par. P-291—delete the sentence at the end of the second paragraph reading:

The lowest permissible water level for the usual types of boilers is given in Par. A-21.

Par. A-21—revise to read.

Fire actuated fusible plugs, if used, shall be located at the lowest permissible water level as determined by the boiler manufacturer; steam actuated plugs, if used, shall be so located that they will operate when the water level is at the point where a fire actuated fusible plug would be located.

Par. A-21—delete (a) to (m) inclusive

Add the following paragraph to the PREAMBLE of Section I:

A pressure vessel in which an organic fluid is vaporized by the application of heat resulting from the combustion of fuel (solid, liquid or gaseous) shall be constructed under the provisions of Section I. Vessels in which vapor is generated incidental to the operation of a processing system, containing a number of pressure vessels such as used in chemical and petroleum manufacture are not covered by the rules of Section I.

Add the following:

Par. P-340—The following special rules shall apply to vapor generators in which organic fluids are vaporized.

(a) The manufacturer shall be responsible for providing in the design the limited heat absorption rates, proper furnace proportions etc. which will permit satisfactory and safe operation of the vaporizer under all conditions of operation.

(b) Safety valves shall be of a totally enclosed type so designed that vapors escaping beyond the valve seat shall not discharge into the atmosphere, except through an escape pipe that will carry such vapors to a safe point of discharge outside of the building. A suitable condenser that will condense all the vapour discharged from the safety valve may be used in lieu of piping the vapours to the atmosphere. The safety valve shall not have a lifting lever. The vaporizer shall be designed in accordance with the rules in this Code for a working pressure of at least 50 psi above the operating pressure at which it will be used.

(c) Gage glasses shall be of the flat glass type with forged steel frames. Gage cocks shall not be used.

(d) Suitable drain valves of the globe or angle type may be used in lieu of the blowoff valve required in Par. P-308.

Par. P-275—Add the following sentence to subparagraph (1)

(1) This method should not be used on a boiler with a superheater or reheater.

Par. A-46—Add the following sentence to subparagraph (1)

(1) This method should not be used on a boiler with a superheater or reheater.

Low-pressure Heating Boilers, 1952

Par. H-23—revise to read:

The diameter of a screw stay shall be taken at the bottom of the thread, provided this is the least diameter. No screwed stay, or stay welded in by fusion process, shall have a cross-sectional area less than .44 square inches.

Unfired Pressure Vessels, 1952

Table UNF-23, Copper-Silicon A, C D, SB-96 Plates & Sheet (1) revise stress value under "250F" from 10,000 to "11,700".

Under Charts for External Pressure add Fig. UNF-28.14 "Chart for Determining Shell Thickness of Cylindrical and Spherical Vessels under External Pressure" (NOTE: This figure is available from the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N.Y.).

Par. UG-47(b) add the following to read:

. . . except for welded construction covered by Par. UW-19.

Par. UG-84—delete the following from subparagraph (b)(3)

. . . with diameters differing not more than 6 in.

Par. UW-51—add the following to the first sentence of subparagraph (e)(4):

. . . being radiographed, but for thin plates need not be less than .005 in.

Par. UW-52—add the following to the first sentence of subparagraph (a)

. . . and except for those vessels or parts of vessels designed for external pressure only.

Fig. UW-19.1 — Typical Forms of Welded Staybolts—revise.

The following revisions were formulated at the meeting of March 4, 1955.

Table P-6 — Add the information shown in Table P-6 (addition.)

Table P-7—Specification SA-268, Grades, TP-405, TP-410 and TP-430, under Welded Alloy Steel, delete the stress values above "700 F".

Table P-7—SA-376, Seamless Austenitic Steel Pipe for High-Temperature Central Station Service, add stress values listed in Table P-7 (addition).

Material Specifications, 1952

The revised specifications published in the March, 1955 *Mechanical Engineering* will assume the existing allowable stress values as contained in Section I, Power Boilers and Section VIII, Unfired Pressure Vessel Codes.

The Boiler and Pressure Vessel Committee has approved adding to Section II the following specification:

Nonferrous Materials

SB-234-54T, Specification for Aluminum-Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers with the exception of alloy GS11C.

Unfired Pressure Vessels, 1952

Par. UCL-23(c), Maximum Allowable Stress Values, revise to read:

When the joints are completed by depositing corrosion-resisting weld metal over the weld in the base plate to restore the cladding, the design calculations may be based on a thickness equal to the nominal thickness of the base plate plus $S_c - S_b$ times the nominal thickness of the cladding after any allowance provided for corrosion has been deducted.

Where S_c = maximum allowable stress value for the cladding at the design temperature, p.s.i.

S_b = maximum allowable stress value for the base plate at the design temperature, p.s.i.

Where S_c is greater than S_b, the multiplier $S_c - S_b$ shall be taken equal to unity Vessels in which the cladding is included in the computation of wall thickness shall not be constructed under the provisions of Par. UW-52(b).

Par. UCL-36(b), Examination of Chromium-Alloy Cladding or Lining, to read:

Joints welded with austenitic chromium-nickel steel electrodes other than those in

material having either type 405 or of type 410 alloy lining with carbon not to exceed 0.08 per cent, shall be given a radiographic spot examination. The examination shall be made in accordance with the requirements for spot-radiography in Par. UW-52. At least one spot-examination shall include a portion of the lining weld that contacts weld metal in the base plate. This examination of the austenitic weld deposits is not required of such joints welded with austenitic chromium-nickel steel electrodes consisting of either type 405 or of 410 with 0.08 per cent maximum carbon.

Table UHA-23—SA-376, Seamless Austen itic Steel Pipe for High-Temperature Central Station Service, add stress values as in Table UHA-23 (addition).

Table UNF-23, under Pipe and Tube, add SB-234, Grade GS11A shall assume the same stress values as now included in this table for SB-274, Grade GS11A of T6 Temper.

Table P-6 (addition)

For Metal Temperatures Not Exceeding Deg. F.

Serial and Spec. No.	Grade, Type or Name	Conditions	Notes	Spec. Min. Tensile	Sub Zero to 150
COPPER ALLOYS					
Pipe or Tube					
SB-111 Seamless Tubes	Copper-Nickel 70-30	Annealed	(2)	55000	13300
SB-111 Seamless Tubes	Copper-Nickel 80-20	Annealed	(2)	50000	12000
SB-111 Seamless Tubes	Copper-Nickel 90-10	Annealed	(2)	40000	10000

250	300	350	400*	450	500	550	600	700	800
12700	12300	12000	11700	11300	11000	10500	10000	9000	—
11300	11000	10700	10300	10000	9500	9000	8500	7500	—
9500	9300	9000	8700	8300	7500	6700	6000	—	—

Additional Materials and Stress Values to be Added to Table P-7

For Metal Temperatures Not Exceeding Deg. F

Spec. Number	Grade	Nominal Composition	Spec. Min. Tensile	Notes	—20 to 100	200	300	400	—20 to 400
PIPES & TUBES Seamless Alloy Steel									
SA-376	TP304	18 Cr-8 Ni	75000	(7)	18750	17000	16000	15450	—
SA-376	TP304	18 Cr-8 Ni	75000	—	18750	16650	15000	13650	—
SA-376	TP321	18 Cr-8 Ni-Ti	75000	—	18750	18750	17000	15800	—
SA-376	TP347	18 Cr-8 Ni-Cb	75000	—	18750	18750	17000	15800	—
SA-376	TP316	16 Cr-13 Ni-3 Mo	75000	—	18750	18750	17900	17500	—

For Metal Temperatures Not Exceeding Deg. F

500	600	650	700	750	800	850	900	950	1000	1050	1100	1150
15100	14900	14850	14800	14700	14550	14300	14000	13400	12500	10000	7500	5750
12500	11600	11200	10800	10400	10000	9700	9400	9100	8800	8500	7500	5750
15200	14900	14850	14800	14700	14550	14300	14100	13850	13500	13100	10300	7600
15200	14900	14850	14800	14700	14550	14300	14100	13850	13500	13100	10300	7600
17200	17100	17050	17000	16900	16750	16500	16000	15100	14000	12200	10400	8500

For Metal Temperatures Not Exceeding Deg. F

1200	1250	1300	1350	1400	1450	1500	PIPES & TUBES Seamless Alloy Steel	
4500	3250	2450	1800	1400	1000	750	SA-376	TP304
4500	3250	2450	1800	1400	1000	750	SA-376	TP304
5000	3300	2200	1500	1200	900	750	SA-376	TP321
5000	3300	2200	1500	1200	900	750	SA-376	TP347
6800	5300	4000	2700	2000	1500	1000	SA-376	TP316

Additional Materials and Stress Values to be Added to Table UHA-23

For Metal Temperatures Not Exceeding Deg. F

Material and Specification Number	Grade	Type	Nominal Composition	Spec. Min. Tensile	Notes	—20 to 100	200	300	100	500	600	650	700	750
PIPES & TUBES Seamless														
SA-376	TP304	—	18 Cr-8 Ni	75000	(1)	18750	17000	16000	15450	15100	14900	14850	11800	11700
SA-376	TP304	—	18 Cr-8 Ni	75000	—	18750	16650	15000	13650	12500	11600	11200	10800	10400
SA-376	TP321	—	18 Cr-10 Ni-Ti	75000	—	18750	18750	17000	15800	15200	14900	14850	14800	14700
SA-376	TP347	—	18 Cr-10 Ni-Cb	75000	—	18750	18750	17000	15800	15200	14900	14850	14800	14700
SA-376	TP316	—	16 Cr-13 Ni-3 Mo	75000	—	18750	18750	17900	17500	17200	17100	17050	17000	16900

For Metal Temperatures Not Exceeding Deg. F

800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	Material and Specification Number	Grade
															PIPES & TUBES Seamless	
14550	14300	14000	13400	12500	10000	7500	5750	4500	3250	2450	1800	1400	1000	750	SA-376	TP304
10000	9700	9400	9100	8800	8500	7500	5750	4500	3250	2450	1800	1400	1000	750	SA-376	TP304
14550	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000	SA-376	TP321
14550	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000	SA-376	TP347
16750	16500	16000	15100	14000	12200	10400	8500	6800	5300	4000	3000	2350	1850	1500	SA-376	TP316

Elections and Transfers

At the meeting of Council held at Headquarters, on Monday, April 25th, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

G. R. Angle, *Dresden, Ont.*
C. Bulatko, *Montreal*
G. S. Daugirdas, *Sault Ste. Marie*
J. H. Forrest, *Montreal*
A. Gram, *Toronto*
C. R. Guest, *Calgary*
B. Hodjera, *Montreal*
J. M. Humphrys, *Montreal*
I. Maliska, *Montreal*
J. T. Moore, *London, Eng.*
E. S. F. Piers, *Georgetown, B.G.*
G. D. Russell, *Montreal*
J. J. Stewart, *Islington*

Juniors:

A. Alexander, *Toronto*
G. L. Bourgault, *Montreal*
J. de Ruiter, *Winnipeg*
G. L. Derrick, *Kingston*
J. Hawes, *Dundas*
D. K. Lawson, *Wellington, N.Z.*
G. E. Prince, *Arvida*
J. E. Simnott, *Windsor*
M. Skanes, *Hamilton*
G. Strother, *Montreal*

Transferred from the class of Junior to that of Member:

G. H. Balcome, *Shawinigan Falls*
L. G. Carignan, *Sherbrooke*
E. U. Deslauriers, *Montreal*
G. M. Ellis, *Vancouver*
J. J. Ellis, *Ottawa*
W. H. D. Hanchet, *Montreal*
J. P. Henderson, *St. John's, Nfld.*
M. J. Kenn, *Colchester, Eng.*
H. Lapointe, *Montreal*
L. Loebenberg, *Montreal*
N. A. Paolini, *Sault Ste. Marie*
W. Paul, *Montreal*
J. H. Reeves, *Ottawa*
A. F. Salvatore, *Montreal*

Transferred from the class of Student to that of Junior:

S. R. Giffin, *Toronto*

The following Students were admitted:

Queen's University

A. G. Blair Jr. — R. C. Howe
P. I. Campbell — G. R. Loffree
J. A. Corcoran — A. A. MacDonald
A. P. Faris — W. B. McCuaig
L. M. Erion — M. Revzen

Nova Scotia Technical College

P. W. Balcom — D. J. Kawaja
R. E. Fraser — J. F. Williams

Royal Military College

B. R. Carter — M. C. Johnston
N. J. Haslett — T. W. Ziegler
F. D. Jardine

University of Alberta

F. W. Bickell — J. W. Nisbet

University of New Brunswick

J. E. Brooks — J. D. Whiteley

University of Toronto

D. G. Hyde — P. B. Walters

McGill University

A. Blum

University of British Columbia

T. P. Juzkow

Laval University

M. Boivin

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have been effective:

ALBERTA

Members:

W. G. Roe — M. Vickers

SASKATCHEWAN

Members:

F. A. Batcheller — C. A. L. Hogg
J. D. MacGregor

Junior:

J. M. Hamilton

Student:

W. K. Baker

Junior to Member:

J. G. Malus

Student to Junior:

J. R. Beatty — J. S. Dudar

MANITOBA

Member:

R. C. Blair

NEW BRUNSWICK

Members:

M. E. MacDonald — L. F. Mason-Tulby

Thirty-five Years Ago

Comment on the *JOURNAL* of May 1920

Running through the *Journal* for May, 1920, in a hasty way to discover some foundation for these remarks, the writer's eye was caught by an advertisement, because of the excellent reproduction of a pencil sketch which headed the page. The subject was a single-cylinder, horizontal steam engine, the kind that once could be found in every factory in the land, but which is now nearly as extinct as the dodo. It had a personal appeal, for it was just such a wide belt as was here shown running off the flywheel to a jack shaft, that used to lift the writer's hair and draw blue sparks from his finger tips whenever he approached it in the "big shop" in the little town where he lived as a small boy.

Institute Policy

Quite evidently there was a faction—a noisy one, though probably small—in the Institute of 1920, which felt it was hardly getting its money's worth out of membership. At any rate, the leading editorial of this *Journal*, emphasized by being printed in blackface type, stated exactly the official stand of the Institute on the matter of service to members. "Despite the fact that . . . Council declared that service to individuals was (a) feature of the Institute's work . . . a large number . . . feel that more might have been accomplished . . ." The editor goes on to say that efforts to raise the salaries of engineers, particularly of those in the Civil Service, and to assist Institute members in the various provinces to secure legislation to raise their status, were distinctly helpful to the individual. And he announced that a conference of many councillors had just been held at which a Committee on Policy was recommended; it was formed almost at once and consisted of J. B. Challies, chairman, A. R. Decary, C. H. Mitchell, W. J. Francis, K. H. Smith, J. G. Sullivan and A. E. Foreman. Probably as we explore later issues of the *Journal*, we shall discover what the committee accomplished.

Journal Begins Third Year

The third year of the *Journal's* life began with this issue, so it gives itself a few quite justifiable pats on the back and concludes its panegyric with "Let no member lose sight of the fact that he is a shareholder in the *Journal* . . . and that all the support and influence he uses in its behalf will react directly to his own benefit." Present members might read and digest.

Professional Engineers Acts

The professional engineers' acts of British Columbia and of Manitoba were published in parallel columns and a stop-press announced the passing of the New Brunswick act, but the Saskatchewan act was bogged down and there appeared little hope that much progress would be made there for some time. Meanwhile Saskatchewan engineers were debating whether to try the government bill or the private bill approach.

The Toronto Branch was still

exercised by the low economic status of engineers. Having filed a resolution asking for action with Council in early 1920 and apparently not having got what it wanted, the branch now passed another more direct and more demanding resolution. One may wonder why it didn't do something on its own; perhaps it did, but there is no hint of any such action. It is noticeable, in reading these early *Journals*, that the branches had not as yet developed much self reliance; they bombarded headquarters with suggestions, but didn't do a great deal for themselves, except in strictly local matters. None of them was out of rompers yet, so perhaps not much could be expected of them.

Forest Resources

G. C. Piché, A.M.E.I.C., chief of the Forest Service of the Province, discussed Quebec's forest resources. He estimated that forests of commercial value covered 130 million acres, not including those of Ungava, so recently added to the province that no figures regarding it were at hand, and also omitting "a portion of the Labrador upland". Of this total, about 78 million acres was quite untouched. From 1867 to 1919 the province had received about $47½ million from forest fees and royalties and income was running at about $2½ million a year. There were then about 2,600 woodworking establishments in Quebec, headed by 2,200 sawmills and including 30 pulp and paper plants.

The first attempts at reforestation were made in 1889 at Oka, by Fr. Lefebvre who planted 18 acres of shifting sands to white and red pine. By 1920 these trees were from 45 to 70 feet tall. The provincial nursery at Berthierville was started in 1908 and had shipped over 3 million seedlings by 1920. Private owners, especially the paper companies, were beginning to show some interest in reforestation and the Laurentide Company had embarked on a rather extensive program.

Mr. Piché seemed not too much disturbed about the future of Quebec's forests. While admitting that there was much room for improvement in forest practice, he thought that the annual cut was going to be a long time in reaching the annual rate of reproduction, if it ever did, and that reforestation could put off the meeting to the indefinite future.

Progress in Telegraphy

"Recent Progress in Wireless Telegraphy", by J. O. G. Cann, chief engineer of Marconi, makes interesting reading. The four ways of generating wireless waves were by spark, by Poulson arc, by dynamic alternator and by thermionic valve, with the latter a brash newcomer, considered unlikely to amount to much. Wireless telephony was mentioned, but not given a major heading in this paper, though it was only three or four years later that regular radio broadcasting was to begin.

Industrial Relations

If any reader has ideas that industrial relations are something of this generation, he should read the paper on that subject by J. S. Cameron, A.M.E.I.C., in this *Journal*. Mr. Cameron, who is now a vice-president of the Northern Electric Co., was then its assistant general superintendent. To the writer, who knows next to nothing about industrial relations and has no particular interest in that topic, but who has had perforce to wade through many pages of manuscript, good and bad, dealing with it, this paper of Mr. Cameron's seems an unusually clear exposition of what industrial relations are all about. It would be a good idea for some of today's "experts" to read it.

Personals

The *Journal's* personals are always a source of interest to the old timers, like the writer, who finds that every now and then he knows one of the persons mentioned. In May, 1920, we find A. K. Hay, M.E.I.C., beginning his long connection with Ottawa as engineer and secretary of its Suburban Roads Commission; he is now chief engineer of the Federal District Commission. Alexander Peden, M.E.I.C., had just joined the engineering staff of the Dominion Bridge Co.; he is now retired. P. L. Pratley, M.E.I.C., had just left his post with that company for a position with the Department of Railways and Canals; he has been a consulting engineer for many years now, with some of Canada's most notable bridges to his credit. W. A. Bowden, M.E.I.C., was designated to represent Canada before the International Joint Commision in preparing a report on the St. Lawrence Seaway. To quote from the *Journal*: "No delay is anticipated. . . . It is understood that Mr. Bowden has . . . plans (for the report?) well advanced. His appointment is regarded as eminently satisfactory." No doubt it was, but the *Journal* could have been a little less smug about it.

Power Reactor

(*Continued from page 639*)

reactor should be located within easy access of Chalk River, since Chalk River will be responsible for nuclear performance. Third, the financial arrangements provide that both parties will accept full responsibility for the cost of their respective portions of the project together with any loss that may be incurred as the result of failure in operation or interrupted operation. This sharing of costs and risk is essential in an experimental project of this kind. Since Ontario Hydro has made the major contribution to the feasibility study on which the specifications of the reactor will be based, the continuing partnership will be of great mutual advantage.

While the reactor will be located in Ontario, it will be the policy to provide full information to the members of the Advisory Committee with regard to its design and operation. In this way we will ensure that all Canadian power producers will be in a position to evaluate its economic significance in terms of their respective systems.

Last December Atomic Energy of Canada Limited invited proposals for the design and construction of the reactor for a number of companies which were considered to have the design, engineering and manufacturing resources needed for an undertaking of this kind. These companies were advised that they would be expected to make some financial contribution to the project. After a careful assessment of these two factors — design, engineering and manufacturing resources and the amount of the financial contribution — Atomic Energy of Canada Limited has recommended that the contract be awarded to the Canadian General Electric Company Limited.

It is intended that detailed design will get underway immediately, with a view to the completion of construction in mid-1958.

Further details with regard to the program will be submitted to the Parliamentary Committee on Research.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Nova Scotia

Professor M. L. Baker, associate professor of mechanical engineering of the Nova Scotia Technical College, whose election as president of the Association of Professional Engineers of Nova Scotia, was announced in our March issue.

Association Appointments

At a recent meeting of the Council of the Association of Professional Engineers of Nova Scotia the following committees were appointed for the current year: Representative on Dominion Council, John E. Clarke, divisional engineer Provincial Department of Highways, Middleton; representative on E.I.C. General Council, Professor A. E. Flynn, dean, Nova Scotia Technical College, Halifax; Examining Board, G. H. Burchill, chairman, G. F. Bennett, M. F. Dean, W. A. Devereaux, M. R. Foran, G. D. Stanfield, and K. E. Whitman; A.P.E.N.S. Representatives on Joint Finance Committee, G. F. Bennett and R. F. Titus; Nominating Committee, M. L. Baker, J. E. Clarke, G. J. Currie, E. Lee Cameron, and J. D. Kline; Executive Committee, M. L. Baker, J. E. Clarke, C. N. Murray, J. W. MacDonald, and G. H. Burchill; Professional Relations Committee, G. D. Anderson, G. T. Clarke, H. W. L. Doane, D. F. Kirk, C. N. Murray, F. C. Morrison, and J. P. Vaughan; Scrutineers' Committee, R. D. T. Wickwire, chairman, A. T. Dean, and F. G. Murphy.

New Secretary-Treasurer

Professor Edward Lee Cameron has been appointed secretary-treasurer of the Association of Professional Engineers of Nova Scotia, succeeding J. D. Kline who served in this capacity for nine years.

Professor Cameron was born in Ottawa and moved west with his family in 1919. He attended public and high school there before moving with the family to Halifax where he attended Dalhousie University for one year of pre-engineering study. He then entered McGill University, graduating in 1942 with a B.Eng. degree in mining engineering. In 1952 he returned to McGill for post-graduate study on deep mining problems and in 1954 was awarded his masters degree.

Professor Edward Lee Cameron, associate professor of mineral engineering of the Nova Scotia Technical College, who has been appointed secretary-treasurer of the Association of Professional Engineers of Nova Scotia.

As an undergraduate, Professor Cameron had a varied experience ranging from a geological reconnaissance of galena deposits in the Nahanni River area, N.W.T., to general engineering problems related to gold and industrial mineral operations in Nova Scotia.

Following graduation in 1942 he was employed by the Metals Controller's Office to assist in the exploration of manganese deposits in Nova Scotia. In the fall of that year he was transferred to the Mines Branch at Ottawa to work on mineral dressing problems related to Canada's war effort. He accepted in 1946 the appointment of industrial mineralogist with the Manitoba Mines Branch and spent the next three years on field and laboratory investigations regarding industrial minerals in Manitoba.

Professor Cameron returned to Halifax in 1949 and since that time has been on the staff of the Nova Scotia Technical College where he is presently associate professor of mineral engineering.

He has published several articles and technical papers in the C.I.M. Bulletin, Canadian Journal of Technology and the Annual Report of the Nova Scotia Department of Mines.

Uniform Examination Syllabus

A study is continuing by the Committee on the Uniform Examination Syllabus approved by Dominion Council. The Nova Scotia Council approved this uniform syllabus in principle and is now endeavouring to set up the mechanics of setting and handling the 14 examinations required under the syllabus. At the present time the Association has an examination syllabus which has been in use for the past five years. Under this syllabus four examinations and a thesis are required, so it will be quite a change to operate under the new syllabus.

Quebec

G. Lorne Wiggs, senior partner of Wiggs, Walford, Frost and Lindsay, consulting engineers of Montreal, who was elected president of the Corporation of Professional Engineers of Quebec at their 36th annual meeting held at the Chateau Frontenac in Quebec City.

C.P.E.Q. - E.I.C. Cooperation

A meeting of the E.I.C. Eastern Townships Branch and the Corporation of Professional Engineers of Quebec was held in Sherbrooke on March 25.

Guest speaker was Leo Roy, of Quebec Hydro, Montreal. Among those present were The Hon. J. S. Bourque and Dean Armand Crepeau, and members of the teaching staffs of the University of Sherbrooke and the Sherbrooke Technical School.

Ontario

News of the Members

James T. Howley, of Chalk River, Ont., has been appointed to the Committee on Nucleonics of the American Institute of Electrical Engineers and as such is the first and only Canadian on this Committee. One of the Committee's responsibilities this year is in connection with speakers for the Nuclear Engineering and Science Congress to be held in Cleveland in December 1955.

John W. Jolly is located in Woodstock, Ont., where he is general manager of Standard Tube and T. I. Ltd.

James E. Irvine is now with Condi Engineering Corporation, 73 North Street, Pittsfield, Mass. as chief engineer. Prior to this appointment, Mr. Irvine was on the engineering staff of Abitibi Power & Paper Co. Ltd., in Toronto.

M. A. Konforti has taken over the Tesla Technical Company, Toronto, and will continue to offer all the previous professional engineering services under the name of Marsel A. Konforti, Consulting Engineer. The address is as before, 1173 Bay Street, Toronto. With this change, D. Lazarevich has terminated his connection with the Tesla Technical Company.

The appointment has recently been announced of **Leonard L. Yonell** of Toronto as vice-president and general manager of Stone and Webster Canada Ltd.

Born in Aylmer, Ont., Mr. Youell completed his engineering course at the University of Toronto in 1920, after serving as a gunner in World War I. After engaging in engineering in Canada for six years he moved to the United States and was associated with a leading chemical company for 19 years. In 1945 he joined Stone and Webster to return to Canada as its engineering representative. When Stone & Webster Canada Ltd. was formed in 1950 he was made manager of its head office in Toronto, and in 1952 was appointed vice-president of the Company.

Dr. E. J. Buckler, of Polymer Corp. Ltd., Sarnia, Ont., will be one of five members of a panel which will discuss the question of how adequately industrial chemistry is being treated in textbooks used in Canadian schools and universities at the annual conference of the Chemical Institute of Canada at Quebec City on May 30-June 1. Panel members will discuss textbooks used throughout Canada from the point of view of their accuracy, balance and reference to Canadian developments and practice.

John Cory has joined the Central Engineering section of the Chrysler Corporation, Detroit, as a text and development engineer. Mr. Cory was formerly with Ford Motor Co. of Canada Ltd., Windsor, as a special products engineer.

Joseph Biskup has recently been promoted to the position of assistant chief engineer and welding engineer of Disher Steel Construction Co. Ltd., Toronto.

J. J. Marta has recently assumed the post of district development engineer at the Vancouver branch of Canadian Liquid Air Co. Ltd. Prior to his move to Vancouver, Mr. Marta was located in Hamilton where he was employed by The Bristol Co. of Canada Ltd.

F. R. Denham has accepted the appointment of development engineer with Lucas-Rotax Ltd., Toronto. Mr. Denham was formerly with the Ford Motor Co. of Canada Ltd. in Windsor.

Peter Schwarzkopf is now living in Cornwall and is on the engineering staff of Howard Smith Paper Mills.

Z. Sanrazas has left Ontario Hydro and is now an electrical design engineer with the Foundation of Canada Engineering Corporation, 200 Bloor Street East, Toronto.

H. E. Lake has moved from Port Radium to Eldorado, Sask., where he is assistant manager of the Beaverlodge Operation of Eldorado Mining and Refining Ltd. While in the North West Territories, Mr. Lake was manager of the Port Radium operation of the company.

C. W. Bowman has recently received the appointment of a divisional cost engineer with Ontario Hydro on the St. Lawrence Power Project and is located in Cornwall. Mr. Bowman was previously on the structural engineering staff of Foundation of Canada Engineering Corp. Ltd. in Toronto.

Edwin Gardner, of Ottawa, has joined the mechanical section of the Dominion Patent and Copyright Office, Ottawa, as a patent examiner.

At a joint C.P.E.Q.-E.I.C. meeting at Sherbrooke, March 25. First row, left to right, Leo Roy, Quebec Hydro, Montreal, G. M. Dick, the Hon. J. S. Bourque, minister of lands, forests and hydraulic resources of the Quebec Government, J. A. Clement. Back row, A. C. Crepeau, Bruce Bradley, W. J. Sutherland, Gaston Masse.

Latterly, Mr. Gardner has been employed by the Sperry Gyroscope company in Ottawa.

W. Gerald Sayers, of Toronto, is now employed by Avro Aircraft Ltd., Malton, as aircraft designer. A graduate in mechanical engineering of the University of Toronto, Mr. Sayers was formerly a design engineer with Mathers and Haldenby, architects, Toronto. He joined that organization upon graduation.

T. C. Hall, who has been associated with Cockshutt Aircraft Ltd. of Renfrew since 1952, has been appointed plant electrical and welding engineer of Renfrew Aircraft and Engineering Co. Ltd., of Renfrew which recently took over the plant and operations of Cockshutt Aircraft Ltd. Mr. Hall is a graduate in electrical engineering from the University of British Columbia and joined Cockshutt Aircraft shortly after graduation.

L. B. Smart, of the Ontario Department of Highways has been appointed maintenance engineer with the Owen Sound division of the Department and will be located in Owen Sound, Ont.

Leonard H. Harper is at Algoma Mills, Ont., as assistant construction engineer at Algom Uranium Mines Ltd. Previously Mr. Harper was with Gore & Storrie, Toronto consulting engineers.

S. C. Roberts, of St. Catharines, is now in the electrical engineering department of H. G. Acres & Associates, of Niagara Falls, Ont. Before making the change, Mr. Roberts was associated with Packard Electric Co. Ltd., in St. Catharines.

Bernard L. J. Ullyett, of Atomic Energy of Canada Ltd., has been moved from Deep River, Ont., to Ottawa where he continues as production supervisor of isotope operations in the commercial products division of Atomic Energy of Canada Ltd., Tunney's Park, Ottawa.

Albert Baber has moved from Hamilton to Montreal, where he is employed by the C. D. Howe Co. Ltd., consulting engineers.

Prior to his move, Mr. Baber, who graduated in mechanical engineering from the University of New York in 1953, was with Canadian Westinghouse Co. Ltd., in Hamilton, Ont.

W. M. James is employed by the Department of Defence Production at Avro Aircraft Ltd., Malton, Ont., as production officer. Before assuming these new responsibilities Mr. James was branch manager of H. O. Trerice Co., Toronto.

P. Howell Davies is with Sir Lindsay Parkinson (Canada) Ltd., 52 St. Clair Avenue East, Toronto, as a field engineer. Before joining this organization Mr. Davies was with the Ontario Department of Highways, in Kingston, Ont.

S. R. Knott of Toronto is general manager of W. Fearnehough (Canada) Ltd., St. Lawrence Avenue, Queensway, Toronto 14. This company is connected with W. Fearnehough Ltd., of Sheffield, England. Mr. Knott, who graduated in 1940 from the University of Toronto, was earlier associated with Toronto Iron Works in Toronto.

George B. O. Abolius has moved from Hamilton, Ont., to Windsor and is a mechanical design engineer with Austin Company Ltd., in Windsor.

W. P. Jones, W. J. Rosenbloom, and **D. H. Pelton,** general manager, chief engineer and project engineer, respectively of Chemical Construction (Inter-American) Ltd., Toronto, have been transferred to the New York office of Chemical Construction Corporation on the closing down of the Toronto office of Chemical Construction (Inter-American) Ltd.

Manitoba

Installation Meeting

On Saturday, April 2, 1955, the Wardens of Camp No. 8 of the ritual of the "Calling of an Engineer" held an installation meeting for the 1955 graduating class of the University of Manitoba and other new members, approximately 110 in all. After the closing of the Camp, Professor Hoogstraten, president of the Association of Professional Engineers of Manitoba, acted as chairman and made a few brief remarks dealing with the activities of the Association. He then introduced A. Sandilands who addressed the installed group on behalf of the University of Manitoba Engineering Alumni.

W. D. Hurst, chairman of the Greater Winnipeg Water District, took part in a symposium on "Water Supply to Suburban Areas", which was held at the 35th Annual Meeting, Canadian Section American Water Works Association. The meeting was convened in the Chateau Frontenac, Quebec City, April 18, 19, 20.

Saskatchewan

W. R. Staples Is Elected President

At the Annual Meeting held February 18, Wm. R. Staples, professor of mechanical engineering, University of Saskatchewan, Saskatoon, was elected president of the Association of Professional Engineers of Saskatchewan and chairman of the Saskatchewan Branch of The Engineering Institute of Canada. He succeeds Geo. N. Munro of Regina.

Approximately 100 members attended from Prince Albert, Moose Jaw, Saskatoon, Swift Current, Lloydminster, Yorkton and Regina.

Other officers' names were E. J. Durnin, Regina, vice-president; and Reginald Bing-Wo, Regina, secretary-treasurer.

Members of the Council elected for a two-year term were C. R. Forsberg, Saskatoon; L. T. Holmes and J. C. Traynor, both of Regina. Members of Council continuing for one year are Wm. M. Berry, Regina, and E. C. B. Macnabb and W. G. McKay, both of Saskatoon. Prof. A. H. Douglas of Saskatoon was appointed to the Council by the government.

Saskatoon Section Holds Annual Meeting

The annual meeting of the Saskatoon Section was held on Thursday, March 10. W. R. Staples presided. A report on Council activities was given by the president. C. R. Forsberg, local secretary, reported that the Section had expenditures of $323.51 during the past year and that nine meetings had been held with an average attendance of 70.

Officers elected for the coming year were W. R. Staples, chairman, B. B. Torchinsky, secretary-treasurer, V. Dallin, publicity. R. E. Ludwig was appointed chairman of the Program Committee with members being S. Ringheim, W. Bunn, S. D. Cavers, and E. Toth representing the university students.

Saskatoon's Natural Gas System Described

Emil Reed, operating superintendent of the Natural Gas Distribution System for the Saskatchewan Power Corporation, spoke to Saskatoon members on March 10 on the gas system recently completed in Saskatoon.

The gas is piped 160 miles from the Brock-Colville area in a ten inch diameter welded steel pipe line. Well head pressures vary from 750 to 1000 psi, with normal line pressures being about 500 p.s.i. The maximum amount of gas transported in one day is about twenty million cubic feet. The project was completed in one construction season between May and November 1953. In addition to the main line, 120 miles of distribution line and 160 miles of service lines were laid.

The talk was illustrated by a film "Silent Servant", which showed many of the construction details.

Mr. Reed is a graduate in civil engineering of the University of Michigan and came to Saskatoon in September 1953 as a consultant in natural gas utilization. After completion of the project, he remained as operating superintendent.

British Columbia

The Engineering Profession Act, 1955

On March 15, before the prorogation of the twenty-fifth Legislative Assembly, the Lieutenant-Governor gave assent to "The Engineering Profession Act, 1955", thereby bringing to a culmination the efforts of Councils of the past several years to bring a new Act into effect which would enable them to administer it more easily.

The Act has been revised so that everything follows in a logical sequence. By agreement with the Architectural Institute anything that was of a controversial nature between the Institute and

the Association remained the same in the new Acts as it was in the old ones. Consequently, the definition of "the practice of professional engineering" remains the same.

Fundamental changes to the Act include:

Section 3(4): The exemption was raised from $5,000 to $25,000, thereby recognizing the increased cost of construction over the past years. Where the safety of the general public or the property of others is involved, however, there is no exemption.

Section 3(6): Corporations which have on their *active* staff professional engineers who directly supervise and assume full responsibility for work of a professional engineering nature, may undertake such work and recover fees for it. This section was added because several such firms are in operation now and the proposed Act prevented them from continuing under Sections 19 and 21. Actually, the addition of this section merely corrected a situation which prevailed under the old Act. The prohibition against corporations was not mentioned in the old Act, however, because the word "person" was believed to include "corporations". It was decided to include the prohibition in sections 19 and 21 because of a recent decision in the Court of Appeal in Ontario which held that an incorporated company could not be prevented from carrying on (in that case) the profession of architecture, because the Act only prohibited "persons" who were not registered from carrying on that profession.

Section 7(9): Provision is made in this section for the number of members of Council to be set by by-law. This will allow the Association to expand the Council if it sees fit because, for example, of new branches of engineering. The Council in future will consist of the President, Vice-President, four members appointed by the Lieutenant-Governor in Council, and as many additional members as the by-laws prescribe.

Section 8: This section gives Council power to carry out the functions now provided by the B.C. Engineering Society. For example paragraph (1) in this section allows Council to embark upon a Public Relations program, part of which may be the publication of a magazine, and paragraph (m) allows regional groups and divisions to be set up.

(Ed. Note: Presumably all the functions of the B.C. Engineering Society will be taken over by the Association. This probably will not take place formally, however, until the 1955 Annual Meeting in Victoria).

Section 9(1): This provides that no by-law may be passed except by a two-thirds majority vote cast by a letter ballot of the members. Previously, by-laws could be passed by an annual or general meeting.

Section 11(1): This section outlines the basic requirements for membership but leaves to the by-laws the period of experience and evidence of qualification required. It also enables Council to prevent a person of bad character or bad repute from being certified by this Association as being qualified. Under the former Act, Council had no alternative but to accept such a man as long as he possessed the technical requirements. To protect the applicant's rights, section 33(1) provides for an appeal from a refusal under section 11(1)(d).

Section 21: Provision is made here for obtaining an injunction through the Courts if a person disregards the provisions of the Act.

Section 25: Under this Section, the Association, in order to obtain a conviction, will only be called upon to prove a single act as an offence against the Act.

Copies of the new Act are now being printed and will be circulated to the membership when they are ready. The next step to be taken is to obtain a new set of by-laws. The committee set up to draw up a new set has almost completed its work and will soon be submitting its report to Council. After Council has accepted the new by-laws and amended them, if necessary, the by-laws will be circulated to the members and a letter-ballot taken.

Engineers in the News

D. G. Dunbar has left the B.C. Engineering Co. for New York where he will be employed by the American Gas and Electric Service Corp. on 330 k.v. expansion of transmission systems in Eastern United States. Mr. Dunbar has done extensive work on hydro-electric transmission work including the Kemano-Kitimat line while with the B.C. International Engineering Co.

Paul Klapp, who has been with the Department of Public Works at Hope, B.C., has accepted a position on the staff of J. L. Miller.

J. E. Dew-Jones is now with J. Laing & Son (Canada) Ltd. on the Annacis Island development. He had been on the engineering staff of the Municipality of North Vancouver.

J. M. Currie, who had been with the Sunshine Lardeau Mines Ltd., Beaton, B.C., is now with Williamsons Diamonds Ltd., Tanganyika Territory, B.E.A.

A. H. Ashworth has resigned as municipal engineer of the District of North Vancouver to enter the consulting field. He will be visiting New Zealand and opening an office there during the next few months, and expects to return to Vancouver in August.

N. J. Goode has accepted a position with the Municipality of Burnaby as assistant municipal engineer in charge of water supplies. He was previously public health engineer with the Division of Public Health Engineering, Dept. of Health & Welfare, in Victoria.

B. A. Quinlan will be leaving the B.C. Engineering Co. at the end of the month to join the Saguenay-Kitimat Construction Co. He expects to leave for Kitimat shortly.

D. G. Treilhard, of Flin Flon, will be leaving for Liverpool on the first stage of his trip to Northern Rhodesia. He has accepted a position as metallurgical assistant senior at the Nkana Copper Smelting of the Rhokana Corporation Ltd., a subsidiary of the Anglo-American Corporation of South Africa Ltd.

Ralph Sultan has been elected president of the Engineering Undergraduate Society for the year 1955-56. Ralph is presently finishing his third year in mechanical engineering and, as president, replaces Bob Johnson, who graduates this spring.

Frederick Friedel, who had been with the Water Resources Division of the Dept. of Northern Affairs and Natural Resources, has joined the staff of the B.C. Electric Co. Ltd.

R. D. Grantham has left the B.C. Engineering Co. to accept a position with the Dominion Construction Co. He will be leaving Vancouver near the end of this month to act as resident engineer on a company project in Halifax.

A. M. Goldberg has recently joined the staff of J. L. Miller. Mr. Goldberg had been with the Greater Vancouver Water District since 1952.

S. W. Forstrom, previously assistant plant engineer with Crown Zellerbach Canada Ltd. at Ocean Falls, has accepted the position of plant engineer with Alaska Pine & Cellulose Co. at Port Alice.

A. R. D. Robertson has transferred from the B.C. Forest Service to the Water Rights Branch of the Department of Lands & Forests, taking an appointment as hydraulic engineer.

E. W. Richardson has been appointed manager of Park Royal Shopping Centre at West Vancouver. He will also continue his former engineering duties for the centre and other holdings of British Properties Ltd.

J. C. Cant, resident engineer with Canadian National Railways, will be leaving construction on the Terrace-Kitimat branch to join the Department of Research and Development in Montreal.

P. T. Cote has left the firm of Williams Brothers - McLaughlin - Marwell, where he was project technical engineer for the Haines-Fairbanks Pipeline, to accept the position of vice-president of The Tide Co. (B.C.) Ltd. and The Bay Company (B.C.) Ltd.

Robert M. Brown, a mechanical engineering student at the University of B.C. has been awarded the American Society of Mechanical Engineers bronze medal for high scholastic achievement and extra curricular activities. This award was made to mark the celebration of the 75th anniversary of the American Society of Mechanical Engineers and was open to all engineering students.

A. J. Paul, who has been employed by the Canadian Pacific Railway Co., has accepted a position with Phillips, Barratt & Partners.

R. E. Bryant has had his release from the Canadian Army (Regular) approved and has accepted employment as an assistant engineer with the Construction division of the B.C. Forest Service.

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Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Douglas Stewart Ellis, M.E.I.C., dean of the Faculty of Applied Science of Queen's University died suddenly at his home in Kingston, Ont., on March 20, 1955.

Dean Ellis had completed 45 years of service to Queen's University and was to retire at the end of this session.

Principal W. A. Mackintosh paid tribute to Dean Ellis, saying that "His continuous service at the university was broken only by his overseas service of more than four years in World War I and a year's leave for graduate work at Cornell. He has had many distinctions, from the D.S.O. in 1918 to the Julian Smith Medal in engineering in 1954, but none greater than the respect and affection of his students and colleagues for an enthusiastic if exacting teacher, a devoted servant of the university, and a warm friend".

Born in Cobourg, Ont., in 1885, Douglas Ellis came to Kingston as a boy when his father was appointed principal of Kingston Collegiate Institute.

Graduating from Queen's University in 1908 with the M.A. degree and two years later with the degree of B.Sc. in civil engineering, Dean Ellis joined the staff of the university as an instructor in mathematics.

He then also began his long career in the Canadian armed forces, joining the 5th Field Company, R.C.E., as a lieutenant in 1910. When World War I broke out, he was a captain with the unit, now the 6th Field Company, and went overseas as second in command under Lt.-Col. Lindsay Malcolm. In 1917, as a major, he held command of the company, which was attached to the 2nd Canadian Division. In 1918 he was mentioned in despatches and was awarded the D.S.O. At the end of the war he remained in England for a year as chief instructor of the Canadian Military School of Engineering and was promoted to lieutenant-colonel. For many years he was honorary colonel of Queen's C.O.T.C.

After a year of graduate work at Cornell University, Lt.-Col. Ellis returned to Queen's as a professor of civil engineering. Twelve years ago he was appointed dean of the faculty.

Besides teaching, Dean Ellis contributed much to the engineering profession in Canada, the U.S.A. and Great Britain. He was for years a consultant for the Ontario Hydro Electric Power Commission, the Ontario government and the federal government in engineering projects. In World War II he was a member of the Bureau of Technical Personnel at Ottawa and in recent years he had been chairman of the board of engineers studying a means of crossing the Strait of Canso in Nova Scotia.

On the occasion of the award of the Julian C. Smith Medal to Dean Ellis in 1954 by The Institute, it was noted that his association with the Institute dated from 1909 when he became a Student member. He transferred to Junior in 1913, to Associate Member in 1919, and to Member in 1940. He served on numerous committees and represented the Kingston Branch on the Council in 1929, 1941 and 1942.

D. S. Ellis, M.E.I.C.

Wilfred Ernest Clarke, M.E.I.C., president and managing director of Sydney Engineering and Dry Dock Co. Ltd. in Sydney, N.S., passed away on March 28, 1955.

Mr. Clarke was born in Cobourg, Ont., on April 13, 1881. After attending general public and high school, he undertook private tuition and night classes at the School of Practical Science (University of Toronto).

After four years' practical shop experience, he went to Sydney in 1900 to join his father in the operation of the Sydney Foundry and Machine Works Ltd. He served for the first five years as superintendent of the company, and for the next six years as manager. In 1911 he was named vice-president and general manager at which time the dry dock and engineering divisions were established at Anderson's Point and the foundry facilities moved to a new location under the firm name of Sydney Dry Dock and Engineering Co. Ltd. Expansion followed rapidly until the company developed into one of the leading operations of its kind and size in the province. It played a leading role during World War II. Upon his father's death, Mr. Clarke became president and general manager of the firm.

Mr. Clarke was active in community affairs and was identified with various undertakings associated with progress and the development of Sydney.

He was a past-president of the Mining Society of Nova Scotia, a member of the Association of Professional Engineers of Nova Scotia, and a member of the Sydney Board of Trade.

Mr. Clarke joined the Engineering Institute as a Member in 1923, and attained Life Membership in January, 1954.

William Scales, M.E.I.C., municipal engineer for the Village of Dawson Creek, B.C., passed away on February 7, 1955.

Mr. Scales was born in Stackallen Navan, County Meath, Ireland, on June 5, 1885, and received his early education at Kings Hospital, Dublin. He attended McGuines Civil Service College, Dublin and graduated from Thompson Civil Engineering College, Rurku, India, in 1910.

Upon graduation he was employed as assistant to the subdivisional officer of the Bombay subdivision of the Public Works Department. In 1916 he volunteered for military service in India and served in Mesopotamia in charge of a section of field park engineering supplies and as garrison engineer with the 16th division of the Royal Engineers. From 1919 to 1920 he was engaged on military works service in Bombay.

Mr. Scales came to Canada in 1920 and was engaged as engineer in the municipalities of St. Lina and Ashmont, Alta. In 1931 he was named city engineer for Fernie, B.C., and three years later, city engineer for Courtenay, B.C.

He was associated with Northern Construction Company in 1941, and afterwards served during World War II with the Royal Canadian Engineers. Assistant C.E.O. in the Pacific Command, he was discharged in 1946 with the rank of major.

Mr. Scales then became location engineer for the Peace River District, B.C. and in 1947 was appointed municipal engineer for Dawson Creek, B.C.

He joined the Engineering Institute of Canada as a Member in 1936.

Ernest Butler, M.E.I.C., assistant to the chief engineer of Consolidated Paper Corporation at Grand'Mere, Que., died suddenly at his home on June 3, 1954, following an automobile accident.

Mr. Butler was born in Manchester, England, on February 15, 1889, and was educated at Warehouseman & Clerke School, Cheadle Hulme, England, and at the Institute of Technology in Manchester, England. He received a first class honours certificate in science and art given by the University of Cambridge.

During the summer months of his course he was employed as draughtsman on steam fittings and appliances for Holden & Brooke Ltd. in Manchester, and as mechanical draughtsman for General Electric Company Ltd. there.

Mr. Butler came to Canada in 1909. He was first associated with the J. McDougall Company in Montreal and with the Canadian Pacific Railway Angus Shops in Montreal. In 1912 he joined the Northern Electric Company in Montreal as designer on telephone exchange equipment, general power station work and laboratory work.

He moved to Grand'Mere, Que., in 1918 to join the staff of the engineering department of Laurentide Paper Company. Following this he was employed by Charles Walmsley in Longueuil, Que., and in 1925 he moved to Three Rivers, Que., and became associated as chief designer and estimator on paper mill equipment, mill extensions and maintenance with the St. Maurice Paper Company. This company later amalgamated with the Consolidated Papers group. In 1930 he was appointed chief designer of the Wayagamack division of Consolidated Paper Corporation Ltd., and in 1937 was named designing engineer. He was transferred to the chief engineer's department in Grand'Mere in 1951.

Mr. Butler joined the Institute as Associate Member in 1937 and transferred to Member in 1940.

George Edward Leigh-Mallory, AFFL. E.I.C., of General Motors of Canada Limited at Oshawa, Ont., passed away on October 2, 1954.

Mr. Leigh-Mallory was born in Burford, Ont., on December 1, 1889. He attended Trinity College School and afterwards studied civil engineering at McGill University.

While still studying Mr. Leigh-Mallory was employed during the summer months by Canadian Northern Railway, Port Hope and Spaidal, and by the Dominion Bridge Company in Lachine, Que. In 1917 he was employed as a draughtsman with the General Railway Signal Co. in Lachine, Que., and in 1920 joined the Dominion Bridge Company at Winnipeg, Man.

He became associated with the engineering department of General Motors of Canada Ltd. in 1921 at Oshawa, Ont. His duties then consisted of drawings and specifications of export cases for automobiles. In 1931 he was engaged in factory assembly work for the company until 1934 when he was made inspector of incoming material. Two years later he became inspector of auto stampings, which position he held at the time of his death.

Mr. Leigh-Mallory joined the Engineering Institute in 1940 as an Affiliate Member.

Edward Holt Gurney, M.E.I.C., chairman of the board of Gurney Products Ltd. in Toronto, Ont., passed away on March 19, 1954.

Mr. Gurney was born in Toronto on August 25, 1882. He was educated at Model School and Jarvis Collegiate and the School of Practical Science (University of Toronto).

During the summer months of his studies he was engaged in heating layouts and plant design with the Gurney Foundry Company.

Mr. Gurney became president of Gurney Foundry Company Ltd. in 1919 after serving for a year as director of the marine machinery supply division of the Imperial Munitions Board. He was also president of Electric Steels Ltd. at Cap de la Madeleine, Que. In 1935 he became chairman of the board of Gurney Products Ltd.

Mr. Gurney served on the council of the American Society of Heating and Ventilating Engineers becoming second vice-president in 1936, first vice-president in 1937, and president in 1938. He was also vice-chairman of the Ontario Research Foundation from 1930 to 1939, serving as its chairman in 1939.

Mr. Gurney received an honourary degree of LL.D. from the University of Western Ontario in 1949.

He joined the Engineering Institute as a Member in 1945.

Mieczyslaw Szczesny Kazimierz Norvid-Neugebauer, M.E.I.C., former lieutenant-general in the Polish Army, passed away in Toronto on October 18, 1954.

Mr. Norvid-Neugebauer was born in Warsaw, Poland on February 15, 1890. He received his mechanical engineering degree from the Politechnical University in Lvov in 1911.

Upon graduation he became designer in the Technical and Industrial Company in Lvov, and two months later joined Rodakowski and Sosnowski Company as designer, subsequently becoming supervisor of mechanical equipment.

From 1914 until 1947 Mr. Norvid-Neugebauer was engaged in military service, beginning as a regular soldier and attaining the rank of lieutenant general. During the last ten years of service he was chief administrator and quarter master general of Polish forces under British command. Mr. Norvid-Neugebauer was awarded 18 honours for his outstanding war contributions.

He went to England in 1947 and was associated with Uskside Engineering Company, Precision Tools Company and Peter Gage Company until 1949 when he came to Canada. During the following two years he was on the staff of Sasco Steel Industries Co. Ltd. as designer and supervisor of assembly work in Toronto. In 1950 he became draughtsman and estimator with City Contracting Ltd. in Toronto, subsequently joining Mathers and Haldenby, architects, Kilborn Engineering Co. Ltd. He was associated latterly with Trane Co. of Canada Ltd. in Toronto.

Mr. Norvid-Neugebauer was a member of the Institution of Polish Engineers of Great Britain, the Association of Polish Engineers of Canada, and a member of the Association of Professional Engineers of Ontario.

He joined the Engineering Institute of Canada as a Member in June, 1952.

Roland Wallace Heine, JR.E.I.C., of the Department of Transport in Winnipeg, Man., died on July 12, 1954, in Gimli, Manitoba.

Mr. Heine was born in Norton, N.B., on June 9, 1922, and was educated at Sussex High School, Sussex, N.B., and at Dalhousie University. He entered Nova Scotia Technical College in 1950, graduating with a B.Eng. degree in civil engineering in 1953.

During the summer months of his University course he was employed as instrumentman with S. F. Willet and as engineering aide with the United States Air Force. Upon graduation he became associated with the Department of Transport in Winnipeg, Man., and was engaged in the development of additional airfields in that region.

Mr. Heine joined the Engineering Institute as a Student in 1951 and transferred to Junior Member in 1954.

Personals

News of the Personal Activities of Members of the Institute

Edgar A. Cross, M.E.I.C., has been elected president of the Association of Consulting Engineers of Canada at the group's annual meeting held in Montreal. Mr. Cross succeeds **A. T. Hurter,** M.E.I.C.

Edgar A. Cross, M.E.I.C.

Born in Petersfield, Hunts, England, Mr. Cross attended Birmingham University, graduating in 1909 with the degree of B.Sc. in civil engineering. In 1910 he became associated with Birmingham Canal Navigations, England, as assistant engineer, and in 1917, after two years with the Royal Engineers in France, he became research engineer at the Royal Arsenal, Woolwich, England. He returned to Birmingham Canal Navigations as chief assistant engineer in 1919, remaining until 1920.

During the following two years Mr. Cross was in the United States as superintendent of construction for W. L. Stoddart, architect, New York City, on such projects as the Mica Insulating Factory, Schenectady, N.Y., Hotel Sheraton, High Point, N.C., and the Lycoming Hotel, Willamsport, Pa. Then he accepted the position of structural engineer for Albert Kahn, Detroit, Mich., remaining until 1927 when he associated himself with Chapman and Oxley, Toronto, as structural engineer. In 1930 Mr. Gross established his private practice as consulting structural engineer in Toronto.

Mr. Cross joined the Institute as an Associate Member in 1925, transferring to Member in 1935. In 1948 he served as a councillor of the Institute for the Toronto Branch.

T. E. Storey, M.E.I.C., has been named the new general manager of the Winnipeg Hydro Electric System, succeeding **H. L. Briggs,** M.E.I.C., who resigned to become head of the British Columbia Power Commission.

Mr. Storey was born in Brockville, Ont., and received his early education in Winnipeg. He graduated from the University of Manitoba with a B.Sc. degree in electrical engineering in 1928.

After a year's association with the Canadian General Electric Company, Mr. Storey joined the Winnipeg Hydro in 1929. He engaged in operating and maintenance work at Slave Falls from the plant's opening in 1931 until promoted to take charge of that plant in 1935. Five years later he returned to Winnipeg as operating engineer, rising to the positon of general superintendent in charge of production in 1944, chief engineer in 1948 and assistant general manager in 1952.

Mr. Storey has served as secretary, chairman and councillor of the Winnipeg Branch of the Institute. He is also a

T. E. Storey, M.E.I.C.

member and past-president of the Association of Professional Engineers of Manitoba and he is a past-president of the Manitoba Electrical Association.

D. C. Bryden, M.E.I.C., chief engineer of the Winnipeg Hydro Electric System since January, 1952, has been appointed assistant general manager following the appointment of **T. E. Storey,** M.E.I.C., as general manager.

Born in England, Mr. Bryden came to Canada in 1911. He attended Edmonton public and high schools, and graduated from the University of Alberta with the degrees of B.A. and B.Sc. in 1928.

Mr. Bryden spent two years with the Canadian Westinghouse Company at Hamilton, Ont., and joined the Winnipeg Hydro as power sales engineer in 1930. From design engineer in 1939 he progressed to assistant superintendent of power plants in 1940, operating engineer in 1946, general superintendent in charge of production in 1948 and chief engineer in 1952.

D. C. Bryden, M.E.I.C.

He is a member of the Association of Professional Engineers of Manitoba and the Manitoba Electrical Association.

Leonard L. Youell, M.E.I.C., has been appointed vice-president and general manager of Stone & Webster Canada Limited, Toronto.

A native of Aylmer, Ont., Mr. Youell served overseas with the artillery in World War I and graduated from the University of Toronto in mechanical engineering in 1920. After six years in engineering work in Canada he spent nineteen years in the United States with the Solway Process Company, Hopewell, Virginia.

In 1945 he joined Stone and Webster to return to Canada as its engineering

Leonard L. Youell, M.E.I.C.

representative. Upon formation of Stone and Webster Canada Limited in 1950, he was made manager of its head office

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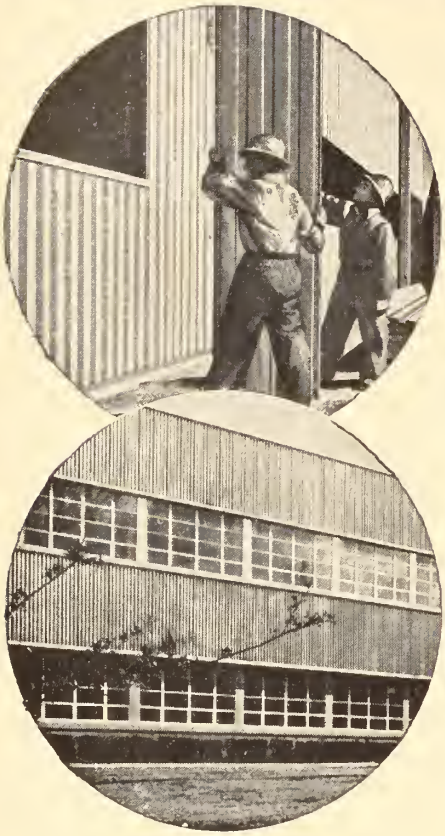

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in Toronto. He was appointed vice-president in 1952.

Mr. Youell is a member of the Association of Professional Engineers of Ontario and the American Society of Mechanical Engineers.

T. C. Higginson, M.E.I.C., president of Eastward Industries Ltd., Saint John, N.B., has been elected chairman of the Saint John Branch of the Engineering Institute.

Born in Montreal, Mr. Higginson received his secondary education at Strathcona Academy, Montreal. During the years 1928 to 1930 he undertook private tuition in engineering subjects, supervised by Professor McCurdy of McGill University.

While still studying he became associated with the Automatic Sprinkler Co. of Canada, Ltd., Montreal, working during his summer holidays as a draftsman. In 1932 he joined the survey and design department of the company, transferring the following year to the sales and engineering department. In 1934 he was appointed manager of engineering and sales for the company, Eastern division, and from 1937 to 1946 he was manager of sales and engineering covering Canada and Newfoundland.

During this period Mr. Higginson was responsible for many "firsts" in industrial design. In 1937 he designed the first type of steel concealed baseboard heating radiation, and in 1939 he designed and supervised installation of the first pilot controlled low pressure immediate action, open head sprinkler systems for paper machine economizers. In 1941 Mr. Higginson surveyed, designed and supervised installation of the first veneer log spray system to control heat and moisture content in logs. During the same year he also designed the first Loup Sprinkler System utilizing 2 inch mains. During the war years he carried on many projects with the Department of Munitions and Supply for fire protection, water works, design of spray room, and protection in power plants.

In 1946 Mr. Higginson resigned from the head office of Automatic Sprinkler Company of Canada, Ltd., and opened and took over their Maritime interests

T. C. Higginson, M.E.I.C.

with a fabricating shop in Saint John with branches in Halifax and Sydney.

He is Maritime manager of Automatic Sprinkler Company, president of Eastward Industries Ltd., and a director of the New Brunswick Development Corporation. He is also a Trustee of Rothesay Regional School Board and a member of the New Brunswick Association of Professional Engineers. He became a Member of the Institute in 1949.

T. M. Patterson, M.E.I.C., has been appointed to the position of director of the engineering and water resources branch of the Department of Northern Affairs and National Resources. He was formerly chief of the Water Sources Division and has been acting director of the branch since the death of **Norman Marr,** M.E.I.C., in April, 1954.

T. M. Patterson, M.E.I.C.

Born at Kincardine, Ont., he received his secondary education at Kincardine and graduated from the University of Toronto, class of 1925, with a B.A.Sc. in civil engineering.

Upon graduation he became assistant engineer on powerhouse construction for the Ontario Hydro-Electric Power Commission in 1926 and in 1927 he was engaged in similar work with the Fraser Brace Engineering Company. In June 1927 he began his continuous federal government service as an engineer on international waterway problems for the Department of the Interior. He continued this assignment until 1932, when he was transferred to the staff of the International Joint Commission where he was engaged on various international waterway assignments.

In 1936 Mr. Patterson was transferred from the staff of the International Joint Commission to the Department of the Interior. He was appointed assistant chief in 1952 and the following year he became chief of the Water Resources Division, Department of Northern Affairs and National Resources.

He is member and honorary secretary of the Canadian Committee of the World Power Conference and is Canadian member of many of the various international engineering boards and boards of control established to deal with waterway problems between the United States and Canada. He is also a member of the Professional Institute of the Public Service of Canada.

H. L. Watts, M.E.I.C., has been appointed project manager for Ontario Hydro's

INCO Research Engineer in consultation at Atlas Steels Limited, Welland, Ont.

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frequency standardization program in the City of Hamilton and surrounding municipalities. He has been acting project manager since last November.

Born in Toronto, Mr. Watts attended King Edward public school and St. Andrew's College. Graduating in metallurgical engineering from the University of Toronto, he entered government service, becoming assistant to the chief of the Bureau of Mines at Ottawa. Mr. Watts served with the Bureau from 1938 to 1948, with the exception of five and a half years during World War II, when he was on overseas service with the Royal Canadian Engineers, holding the rank of major on demobilization.

After a year with the Central Mortgage and Housing Corporation he joined Hydro's frequency standardization division, serving as assistant project manager during the changeover to 60 cycles in London, Windsor, and surrounding districts, and then Hamilton.

Mr. Watts' office is at Hydro's frequency standardization base at Beach Road, Hamilton. It will remain in operation until 1957, when changeover of the city is scheduled to be completed.

Guy Rinfret, M.E.I.C., chief engineer of the Shawinigan Engineering Company Ltd., has been elected a director and made a vice-president of that company. The announcement was made by **R. E. Heartz,** M.E.I.C., president of the company.

Mr. Rinfret, who will continue as chief engineer as well, was born in Dawson City, Yukon, and educated at Loyola College, Montreal, the Shawinigan Technical Institute at Shawinigan Falls, and McGill University where he received his degree in civil engineering.

He joined the Shawinigan Water and Power Company in 1918, and transferred to the engineering subsidiary when it was formed in 1919. Mr. Rinfret was resident engineer on the construction of the Shawinigan hydro-electric plant at Rapide Blanc and the St. Maurice Power Corporation plant at La Tuque on the St. Maurice River. After World War II he spent several months in China when the company took part in

Guy Rinfret, M.E.I.C.

a study of hydro-electric sites for the Nationalist government.

W. A. Devereaux, M.E.I.C., manager of the Halifax branch of Bailey Meter Company Ltd., has been elected chairman of the Halifax Branch of the Institute.

Mr. Devereaux is a native of Georgetown, Ont., where he received his secondary school education. He graduated from the University of Toronto in 1937 with a degree of B.A.Sc. in mechanical engineering. Upon graduation he joined Bailey Meter Company Ltd. and took their cadet engineering course at Cleveland, Ohio. Returning to Canada in 1938 he spent a year at the head office of

W. A. Devereaux, M.E.I.C.

the company at Montreal and was then transferred to Winnipeg where he carried out service and sales engineering work in Western Canada. In 1941 he became their first resident engineer in Vancouver. However, in 1942 he was recalled to Montreal in connection with work on defence projects for the Navy and Air Force on the East Coast and in Newfoundland. In 1945 he opened the Halifax branch office of Bailey Meter Company Ltd. and was appointed its first manager, a position which he has held since then.

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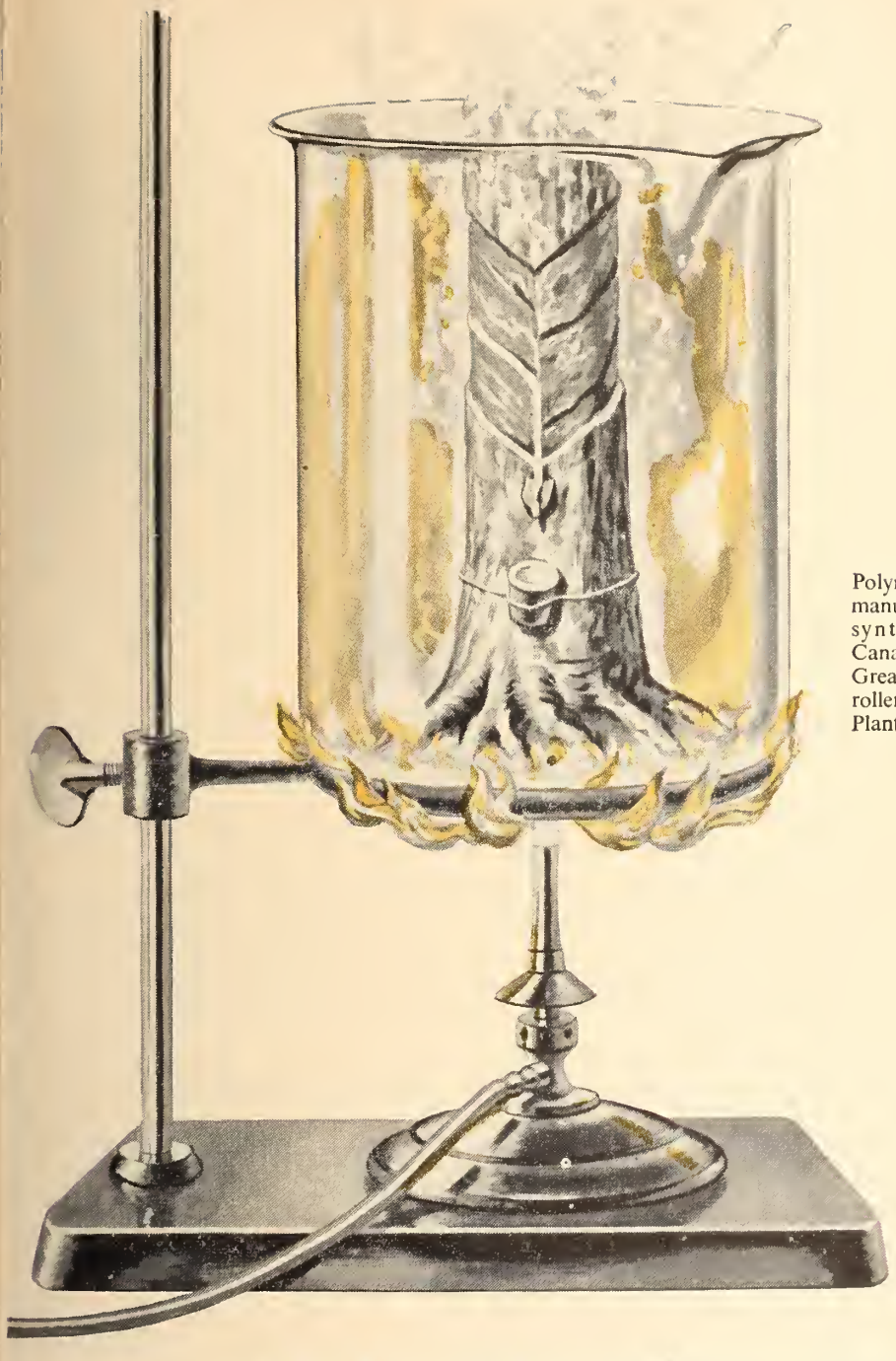

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He was the first chairman of the Committee on Professional Development for the Halifax Branch of the Institute in 1952, and has served on the Branch executive for the past two years and was vice-chairman last year. Mr. Devereaux is a member of the Association of Professional Engineers of Nova Scotia and was a member of its council for two years. He also served on the Association's Examining Board and the Committee on Professional Relations. He is a member of the American Society of Mechanical Engineers and the American Water Works Association, Maritime Branch.

D. R. Robson, M.E.I.C., plant superintendent of Fawcett Enamel & Heating Products Limited, in Amherst, N.S., has been elected chairman of the Amherst Branch of the Engineering Institute.

He was born in Pictou, N.S., and received his early education at Truro, N.S. After service in the R.C.A.F. he attended Acadia University and Nova Scotia Technical College, graduating in mechanical engineering in 1950. Since that time he has been employed with Fawcett Enamel & Heating Products, first in Sackville, N.B., as development engineer, and since August, 1953, as plant superintendent of Plant 2 engaged in the manufacture of warm air furnaces and air conditioning units in Amherst.

During the summer months of his university course Mr. Robson was employed by the Nova Scotia Department of Highways at Middleton, N.S., and at the Town Engineer's office, Truro, N.S., While with the latter he was engaged for a time as assistant on a water distribution survey made by the Cole Pitotmeter Co., N.Y., on the water system of Truro.

W. C. Heim, M.E.I.C., has been appointed vice-president by the board of directors of Alchem Limited, Burlington, Ont.

He graduated in chemical engineering from the University of British Columbia in 1940, and joined Alchem Limited two years later as a field service engineer with the industrial department. In January, 1943 he was transferred to railroad department service.

In October, 1946 he was named chief engineer of the railroad department, and in 1951 manager of the same department. He was appointed assistant to the vice-president in 1953 and assistant general manager later that same year.

W. C. Heim, M.E.I.C.

E. F. Carson, AFFIL.E.I.C.

E. F. Carson, AFFIL.E.I.C., has been appointed district sales manager of the midwest district of Northern Electric Co. Ltd., with headquarters in Winnipeg.

He joined the company in 1929 and since that time has held a wide variety of sales positions in various parts of Canada.

In 1942 he was loaned by the company to the Department of Munitions and Supplies' Naval Branch, and was appointed manager of the Northern Electric Company's London branch upon his return to the company in 1943. Mr. Carson was appointed wire and cable manager of the eastern sales district in 1950, and became wire and cable manager of the sales division the following year.

He is a member of the American Institute of Electrical Engineers.

R. A. Marvin, M.E.I.C., has been appointed wire and cable marketing manager of the sales division of Northern Electric Co. Ltd., with headquarters in Montreal.

Mr. Marvin was born in Edrans, Manitoba. After graduating with a B.Sc. degree from the University of Manitoba in 1935, he was employed by the provincial government as plant inspector before joining the Northern Electric Company in Winnipeg in 1936 as power apparatus specialist. In June of the following year he was transferred to Regina as power apparatus specialist, wire and cable specialist and overhead and underground specialist. He remained in Regina until November 1944 when he was transferred to Montreal as technical naval engineer on the Degaussing program.

In March 1945 Mr. Marvin returned to Winnipeg as manager, overhead and underground, power apparatus department and wire and cable department.

Mr. Marvin is a past president of the Manitoba Electrical Association and a member of the Professional Engineers of Manitoba. He is also a past-chairman of the electrical section of the Winnipeg Branch of the Engineering Institute.

Gordon H. Finch, M.E.I.C., who, for the past four years, has been district sales manager of the Canadian Westinghouse Co. Ltd. apparatus division, has been named district manager of the Western district with headquarters in Winnipeg, and now heads the district apparatus division sales operations in the provinces of Manitoba and Saskatchewan and the Fort William territory.

G. H. Finch, M.E.I.C.

Mr. Finch who graduated in electrical engineering from the University of Manitoba in 1924, joined the company in 1922 and served at the Winnipeg, Calgary and Ottawa offices.

Ronald H. Hall, M.E.I.C., has been named general manager of B.A.-Shawinigan Limited. Mr. Hall has been plant manager of the company's plant in Montreal East.

Born in Regina, Mr. Hall is a chemical engineering graduate of the University of Saskatchewan, class of 1941. He joined Shawinigan Chemical Limited's plant research department in Shawinigan Falls upon graduation, and in 1943 was loaned to the National Research Council.

In 1944 he enrolled in the army, and spent a year in the Canadian Paratroop Corps. After the war, he obtained his master's degree in chemical engineering from the University of Toronto, and then returned to the plant research department of Shawinigan Chemicals Limited. He joined B.A.-Shawinigan in 1951, becoming assistant plant manager in 1952.

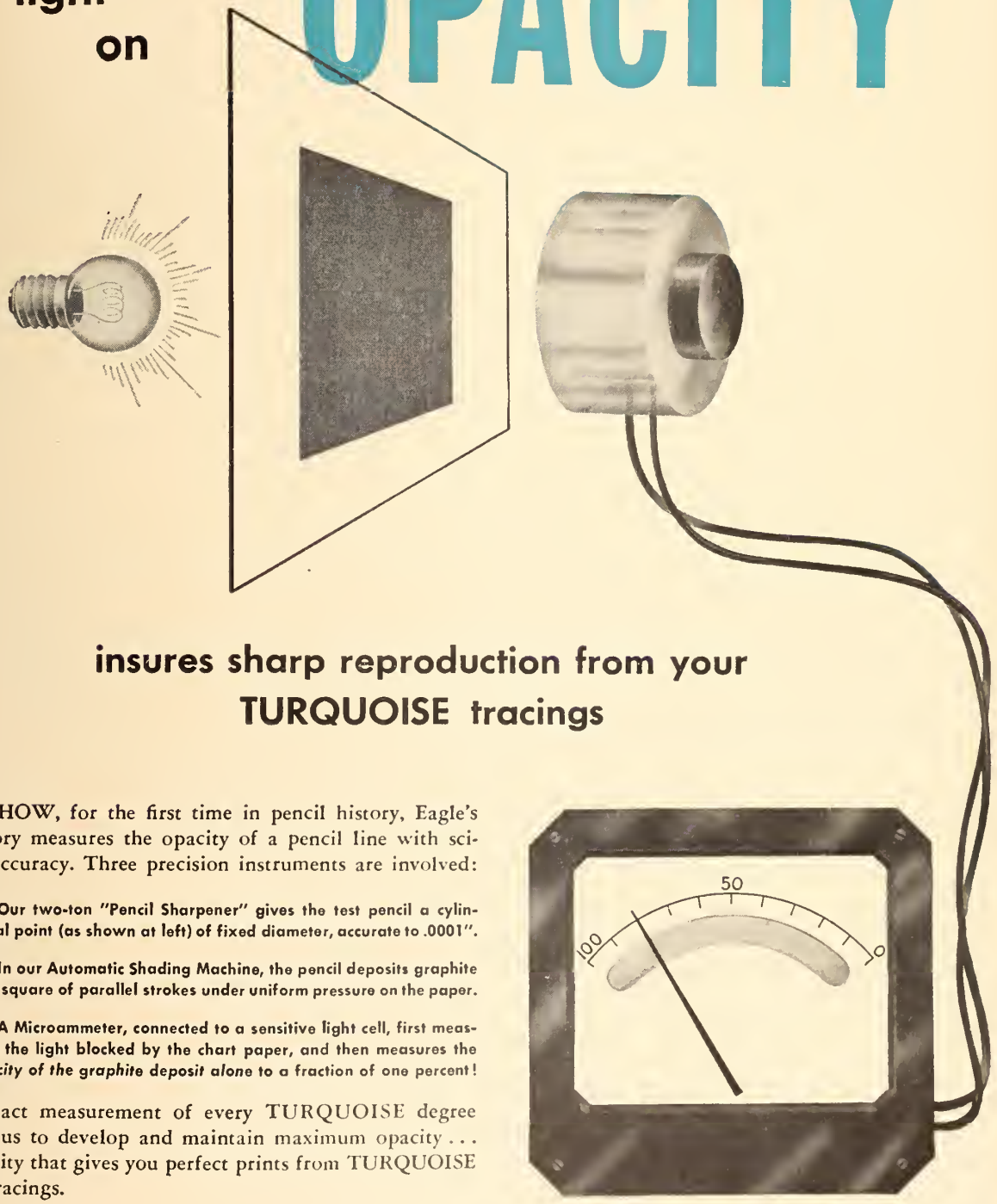
T. J. Boyle, M.E.I.C., of the Canadian Pacific Railway has been appointed special engineer to deal with engineering matters arising out of the construction of the St. Lawrence Seaway ship canal affecting the Canadian Pacific Railway.

Mr. Boyle was born in Crystal Springs, Sask., and after attending high school at Kinistino, graduated from the University of Saskatchewan with a civil engineering degree in 1937. Upon graduation he stayed on at the University for the next two years as an instructor in engineering, after which he was employed for a number of years in survey design and construction in Saskatchewan, Alberta and Ontario.

He joined the Canadian Pacific Railway in 1946 as an assistant engineer in the office of the chief engineer in Montreal.

Garth Griffiths, M.E.I.C., has been named to the newly created post of assistant to the general manager and chief engineer of the B.C. Power Commission in Victoria. He previously occupied the position of distribution superintendent.

A new light on OPACITY



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An electrical engineering graduate of the University of British Columbia, class of 1941, Mr. Griffiths joined the Commission in 1946 after wartime army service. Before attending university he taught school in British Columbia for six years.

He has held the position of power district supervisor, assistant to interior region superintendent, coastal region superintendent, deputy chief engineer and distribution superintendent.

Mr. Griffiths is a member of the Association of Professional Engineers of British Columbia.

A. F. Brooks, M.E.I.C., who is research engineer with the Consolidated Mining and Smelting Company of Canada Ltd., Trail, B.C., has been elected chairman of the Kootenay Branch of the Engineering Institute.

Mr. Brooks, who was born in London, England, graduated from McGill University in 1950 with a degree in chemical engineering, after having served with the R.C.A.F. from 1939 to 1945, attaining the rank of Flight Lieutenant. While in the air force he was engaged in Technical Armament work, including liaison with British government departments.

While at university he spent his summers with Canadian Industries Limited at Shawinigan Falls, Que., and with Shawinigan Chemicals Limited. The summer prior to his graduation he joined the Consolidated Mining and Smelting Company of Canada Ltd., and after his graduation he returned to the company as engineer-in-training. In 1951 he became research engineer in smoke and fuel control development for the company, a position which he still holds.

A. F. Brooks, M.E.I.C.

Charles W. Williams, M.E.I.C., has been appointed division engineer of the Laurentide division of Consolidated Paper Corporation, succeeding **Viggo Jepsen,** M.E.I.C.

Mr. Williams, who was previously assistant superintendent of the pulp department, attended Shawinigan Falls High School. From 1942 until 1946 he was a member of the Canadian Armed Forces, and in 1949 graduated in mechanical engineering from McGill University. He joined Consolidated Paper Corporation upon graduation.

He is a member of the Corporation of Professional Engineers of Quebec. Mr. Williams is also a member of the executive of the St. Maurice Valley Branch of the Institute.

Viggo Jepsen, M.E.I.C., of Consolidated Paper Corporation has been promoted from division engineer to assistant to the chief engineer, **E. T. Buchanan,** M.E.I.C.

Mr. Jepsen was born in Denmark where he obtained his degree in civil engineering in 1927. The following year he came to Canada and joined Shawinigan Engineering Company on the development of the Upper St. Maurice River.

From 1932 he was employed by various firms in Montreal until September, 1936, when he joined Consolidated Paper Corporation at Grand'Mere, first as engineer in the woodlands division and then as chief draughtsman of the Laurentide division. In 1945 he was appointed division engineer, the position he held until his recent appointment.

Mr. Jepsen is a member of the Corporation of Professional Engineers of Quebec, for which he was regional representative in 1947-49, and of the Technical Section of the Canadian Pulp and Paper Association. He served as secretary-treasurer of the St. Maurice Valley Branch of the Engineering Institute in 1939-40, a branch chairman in 1942-43 and as councillor in 1947-48.

J. M. Jopp, M.E.I.C., has been appointed as director of engineering of Columbia Cellulose Company Limited in Vancouver.

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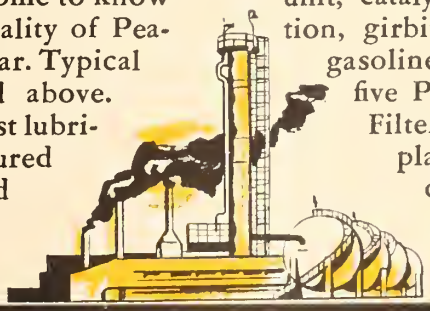

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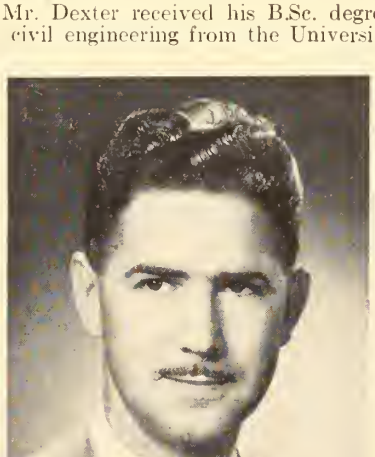
Mr. Jopp graduated in electrical engineering in 1925 from the University of Wisconsin, and joined the Manitoba Paper Company, a subsidiary of Abitibi Pulp and Paper Company, as engineer on the construction of a newsprint mill at Pine Falls, Man.

In 1945 he joined the Brown Company at La Tuque, Que., as design engineer, and three years later was appointed chief engineer. In May, 1953, he was promoted to assistant to the president-engineering, for Brown Company and Brown Corporation.

With the sale of the Brown Corporation, he was transferred to the Berlin operations in New Hampshire, where he was engaged in modernization, rehabilitation and expansion plans of the company's Berlin properties.

W. A. Dexter, M.E.I.C., has been transferred by Haddin, Davis and Brown from Edmonton, Alta., to Winnipeg where he is serving as office manager. Prior to joining the company Mr. Dexter was provincial sanitary engineer for Alberta.

Mr. Dexter received his B.Sc. degree in civil engineering from the University



W. A. Dexter, M.E.I.C.

of Alberta in 1950, and his M.Sc. degreee in sanitary engineering from the University of Toronto in 1951.

W. A. Ker, M.E.I.C., district engineer at Kelowna, B.C., for the Water Rights Branch of the B.C. Department of Lands and Forests, has been elected chairman of the Central British Columbia Branch of the Engineering Institute.

Born in Vancouver, Mr. Ker received his secondary education in that city. He attended the University of British Columbia from 1935 to 1939. Then he joined Northern Construction Co. and the following year became an inspector at Boeing Aircraft of Canada, where he remained until 1943. Returning to the University of British Columbia, he graduated in 1945 with a B.A.Sc. degree.

Upon graduation he again joined Northern Construction Co. as assistant engineer. In 1946 he was appointed assistant hydraulic engineer with the Water Rights Branch of the B.C. Department of Lands and Forests at Victoria, transferring the following year to Kelowna as assistant district engineer. He attained his present position of district engineer in 1951.

Mr. Ker joined the Institute in 1944 as a Student, transferring to Junior in 1946 and to Member in 1950.

L. S. McGregor, M.E.I.C., has been named general superintendent of M.P. & C. Equipment for the central region of Canadian National Railways in Toronto. Previously he was superintendent, M.P. & C. Equipment, northern Ontario district.

Mr. McGregor, a graduate in mechanical engineering of McGill University, has been associated with C.N.R. since 1926. During the war he served with the R.C.E.M.E., attaining the rank of lieutenant-colonel.

A. N. Campbell, M.E.I.C., has been transferred by Dupont Company of Canada, Ltd. from Brockville, Ont., to Montreal as construction supervisor in the engineering department.

Mr. Campbell, who has been associated with C.I.L. since 1953, is a graduate of the University of Toronto in mechanical engineering.

F. W. Bradshaw, M.E.I.C., has been appointed acting manager of manufacturing, Consolidated Paper Corporation Ltd., Grand'Mere, Que. Mr. Bradshaw has been with the company since 1934 when he was development engineer in the research and technical department at Three Rivers, Que. In 1937 he was named assistant to the chief engineer and was transferred to Grand'Mere. He became assistant chief engineer in 1941, chief engineer in 1943 and prior to his present appointment, was acting division manager in 1953 of the Laurentide division.

Born in England, Mr. Bradshaw is a graduate of Wellington College, class of 1918, and an honours graduate in chemical engineering from McGill University in 1925. He has also been associated with Price Brothers at Kenogami, Riverbend and Quebec, and with Carlton Mills Ltd., G. D. Peters & Company and with Beardmore Leathers Limited.

He is a past-chairman of the St. Maurice Valley Branch of the Institute and a past councillor, having joined the Institute in 1920 as a Student, transferring to Junior in 1925, to Associate Member in 1929, to Member in 1940.

J. C. D. Taylor, M.E.I.C., has joined the firm of Haddin, Davis & Brown Limited, consulting engineers, and will be specializing in engineering design with headquarters in Winnipeg.

Mr. Taylor graduated in civil engineering from Temple University, Philadelphia, in 1912. After a year with the Canadian National Railways, he was engaged as engineer on construction of the Winnipeg aqueduct. In 1920 he joined the Manitoba Drainage Commission and the following year he was appointed municipal engineer for West Kildonan, Man.

From 1924 to 1930 Mr. Taylor served as superintendent with Canadian Engineering and Construction Company, Ltd. From 1935 until the outbreak of World War II he worked on the design of the Winnipeg Sewage Treatment Plant. During the war he was command engineer, No. 2 Air Command, R.C.A.F., on the design of water supplies and sewage disposal systems. In 1945 Mr. Taylor was appointed hydraulic engineer of the City of Winnipeg and was engaged on the design of sewage treatment plant extension, storm sewers, water distribution, and pumping stations, a position which he has held until his present connection with Haddin, Davis and Brown Limited.

Correction

Group Captain C. V. Trites, R.C.A.F., M.E.I.C., on page 154 of the February 1955 *Journal* was mentioned in error as having been transferred recently to Montreal. Instead, he is now chief of construction division of headquarters, Allied Air Forces, Central Europe, Fontainebleau, France, where he is serving on a three-year tour of duty. The R.C.A.F. detachment at the Fontainebleau headquarters is part of the Canadian contribution to the NATO forces.

Group Captain Trites took the place of **Group Captain E. C. Luke,** M.E.I.C., who is now assistant general secretary at the Engineering Institute headquarters in Montreal.

G. A. Havers, M.E.I.C., has been appointed district engineer for the Department of Public Works in New Westminster, B.C. Prior to his new appointment Mr. Havers was with the engineering section of the B.C. Forest Service in Victoria.

Mr. Havers, who is a civil engineering graduate from the University of Saskatchewan, class of 1950, has also been resident engineer with the Saskatchewan Department of Highways in Regina.

R. J. Trinder, Jr.E.I.C., supervisor of the quality control unit of Ford Motor Company of Canada Ltd. in Windsor, Ont., has been elected chairman of the Border Cities Branch of the Engineering Institute.

R. J. Trinder, Jr.E.I.C.

Mr. Trinder was born in Windsor and was educated at the Kennedy Collegiate there. He entered the University of Toronto in 1946, graduating with a B.A.Sc. degree in mechanical engineering in 1950.

A. B. Sanderson, M.E.I.C., formerly bridge engineer with the British Columbia Department of Public Works, has opened his own consulting offices in Victoria.

Mr. Sanderson will continue to superintend construction of the Aggassiz-Rosedale Bridge which he designed while he was in the government service. He has been connected with the design and construction of some 160 bridges to date, and will continue to specialize in that field in private practice.

Mr. Sanderson graduated in civil engineering from the University of British

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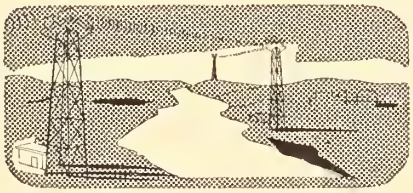
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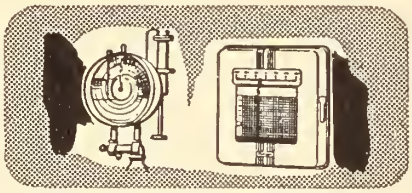
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Columbia in 1933. Prior to World War II in which he served with the Canadian Navy, he was works engineer with Canadian Industries Limited at James Island.

Since 1945 he has been with the Department of Public Works as bridge engineer.

R. W. Fugler, M.E.I.C., plant engineer of Dominion Tar and Chemical Company Ltd. at Beauharnois, Que., has been transferred to Toronto as works manager of the company plant there.

Mr. Fugler, a 1941 graduate of the University of Toronto in chemical engineering, has previously been associated with Canadian Resins and Chemicals at Shawinigan Falls, Que.

E. A. Olafson, M.E.I.C., has returned to Vauxhall, Alta., after one year's leave of absence from P.F.R.A. as irrigation and drainage engineer with the Food and Agricultural Association in Pakistan.

Mr. Olafson received his B.Eng. degree in agriculture from the University of Saskatchewan in 1942, and his B.Sc. and M.Sc. degrees in civil engineering from Utah State University in 1947 and 1948, respectively.

D. P. Lambert, M.E.I.C., has been transferred by Canadian Copco Limited from Montreal to Vancouver as general sales manager of the West division. Mr. Lambert was sales manager of the Eastern divsion previous to his present appointment.

Mr. Lambert graduated from Queen's University in 1941 with a B.Sc. degree in mining engineering.

A. T. Girard, M.E.I.C., has been named to the position of manager of the Carthage Machine Company, Carthage, N.Y. Previously Mr. Girard was assistant manager of the company.

A graduate in mechanical engineering from University of Toronto, class of 1943, Mr. Girard was formerly employed by the Brown Corporation in La Tuque, Que., following service during the war with R.C.E.M.E. Canadian Workshop.

J. N. Siddall, M.E.I.C., formerly associated with Cockshutt Farm Machinery Limited in Brantford, Ont., is now employed as mechanical engineer with the National Steel Car Corporation in Hamilton, Ont.

A 1944 graduate of the University of Saskatchewan in mechanical engineering, Mr. Siddall undertook his post-graduate work at the Massachusetts Institute of Technology.

Professor G. A. Wallace, M.E.I.C., professor of electrical engineering at McGill University has been named Macdonald professor of electrical engineering, a chair endowed in his lifetime by Sir William Macdonald.

Appointment to the endowed chair does not change Professor Wallace's duties. It is accorded as a distinction by the university.

R. W. Sterns, M.E.I.C., has retired from Abitibi Power and Paper Company Limited of Toronto. He was associated with the company since 1946 when he joined the firm as a development engineer.

Prior to this he was plant engineer with the Ste. Anne Paper Company at Beaupré, Que. Mr. Sterns graduated in 1912 from McGill University with a B.Sc. degree.

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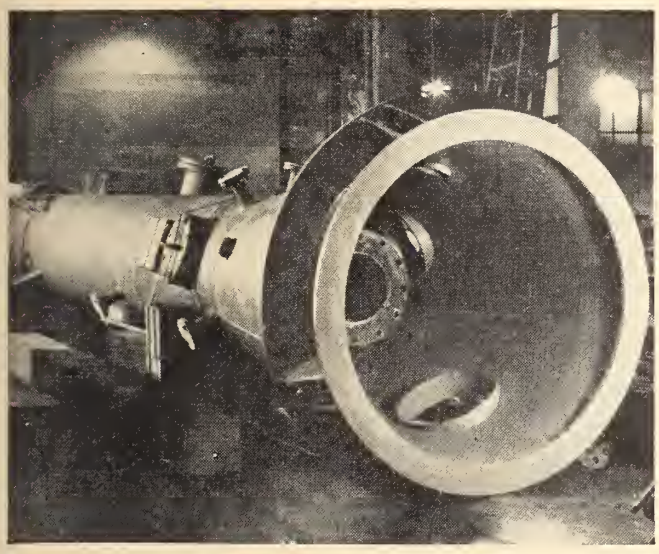

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GP-PA-3-54

Brigadier H. L. Meuser, M.E.I.C., Canadian assistant military attaché in Washington, D.C., has been appointed Commander of the Northwest Highway System in Whitehorse, Yukon Territory.

A civil engineering graduate of Queen's University, class of 1935, Brigadier Meuser was located in Halifax prior to his appointment to Washington.

Arthur Donaldson, M.E.I.C., has been transferred from Montreal to the headquarters of the Henry J. Kaiser Company, Ltd., in Oakland, Cal., as civil engineer in the estimating department.

A graduate civil engineer of the University of Alberta, class of 1922, Mr. Donaldson has been associated with the company since 1953 when he joined as chief engineer for the Montreal office.

H. M. Anderson, M.E.I.C., has been appointed assistant office engineer with Defence Construction (1951) Limited on the Gagetown Project.

Mr. Anderson, a 1950 graduate of Nova Scotia Technical College in civil engineering, was previously employed as engineer, grade 2, on the staff of the Department of Public Works, Halifax.

David Hunter, M.E.I.C., is now district engineer with the Canadian Westinghouse Company Ltd., in Toronto. Mr. Hunter, who has been with the company since 1948 was previously district sales engineer in Winnipeg. He also has been district sales manager in Fort William, Ont., and branch manager in Winnipeg for the company.

Col. D. A. G. Waldock, M.E.I.C., has been appointed director of armament development at Army Headquarters in Ottawa. He was previously deputy chief superintendent, Canadian Armament Research and Development Establishment at Valcartier, Que.

Col. Waldock is a 1936 graduate in electrical engineering from London University.

Haig Fleming, M.E.I.C., has been appointed to the position of construction engineer with the Saskatchewan Department of Highways and Transportation. Mr. Fleming joined the Department of Highways in 1952 as resident engineer.

He is a graduate in civil engineering from the University of Saskatchewan, class of 1949.

N. Malloch, M.E.I.C., is now office engineer on the Bersimis Project—Lac Cassé Development of the Quebec Hydro-Electric Commission. Previously, Mr. Malloch has been associated with the Hydro-Electric Power Commission of Ontario at Arnprior.

Mr. Malloch received his B.Sc. degree in civil engineering from Queen's University in 1912.

K. A. Skjaevestad, M.E.I.C., is now on the staff of Racey MacCallum & Associates Ltd. in Montreal, having been previously associated with the J. P. Porter Company Ltd., Montreal.

Mr. Skjaevestad received his civil engineering degree in 1943 from Trondheim University.

R. L. Payne, M.E.I.C., formerly associated with the Canadian Fishing Company Ltd., in Vancouver, has joined J. H. Todd & Sons Limited in Vancouver.

Mr. Payne graduated from McGill University in 1946 with a degree in mechanical engineering.

J. Raleigh, M.E.I.C., is on the staff of the Mines Branch of the Department of Mines and Natural Resources in Winnipeg. Previous to his new appointment he was petroleum engineer with Imperial Oil Limited at Smiley, Sask.

He is a graduate from the University of Manitoba, class of 1952, in civil engineering.

Roger C. Hughes, M.E.I.C., is now associated with the Powell River Company Ltd. in Powell River, B.C. He was previously with the Aluminum Company of Canada.

Mr. Hughes graduated from University of British Columbia in 1947 with a degree in chemical engineering.

C. N. Kirby, M.E.I.C., formerly design engineer with Pennock Engineering Company, Ottawa, has joined the staff of J. L. Richards and Associates, consulting engineers in Ottawa.

Mr. Kirby graduated in civil engineering from Queen's University in 1951.

G. H. Lowry, M.E.I.C., is now associated with the Algom Uranium Mines Limited as a construction engineer. Prior to this appointment he has been associated

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with the Ontario Department of Highways as division engineer.

Mr. Lowry joined the Institute as an Associate Member in 1919, transferring to Member in 1940.

R. Mangiarotty, M.E.I.C., who was formerly with the C. D. Howe Company in Montreal is now associated with Canadair Limited also in Montreal. Mr. Mangiarotty is a graduate mechanical engineer.

Paul Tourigny, M.E.I.C., has opened a consulting engineer's office in Montreal.

A 1946 civil engineering graduate of Ecole Polytechnique, Mr. Tourigny was previously associated with Foundation Company of Canada Limited, Dufresne Engineering Co. Ltd. and for the last four years, with the firm of Surveyer Nenniger and Chênevert.

He served as councillor for the Junior Section of the Montreal Branch Executive of the Engineering Institute during the 1948-49 term.

J. L. Greer, Jr.E.I.C., who was previously with the Foundation Company of Canada Ltd. at Chalk River, Ont., is now connected with W. L. Wardrop & Associates in Winnipeg, Man.

Mr. Greer graduated from the University of Saskatchewan, class of 1948, as a mechanical engineer.

W. A. Burgess, Jr.E.I.C., is now maintenance superintendent with Canadian Industrial Minerals Ltd., in Walton, N.S.

Mr. Burgess is a 1948 mechanical engineering graduate of Nova Scotia Technical College.

J. P. Henderson, Jr.E.I.C., has joined the Newfoundland Light and Power Company Ltd. at St. John's.

Prior to his new position Mr. Henderson, who is a 1948 graduate of Nova Scotia Technical College in electrical engineering, was employed by the Montreal Engineering Company Ltd. in Montreal.

H. K. Larsen, Jr.E.I.C., has been transferred from Ottawa to the far north by Foundation Company to act as a site engineer on the D.E.W. line project.

Mr. Larsen has previously been connected with E. G. M. Cape and Company both in Cornwall and in Moncton. In Cornwall he was assistant superintendent on the contract for the extension to the Courtaulds Rayon Mills and the building of a new plant for T.C.F. Canada Limited. When in Moncton Mr. Larsen was construction engineer on the extension to the Dominion Government Building. Prior to joining E. G. M. Cape and Company he was employed by T. Pringle and Son, working in both Montreal and Three Rivers. He was also with the Fluor Corporation of Los Angeles and with the Dominion Bridge Company, Ltd., Montreal.

He is a civil engineering graduate from the University of New Brunswick, class of 1949.

E. W. Groves, Jr.E.I.C., is now with the Department of National Defence — Naval Headquarters, as specifications engineer in power equipment. Prior to his new position, Mr. Groves was with the Quebec North Shore and Labrador Railway at Seven Islands, Que.

Mr. Groves is an electrical engineering graduate from the University of Manitoba, class of 1949.

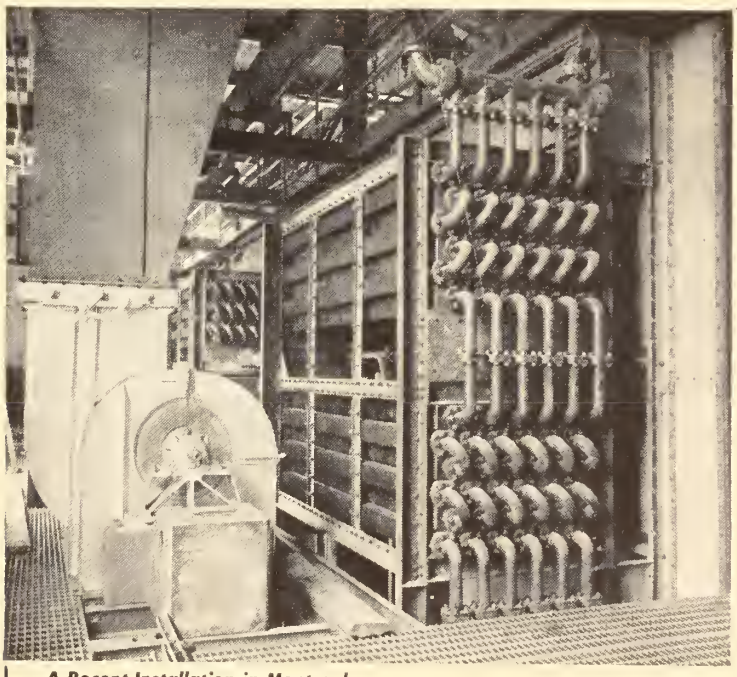
A. R. D. Robertson, Jr.E.I.C., is now employed as a project engineer with the British Columbia Forest Service, Project 4479. Project 4479 is the construction of a 22-mile forest development road in the Prince George district of British Columbia.

Mr. Robertson joined the Forest Service in June 1954 as operations engineer, after serving as design engineer with B.C. International Engineering Co. Ltd. in Vancouver.

He is a 1949 graduate in civil engineering from the University of British Columbia.

G. F. Bishop, Jr.E.I.C., has opened a new firm in Edmonton together with R. J. Hilliker. The new company will be known as Hilliker and Bishop Ltd., and will act as consulting mechanical engineers, and will be associated with Allsopp & Simpson Ltd., consulting electrical engineers in Edmonton.

Mr. Bishop, a graduate of Nova Scotia Technical College, class of 1949, in mechanical engineering, was previously



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with Angus Butler & Associates Ltd. Following his graduation from University he was assistant plant superintendent at Acadia University.

Bernard L. Theriault, JR.E.I.C., is now employed by the Anglo-Canadian Pulp and Paper Mills Company, Ltd., in their general engineering office as a mechanical engineer. Prior to his new position he was with Canadian International Paper Company at Hawkesbury, Ont.

He is a graduate in mechanical engineering from the University of Maine in 1949.

Scott J. Babin, JR.E.I.C., is now employed by the St. Paul Construction Company of Boston, Mass., as a construction engineer.

Before locating in the United States Mr. Babin was with Community Enterprises, Saint John, N.B., Defence Construction Limited, Ottawa and with Central Mortgage and Housing Corporation, Montreal.

He is a 1949 graduate in civil engineering from the University of New Brunswick.

William P. O'Malley, JR.E.I.C., has been appointed head brewer of Carling's Red Cap Brewery Ltd., Montreal. Mr. O'Malley was formerly senior assistant head brewer in Carling's Montreal plant.

Mr. O'Malley is a graduate in chemical engineering of Laval University in 1949. He is a member of the British Institute of Brewing and the Corporation of Professional Engineers of the Province of Quebec.

John W. Clarke, JR.E.I.C., has been appointed division engineer for Canadian National Railways Laurentian division in Quebec City. Previous to this appointment he was assistant division engineer in Montreal.

Mr. Clarke is a 1949 civil engineering graduate of McGill University.

D. B. Dutton, JR.E.I.C., has been appointed assistant city engineer for the City of Waterloo, Ont. He was formerly assistant engineer for the Township of Etobicoke and in the city engineer's office in Port Arthur, Ont.

Mr. Dutton graduated in civil engineering from the University of Manitoba in 1949.

J. A. Morton, JR.E.I.C., has been transferred by Canadian Industries Limited from Maitland, Ont. to Beloeil, Que. He joined the company in 1952 as inspection engineer for the Montreal area.

Mr. Morton graduated in mechanical engineering from McGill University in 1949.

W. F. Light, JR.E.I.C., has been transferred by the Bell Telephone Company of Canada from Montreal to Toronto as local equipment engineer for the Toronto area. Previous to this transfer Mr. Light was supervising engineer in Montreal.

Mr. Light graduated in electrical engineering from Queen's University in 1949 and joined the company in 1950.

Archie B. Platt, JR.E.I.C., is now associated as industrial sales representative in the Toronto district of Imperial Oil Limited.

Previous to joining the company he was employed by Algoma Steel Corporation in Sault Ste. Marie.

A mechanical engineering graduate of the University of Saskatchewan, class of 1949, Mr. Platt served as secretary-treasurer of the Sault Ste. Marie Branch from December, 1952 until September, 1954.

James C. Akerley, JR.E.I.C., has been transferred by Chas. T. Main, Inc. of Boston, Mass., to Detroit as construction co-ordinator in the installation of a new paper machine at the Scott Paper plant, formerly Detroit Sulphite.

Mr. Akerley is a 1950 graduate in civil engineering of the University of New Brunswick.

Mervyn G. Brown, JR.E.I.C., formerly associated with the International Nickel Co. in Copper Cliff, Ont., and Mathews Conveyor Co. Ltd. in Port Hope, Ont., is now design engineer in the commercial products division of Atomic Energy of Canada in Ottawa.

Mr. Brown is a 1950 mechanical engineering graduate of the University of British Columbia.

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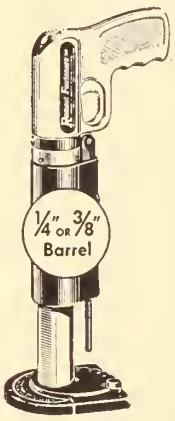

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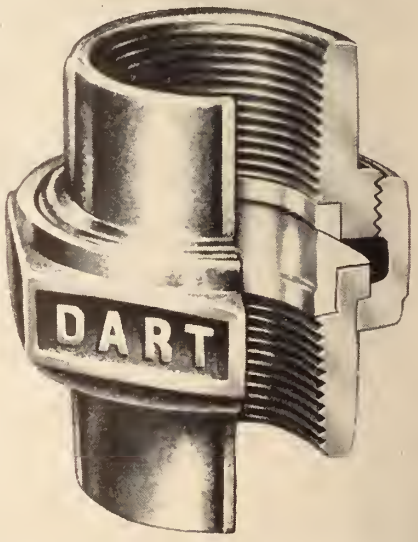

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GOODYEAR

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V. C. Dohaney, JR.E.I.C., is senior engineer for district No. 2 of the Department of National Health and Welfare, in Moncton, N.B. He has recently been promoted from the position of assistant sanitary engineer.

Mr. Dohaney is a University of New Brunswick civil engineering graduate of 1950.

R. W. Lockie, JR.E.I.C., has joined the staff of the hydraulic department of John Inglis Company Ltd., in Toronto. He was formerly associated with the English Electric Company, steam turbine office, in St. Catharines, Ont.

Mr. Lockie is a 1950 mechanical engineering graduate of the University of British Columbia.

R. W. Lockie, Jr.E.I.C.

A. F. Dudek, JR.E.I.C., has been appointed structural engineer with Letendre, Monti & Associates, consulting engineers, in Montreal. He was previously in the employ of the Aluminum Company of Canada Limited as design draughtsman in Montreal.

Mr. Dudek attended University in Poland, and received his civil engineering degree in 1950.

D. G. Manzer, JR.E.I.C., a 1950 electrical engineering graduate of the University of British Columbia, has joined the electrical department of the Quebec North Shore Paper Mill in Baie Comeau, Que.

He was previously with Canadian General Electric Company in Peterborough.

W. J. McNicol, JR.E.I.C., former manager of sales for the Canadian Westinghouse Company's turbine division, has been named manager of the sales department in the company's power products division.

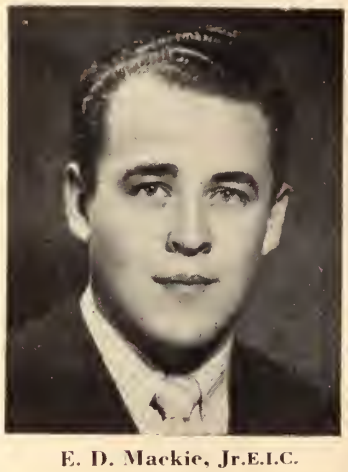
A 1950 mechanical engineering graduate of the University of British Columbia, Mr. McNicol joined Westinghouse in 1950 and later studied gas and steam turbine design, engineering and applications at Metropolitan-Vickers in England.

Prior to his October, 1953 appointment as manager of turbine sales, Mr. McNicol acted as a specialist on gas and steam generating apparatus and concluded numerous significant negotiations with utilities across Canada.

W. J. McNicol, Jr.E.I.C.

Mr. McNicol is a member of the Metropolitan-Vickers Overseas Association. During the past war he served with the RCAF bomber command and was awarded the DFC. He retired from the service with the rank of Squadron Leader.

E. D. Mackie, JR.E.I.C., has joined the sales division of Electrical Contracting & Machinery Company Ltd., in Calgary. He was previously associated with Canadian Westinghouse Company Ltd., in Hamilton.



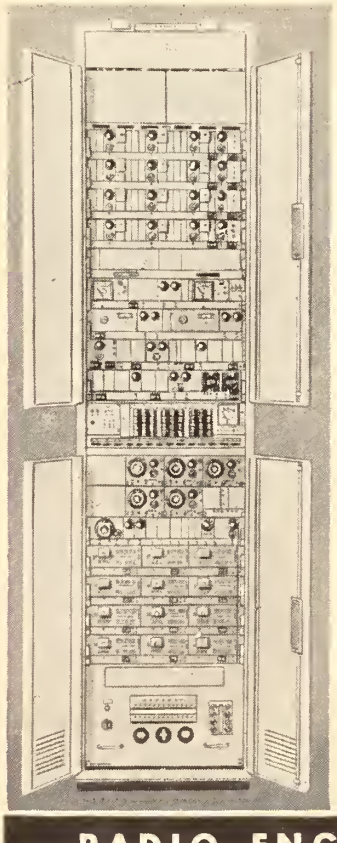
E. D. Mackie, Jr.E.I.C.

Mr. Mackie graduated in electrical engineering from the University of Saskatchewan in 1950, and joined Ferranti Electric Limited, serving in the Ontario district sales division in both the meter and transformer divisions.

K. A. Mellish, JR.E.I.C., has recently been promoted to the position of senior engineer for district No. 1, Atlantic region, Department of National Health and Welfare, in Truro, N.S. He joined the Department in 1952 as sanitary engineer in Moncton, and was made assistant engineer for the Nova Scotia, Prince Edward Island district, in 1953.

Mr. Mellish is a civil engineering graduate of the University of New Brunswick, class of 1950.

Samuel Shapiro, JR.E.I.C., is employed as design engineer with Canadair Lim-



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ited in Montreal. He was previously quality control technician with Trans-Canada Air Lines in the Pratt and Whitney overhaul base in Winnipeg, and tool inspector with A. V. Roe (Canada) Limited in Malton, Ont.

Mr. Shapiro graduated in mechanical engineering from the University of Manitoba in 1950.

John K. Cavers, JR.E.I.C., sales engineer with F. D. Bolton Limited in Vancouver, has joined Douglas Power

John K. Cavers, JR.E.I.C.

Equipment Limited in Vancouver.

Mr. Cavers, a 1951 mechanical engineering graduate of the University of British Columbia, had previously been associated with Canadian General Electric Company Ltd., and with Bepco Canada Ltd.

S. J. Einarson, JR.E.I.C., recently joined the staff of the Maitland Works of DuPont Company of Canada. He was formerly associated with Dominion Alkali and Chemical Company Ltd., of Beauharnois and later with Dominion Tar and Chemical Company Ltd. in Montreal.

Mr. Einarson is a 1951 electrical engineering graduate of the University of Manitoba.

George W. Piper, JR.E.I.C., is now shift foreman on the staff of Minnesota Mining and Manufacturing of Canada Ltd, in London, Ont.

He previously served with the Royal Canadian Engineers, Canadian works section, as a lieutenant.

Mr. Piper is a 1951 civil engineering graduate of McGill University.

F/O J. C. Richard, R.C.A.F., JR.E.I.C., has been posted to the RCAF Station, Sydney, N.S., as construction engineering officer. Previous to this appointment he was stationed in Senneterre, Que.

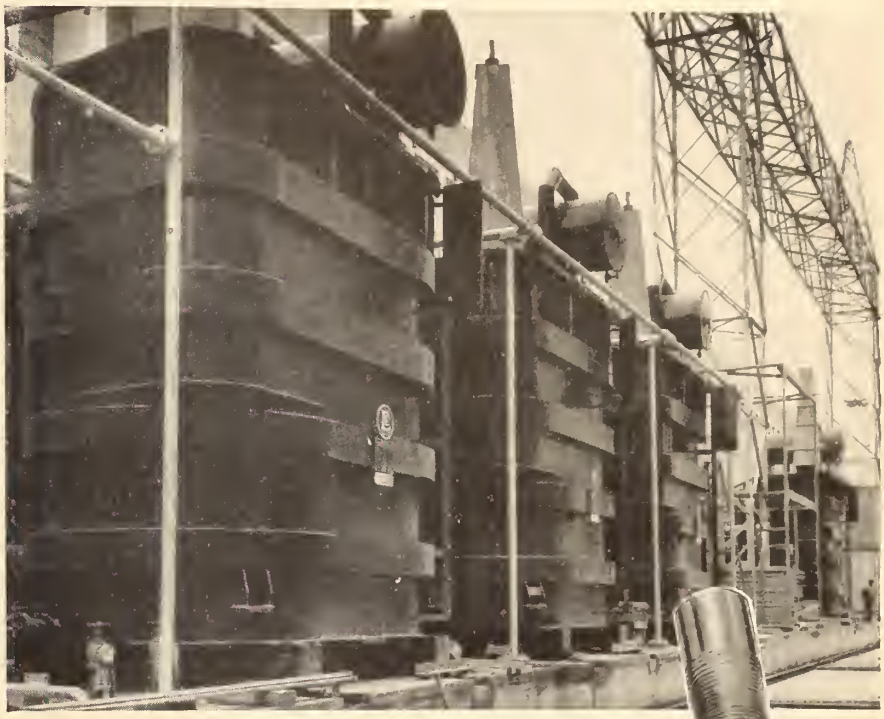
F/O Richard is a 1951 civil engineering graduate of L'Ecole Polytechnique.

D. H. Franklin, JR.E.I.C., who has recently completed a two-year period in the United Kingdom as an Athlone Fellow, has returned to Canada and is now on the staff of K. E. Whitman. Construction engineers in Halifax.

Mr. Franklin graduated in 1952 from the Nova Scotia Technical College with his B.Eng. degree.

Lt. (L) C. G. L. Joudrey, R.C.N., JR.E.I.C., has been transferred from the

9 out of 19 Transformers and all 12 Generators are cooled by "UNIFIN"...*



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Shell and tube heat exchangers, employing Unifin Type S/T (Lo-Fin) Tubing, are installed on 9 of the 19 transformers at this station. More compact, more efficient, less costly cooling equipment is the result. A Design Manual demonstrating the superior efficiency and economy of Unifin Type S/T Tubing is available on request.

Cooling equipment for all 12 of the hydro-electric generators is also supplied by Unifin . . . partly in the form of complete heavy duty cooling coils, and partly in the form of finned tubing for fabrication into coolers. Unifin all-copper Hi-Fin coils are also used in the oil-bath cooling of bearings.

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staff of manager electrical engineering, H.M.C. Dockyard, Halifax, to that of electrical overseer (power) of the resident naval overseer, Canadian Westinghouse Company Ltd. in Hamilton.

Lt. Joudrey, a 1952 electrical engineering graduate of the University of New Brunswick, was in 1953 a sub-lieutenant attending H.M.C. Electrical School in Halifax, and in 1954 was promoted to the rank of lieutenant.

He served at the R.C.N. Beaverbank station, Halifax County, prior to his present appointment.

J. G. Aldrich, Jr.E.I.C., is on the staff of The Foundation Company of Canada Ltd., in Calgary. Previously, he was resident engineer with Main, Rensaa and Minsos of Edmonton.

Mr. Aldrich graduated in civil engineering from the University of Alberta in 1952.

D. R. G. Cameron, Jr.E.I.C., is electrical engineer with the Department of Transport (Air) in Moncton, N.B. He was formerly associated with the Trenton Steel Works, N.S., and Canadair Limited in Montreal.

Mr. Cameron graduated in electrical engineering from Nova Scotia Technical College in 1952.

B. P. Cirka, Jr.E.I.C., has joined C. B. Taylor and Associates in Toronto as technical director.

He is a 1952 mechanical engineering graduate of the University of Manitoba.

J. C. Weseh, Jr.E.I.C., has been transferred by Aluminum Company of Canada Ltd. from Arvida to Kitimat, B.C.

A 1952 chemical engineering graduate of the University of British Columbia, Mr. Wesch joined the Aluminum Company in 1954.

Kenneth G. Clarke, Jr.E.I.C., is on the staff of the Hydro Electric Power Commission of Ontario in Toronto. Previous to joining the Commission, he was laboratory instructor in electrical engineering at Queen's University, of which he is a 1953 electrical engineering graduate, and has also been associated with the Shell Oil Company in Calgary.

W. R. Hammond, Jr.E.I.C., is associated with Martlin and Lawrie Limited in Hamilton.

A 1953 graduate in mechanical engineering of the University of Toronto, Mr. Hammond was previously on the staff of Canadair Limited in Montreal.

John E. Houghton, Jr.E.I.C., is on the staff of the engineering department of the Belgo division of Consolidated Paper Corporation Ltd. in Shawinigan Falls, Que. He was formerly with Canadian General Electric Company Ltd. in Peterborough.

Mr. Houghton graduated in mechanical engineering from the Nova Scotia Technical College in 1953.

E. H. McIntyre, Jr.E.I.C., who is still in England on an Athlone Fellowship, is now working as a member of the metallurgical staff of Steel, Peech and Tozer, a branch of the United Steel Companies combine.

Mr. McIntyre graduated in metallurgical engineering from McGill University in 1953.

Keith R. Park, Jr.E.I.C., is now on the staff of Defence Research Board, C.A.R.D.E., at Valcartier, Que.

He graduated in electrical engineering from the University of British Columbia in 1953.

John Gordon Ripley, Jr.E.I.C., is associated as construction engineer with McColl-Frontenac Oil Company Ltd. in Montreal.

A 1953 graduate in civil engineering of McGill University, Mr. Ripley was formerly on the staff of Defence Construction (1951) Ltd. Gagetown Project.

R. Sterling Shephard, Jr.E.I.C., during his second year as an Athlone Fellow, is studying business administration at the London School of Economics.

Mr. Shephard graduated from the University of New Brunswick in 1953 with a B.Sc. degree in civil engineering.

Michel Gauthier, S.E.I.C., a 1954 civil engineering graduate of Laval University, is on the staff of the St. Lawrence Ship Channel of the Department of Transport in Montreal.

J. D. Scott, S.E.I.C., formerly associated with Socony Vacuum Oil Company of Canada in Calgary, has joined Engineering and Construction Services Ltd. in Whitehorse, Yukon Territory.

Mr. Scott is a graduate in civil engineering of Queen's University, class of 1954.

R. Yoneda, S.E.I.C., is at present on the staff of Angus, Butler and Associates Ltd., consulting engineers in Edmonton.

CANADA CREOSOTING COMPANY *FOR THE BEST IN TREATED TIMBER*

Any structure is sound from foundation through superstructure when it's built with Canada Creosoting pressure-treated timbers. Foundation pilings are "economically permanent", will give long, useful service life within the limits of sound economics, resulting from low first cost and low maintenance costs. Canada Creosoting timber is protected against decay, insect attack and in salt water, against marine borer attack.

Canada Creosoting timbers mean extra-long, dependable service.

Canada Creosoting Company's sales force of engineers can help you choose your requirements and supply you quickly with all your treated timber needs.

Track ties • Wood Block Floors • Bridges & Culverts • Wharves Poles & Cross-arms • Roof Planking • Foundation Timbers & Piling • Fence Posts • Guardrails • Mine Timbers (Salt Treated).

SALES OFFICES IN:

TRURO, N.S.
MONTREAL, P.Q.
TORONTO, Ont.
WINNIPEG, Man.
CALGARY, Alta.
NORTH VANCOUVER, B.C.

CANADA CREOSOTING COMPANY LIMITED

G-E ALKANEX Magnet Wire

Cuts 25% to 65% off motor wiring costs on Class B applications . . . increases overload rating on present designs . . .

NEW G-E ALKANEX MAGNET WIRE is insulated with a newly-developed, heat-resisting polyester-film that raises the limiting "hot-spot" temperature for motor operation from 105°C to 150°C. Alkanex costs up to 25% less than Formex single glass and up to 65% less than Deltabeston asbestos magnet wire. The improved physical and thermal characteristics of Alkanex also permits designers to pack 25% more power into a given motor size.

This new improved magnet wire is currently available in round shapes only. Sizes now made are from 13 to 26 B & S inclusive. Square and rectangular shapes and other sizes are presently under development and enquiries will be considered on a special basis.

The superior performance of Alkanex is shown in these
CUT THROUGH TEMPERATURES:
For wire sizes .0159 to .0302 inches — Values above 200°C.
For wire sizes .0320 to .0720 inches — Values above 225°C.

In short this new magnet wire assumes considerable importance for the motor, transformer and electrical equipment industry. Present wire sizes open new fields to designers in these industries. In the near future similar benefits will be extended to manufacturers of fine wire radio coils, relays and similar equipment.

For further information about revolutionary G-E Alkanex Magnet Wire call your nearest C-G-E office or contact: Wire and Cable Department, Canadian General Electric Co. Ltd., 212 King St. West, Toronto.

ALKANEX
Magnet Wire

MECHANICALLY
Mechanically, Alkanex meets the specification requirements set down for Formex. It has successfully withstood all tests applied with automatic winding machines.

FLEXIBILITY
Tests prove Alkanex equal to Formex and superior to silicone film insulations. Alkanex will pass 25% stretch plus winding on a 3X mandrel, conditions which usually crack silicone.

CHEMICAL RESISTANCE
Tests prove Alkanex superior to both Formex and Silicone enamels. It resisted the effects of boiling alcohol - toluol tests and withstood the Zandrol varnish treatment process.

403W-555

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS VACANT

CHEMICAL

CHEMICAL ENGINEER with some production experience required by large modern plant in Montreal for the study and development of production technique associated with new products. Salary to be arranged. File No. 5129-V.

CHEMICAL ENGINEERS, graduates from recognized Canadian universities with 0-5 years experience. Required for process development studies, solution of technical assignments in production units, and on-the-job training in production supervisory capacities. Positions are in petrochemical plant located in Sarnia. Please reply in detail stating experience, education, etc. All replies will be kept in strict confidence. File No. 5137-V.

PETROCHEMICAL, CHEMICAL AND PETROLEUM ENGINEERS and constructors require engineers, designers and draftsmen with experience in the above fields, for their engineering design office in Southern Ontario. Please reply with brief details of experience, academic qualifications and salary. File No. 5140-V.

CHEMIST OR CHEMICAL ENGINEER, for general supervision of staff and operation of chemical plant integrated with Kraft Pulp mill, located in Northwestern Ontario. Must be graduate chemist or chemical engineer and be in excellent physical condition. Salary commensurate with experience and ability. Excellent employee benefits. Apply stating full particulars of experience, education, age, marital status, etc. File No. 5148-V.

CHEMICAL ENGINEERS, young, with a few years practical industrial background in chemical or allied fields together with sales experience, required as technical representatives. World-wide concern offers processes and equipment to a broad industrial market. Salary is open, car provided. Location: Ontario and Quebec. File No. 5156-V.

CHEMICAL ENGINEER with 3 to 5 years experience, preferably in chemical plant process engineering and/or operations, for process engineering work, plant located 25 miles from Montreal. File No. 5161-V.

A CHEMICAL ENGINEER required for development work in latex and solvent adhesives. Experience in this field an asset but not essential. The field is expanding and offers good opportunities. Location Montreal. Replies will be treated in confidence. File No. 5173-V.

A CHEMICAL ENGINEER will be required to assist our sales man. He should preferably have some experience in the latex field. He should have some imaginative ability in order to recognize and be able to apply new uses to our growing list of products, as related to the construction industry. A period of training will be offered to a recent graduate in chemical engineering, or to someone with 2 or 3 years industrial experience. Offices in Montreal. File No. 5173-V.

CHEMICAL SALESMAN for Montreal area to represent an established manufacturer of fine chemicals, offering a wide range of products reinforced by intensive research and development policies. Primary responsibility will be industrial accounts. Preferred qualifications include technical degree, several years experience in field work, ability to plan and execute without close direction, age under thirty-five, own automobile. Liberal employee benefits, salary commensurate with qualifications. Replies will be held in confidence. Please submit full details of training and experience by letter only to File No. 5195-V.

TWO SALES ENGINEERS wanted with plant maintenance experience preferred, but not necessary, to sell corrosion resistant cements, coatings, pipes, tanks etc. We prefer chemical engineers and require one each for Quebec and Ontario. Salary and expenses plus profit sharing. File No. 5199-V.

CIVIL

THE CITY OF PRINCE ALBERT (pop. 19,000) requires an assistant engineer. Must hold an engineering degree, preferably civil, from a recognized university. Position offers varied experience, future security, and an opportunity for advancement. Salary $325 to $375 per month, depending on qualifications. Reply stating age, experience, education and relevent information to File No. 5121-V.

CIVIL ENGINEER, preferably recent graduate, for bridge section of large transportation company with headquarters in Montreal. Duties include design of steel and reinforced concrete structures, preparation of reports and some travelling. File No. 5127-V.

CONSTRUCTION SUPERINTENDENT, excellent opportunity for top flight man with a proven record of successful jobs completed in the chemical or petrochemical field. Ability to organize and administer large projects including cost control, labour relations, stores, field supervision, together with a good technical and practical background. Applicant should have 10 years experience in construction field. Vacancy open with major petrochemical and petroleum engineers and constructors. Please reply with experience and salary expected to File No. 5139-V.

GRADUATE ENGINEERS WITH experience in the design and layout of steam power plants and large industrial steam plants. Piping and equipment layout draughtsmen with experience in steam power plant and refinery work. Structural steel designers and draughtsmen. Draughtsmen with reinforced concrete or general draughting experience. Consulting firm located in Ontario. File No. 5142-V.

CIVIL ENGINEER young Canadian graduate, 2 years maximum for academic design engineering related to steel and concrete support of equipment, pipes, etc. work in Sarnia. File No. 5155-V.

CIVIL ENGINEER Canadian graduate preferably—minimum 3 years recent design experience in R C bridge and highway required. Previous experience in industrial building design considered useful. Work in Windsor, Ontario. File No. 5155-V.

SENIOR PROJECT ENGINEER required by engineering-construction firm specializing in oil refineries and chemical plants. Applicants should have at least ten years experience in the design and installation of process equipment including pressure vessels, piping, pumps and compressors, buildings and structures. Plant operating or maintenance experience desirable. Location will be Montreal office. Please furnish personal data, detailed experience record and references. File No. 5158-V.

TWO GRADUATE CIVIL ENGINEERS for consulting firm engaged in large scale development projects. One to three years experience in design and supervision of roads, sewerage systems, water distribution systems, etc. required. Please reply giving full details of academic training and professional experience, references and salary requirements. File No. 5163-V.

THE PUBLIC UTILITIES COMMISSION of the City of Kingston requires a graduate engineer with water works engineering experience to plan, design and supervise projects in connection with a municipal water works system. Duties would include supervising the installation of new watermains and eventually supervising the operation of a modern filtration plan. Salary commensurate with qualifications. Position offers participation in commissions hospitalization and pension plans. Applicant should submit full details of education, experience, age and references. Replies will be kept confidential. File No. 5154-V.

MANAGER REQUIRED FOR Canadian subsidiary of British organization, manufacturing construction equipment. To take complete charge of the appointment of distributors and demonstrations, to service customers, and conduct the entire business. Preferably civil engineer and/or experience in construction work and particularly in regard to construction equipment and the sale thereof. File No. 5165-V.

CIVIL ENGINEER required by general contractor to administer a group of contracts distant from the firm's head office which is in Quebec. Applicant must have experience in all phases of general contractors' operations and be not less than about 30 years of age. The administrator would be domiciled in Quebec or the Maritime Provinces. Applicants must state salary expected. File No. 5176-V.

CIVIL ENGINEER required by Provincial Government Department with headquarters in Toronto. To assist in the design and construction of small timber and concrete

dams and maintenance and operation of locks and dams, etc., throughout the Province of Ontario. Applicant should have experience in the construction of timber and concrete dams. Salary can be arranged to meet qualifications. Permanent position with illness, vacation and pension privilege if applicant proves satisfactory after a trial period. File No. 5180-V.

ARCHITECTURAL DESIGN, structural engineers and draughtsmen required for long range industrial program in an established consulting office. Must be experienced and capable of checking design drawings. Draftsmen experienced in structural steel detailing. Send complete résumé of experience. Location: Toledo, Ohio. File No. 5181-V.

HYDRAULIC ENGINEERS, salary up to $7,200 per annum, depending upon qualification for St. Lawrence River Joint Board—competition 55-1252. Northern affairs and National Resources, Ottawa, competition 55-1250. Quote competition number. File No. 5182-V.

ESTIMATOR QUANTITY SURVEYOR, required by construction company in Ottawa. State qualifications, age, marital status, experience, salary expected. Replies will be treated confidentially. File No. 5187-V.

APPLICATIONS WILL BE RECEIVED up to Monday, 30th May, 1955, for the position of Assistant City Engineer. Previous employment with a municipality desirable, but not essential. Application forms will be forwarded on request. Complete statement as to experience and qualifications, in detail, must be submitted with the application form. Consideration will be given to sharing expenses of interview and moving expenses of successful applicant. File No. 5191-V.

CIVIL ENGINEER (Junior) required by established public utility supervisory-consulting organization, 2-3 years experience, preferably in field on construction and/or surveying, for work connection design and operation hydro systems also structural, foundations for steam and diesel plants. Location: New York. Some travel field future. Reply stating age, education, experience, personal particulars, minimum salary expected. File No. 5193-V.

ENGINEER WITH SOIL EXPERIENCE and soil mechanics training for interesting position in Montreal. Should be professional engineer or eligible for registration in Quebec. This position has good prospects for an intelligent engineer with initiative who has a reasonable amount of soil training with laboratory and field experience. The position involves some work in other fields where any type of engineering experience will be an asset. Please give details of education and experience and other relevant information to File No. 5194-V.

MUNICIPAL ENGINEER required by Montreal suburb. Graduate engineer with two or more years experience in layout and supervision of watermain and sewage extensions, street and sidewalk construction. Replying stating age, experience, education, salary expected and telephone number to File No. 5203-V.

ENGINEER, ARCHITECT OR ESTIMATOR wanted for young construction company doing sewers, roadwork and building. Apply stating age, experience, references and salary expected. File No. 5205-V.

GRADUATE CIVIL ENGINEER with at least three years experience. Man to be employed on the design, construction and maintenance of reinforced concrete, building structures and building services. He would also have other duties such as the maintenance of roads and lands, occasional instrument surveys and other civil engineering work. Location Province of Quebec with large chemical plant. File No. 5210-V.

GRADUATE ENGINEER with construction experience, bilingual, public speaking ability, and sales promotion experience helpful to represent Western Canadian organization in Province of Quebec. Duties: to provide professional men, contractors and industrial officials with technical information concerning a basic building material. Detailed technical training provided. Salary open. File No. 5211-V.

ELECTRICAL

ELECTRICAL ENGINEER required as junior or assistant distribution engineer. Graduate with at least 3 years field experience operating U.S. or Canadian Public utility. Permanent position with long established consulting organization New York. Some travel Latin America necessary in future. Knowledge of Spanish or Portuguese useful. Salary commensurate with experience. Reply giving age, education, experience and personal particulars. File No. 5042-V.

GRADUATE ELECTRICAL ENGINEERS, one senior—two juniors. Senior at least 10 years experience—junior 3-5 years experience in electrical design, operation and construction of steam, hydro plants and substations. Permanent position with long established consulting organization for public utility operating companies located Latin America. Headquarters New York. Some travel necessary in future. Knowledge of Spanish or Portuguese useful, not essential. Salary commensurate with qualifications. Good opportunity. Reply stating age, education, experience and personal particulars. File No. 5118-V.

A LARGE MANITOBA UTILITY requires a graduate electrical engineer, to fill the position of asst. to the transmission line engineer. Applicant should have at least three years experience in distribution practices, including layout of large distribution areas, estimating of costs of distribution changes and extensions, improvement of voltage conditions and expansion of existing systems, basic economic studies. Ability to write clear and concise reports to supervise and deal with field staff is essential. Location Winnipeg. Applications treated confidentially. File No. 5121-V.

ELECTRICAL ENGINEER communication option from Canadian University required by manufacturer of television located in Ontario. Applicants should be 2 to 3 years out of university and have some experience in radar or allied equipment. Position open in Production Department. File No. 5122-V.

GRADUATE ELECTRICAL ENGINEER to assume responsibility for design and development of distribution and small power transformer with manufacturer established in Alberta. At least one year design and/or manufacturing experience desirable. Applicants to give personal data (including recent photo), education, experience, references and minimum initial salary expected. File No. 5131-V.

ELECTRICAL ENGINEER with at least two years of experience in industry. To handle under supervision, design of power distribution and control for plant extension and development work, supervision of draughting, test work, preparation of test reports and estimates. Required by smelting firm in the vicinity of Montreal. Experience in electric furnace smelting. File No. 5132-V.

MANAGER OF ENGINEERING required to direct our guided missile development and design program. The man for whom we are looking will have a background of at least ten years electronics experience. Specific experience in guided missiles would be a definite asset. His executive ability must be of a high order, and his supervisory experience be at engineering management level. This position will demand the best from a highly capable and mature engineering executive and in return offers an attractive salary, plus excellent opportunity for further professional and personal advancement. Reply in strictest confidence. File No. 5133-V.

SENIOR AND INTERMEDIATE ELECTRONIC engineers and physicists are required by a leading Canadian firm to carry out design and development work in the fields of radar, microwave communications, telephony and AM & TV broadcast equipment. All replies are confidential and will be acknowledged. File No. 5135-V.

A LARGE PROGRESSIVE AND WELL established electrical engineering company in N.E. England offers opportunities to engineer designers and draftsmen who have served a recognized engineering apprenticeship, possess technical qualifications to Higher National Certificate standard in electrical and/or mechanical engineering and have had practical experience on the drawing board preferably in connection with the design of electrical switchgear. Engagement would be for a minimum period of 2 years with the opportunity of continuance thereafter on a pensionable basis. Minimum salaries £585 per annum at age 25 and £663 at age 30. Passage paid and housing assistance in approved cases. A few opportunities also occur on much similar terms for contract engineers with qualifications and experience adequate to handle all phases of tender and contract work met with in world-wide electrical power supply equipment industry, particularly in respect to control and switchgear. File No. 5144-V.

PROJECT MANAGER (electrical and electronic) to design electrical and electronic installations in aircraft and to supervise a small section of electrical and mechanical draughtsmen. Applicants should have a degree in electrical engineering or mechanical engineering with electrical subjects and a strong secondary and preferably 5 years experience in design of electrical and electronic installation in aircraft. Experience in supervision of draughtsmen desirable. Salary commensurate with experience and qualifications. Reply stating age, education, experience, personal particulars and salary expected. File No. 5147-V.

ELECTRICAL ENGINEER, Canadian graduate with 4 to 6 years experience lighting and power distribution for industrial buildings. Work in Windsor or Sarnia. File No. 5155-V.

THE PUBLIC UTILITIES COMMISSION of the City of Kingston requires a graduate engineer with electrical distribution engineering experience to plan, design and supervise projects in connection with an electric utility. Position offers participation in commission's

Available June 1st 1955

SEVENTEEN CANADIAN ENGINEERS

FOR

PERMANENT AND SUMMER EMPLOYMENT

These men with degrees in electrical, civil, mechanical, engineering business, engineering physics, aerodynamics, chemical or petroleum engineering are doing graduate work at the School of Business Administration, University of Western Ontario.

Please contact the Placement Director, School of Business Administration

UNIVERSITY OF WESTERN ONTARIO

Resumes available upon request.

ENGINEERS

Continuing progress and expansion of this Company's operations have created many interesting new career opportunities for

ELECTRONICS, ELECTRICAL, CIVIL, MECHANICAL

and other Engineers interested in

COSTING, SELECTING and DEVELOPING COMMUNICATIONS SYSTEMS

involving uses of the latest types of

Microwave Equipment
Network TV Transmission
Telephone Switching Systems
Carrier Systems
Cable Distribution Systems

In addition to employee security and benefit plans for which this Company is well-known, the Bell offers its Engineers opportunity to advance to higher executive positions in both engineering and administrative capacities.

Salary: commensurate with experience and ability.

All replies will be treated in strict confidence. To arrange an interview, write our Employment Manager at Montreal, (Mr. R. B. McGiverin, 620 Belmont Street), or at Toronto, (Mr. T. R. Traynor, 76 Adelaide St. West).

THE BELL TELEPHONE COMPANY OF CANADA

hospitalization and pension plans. Salary commensurate with qualifications. Applicant should submit full details of education, experience, age and references. Replies will be kept confidential. File No. 5164-V.

GRADUATE ELECTRICAL ENGINEER interested in a career in Latin America with a Canadian owned electric light and power utility located in La Paz, Bolivia. Age limit 30 years and should have 4 to 5 years experience in electrical distribution. Prospects of promotion are excellent due to the company's continued growth and expansion. File No. 5170-V.

TWO COMPETENT GRADUATE ELECTRICAL engineers, age 30 to 40 with minimum 8 years experience design operation and maintenance of distribution facilities, required by rapidly growing utility. Location South America, Portuguese or Spanish useful, not essential to start. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5171-V.

ELECTRICAL ENGINEERS required to fill two vacancies in the teaching staff of the electrical engineering department at the University of New Brunswick. Good academic standing and either an advanced degree or at least two years of technical experience preferred. Should have an interest in teaching and initiative and energy to be effective in the growth of a rapidly expanding department. Reply stating age, education, experience, personal particulars, references and minimum salary expected. File No. 5172-V.

SALES ENGINEER required by well established and highly respected company in the field of scientific illumination. Duties after a specific training program, will involve the sale of prismatic lighting units and the discussion of lighting applications with architects, consulting engineers and electrical contractors, officials of industrial and commercial firms, municipal and hydro officers. Qualities of personality, diligence, and dependability along with a sincere desire for a permanent career in the lighting industry are of prime importance. File No. 5174-V.

ELECTRICAL ENGINEER required as sales engineer with a leading electronics firm. Good salary plus commission and excellent opportunity for future advancement. All applicants should state qualifications and salary expected. File No. 5177-V.

JUNIOR ELECTRICAL ENGINEER, required to act as an assistant to the distribution engineer. Please state education, experience, and salary expected. Replies will be held strictly confidential. Location Ottawa. File No. 5188-V.

ELECTRICAL ENGINEER 1954 or 1955 graduate to work in hydro department. Duties will be to work under one of our engineers on a power system. Starting salary $325-$350 per month. Pension plan, group insurance, blue cross. File No. 5201-V.

MECHANICAL

MECHANICAL ENGINEER required in Edmonton, who has graduated from a Canadian University and who has about 3-5 years experience in a chemical plant or refinery. He will deal mostly in equipment used in the manufacture of petro-chemicals and synthetic fibres. Duties will consist of general engineering which will include design, layout and estimating. File No. 5055-V.

VACANCIES IN CORNWALL, Ontario for graduate mechanical engineers. Age 24 to 28. Duties will cover design, construction and maintenance of all types of rayon machinery. Applications should be made to File No. 5120-V.

MECHANICAL ENGINEERS, graduates from recognized Canadian Universities with 0-10 years experience in a chemical plant or refinery. Duties will consist of general engineering, including design layout and estimating. Please reply in detail stating experience, education, etc. All replies will be kept in strict confidence. File No. 5137-V.

MECHANICAL MAINTENANCE ENGINEER with 5 years experience in oil refineries required as assistant maintenance superintendent in Southern Ontario. Please reply giving details of experience and salary expected. File No. 5141-V.

APPLICATIONS ARE invited for the position of instructor in Engineering at Mount Allison University. Duties to begin about Sept. 15th. Candidates must be university graduates in engineering, preferably in mechanical engineering. Salary range $2,500 to $3,000. Please apply to File No. 5150-V.

GRADUATE MECHANICAL ENGINEER, for large industrial concern near Montreal to take charge of a research project involving the design and development of new pilot plant machinery. Only those having initiative and capable of doing independent research work need apply. State age, experience and salary expected. File No. 5151-V.

MECHANICAL ENGINEER, Canadian graduate, 3 to 8 years experience process piping and equipment in refinery or chemical plants. Field experience valuable. Work in Sarnia. File No. 5155-V.

MECHANICAL ENGINEER required immediately for manufacturing department of electrode manufacturing plant in Montreal. Applicant should be a graduate of Canadian university, bilingual, with approximately five years of general engineering experience. Must be willing to do practical work. Remuneration in line with qualifications. Generous pension plan and other employee benefits. File No. 5160-V.

MECHANICAL ENGINEER with 3 to 5 years experience, preferably in connection with construction projects of various kinds, for work on plant engineering projects. Plant located 25 miles from Montreal. File No. 5161-V.

MECHANICAL ENGINEER OR graduate of engineering physics required by leading manufacturer of heating, ventilating and air conditioning equipment for sales engineering work. Age 21 to 27 years. Prefer a graduate of 1953, 1954 or 1955 classes. Previous experience in this work is not necessary, however, please state age and experience when replying. File No. 5168-V.

MECHANICAL ENGINEER required by automotive manufacturing company in Montreal. Applicant should be between the ages of 30-40 and preferably bilingual with experience in internal combustion engines. Duties will include the study of quality problems and production planning. File No. 5178-V.

PROGRESSIVE, MODERN TEXTILE COMPANY in Granby, Quebec, wishes to engage a mechanical or textile engineer as assistant superintendent. A man of 25 to 35 years of age who is primarily interested in production and plant engineering is desired. Previous manufacturing experience including staff supervision, is essential. All communication will be considered strictly confidential and interviews will be arranged in Montreal

CHEMICAL ENGINEERS

Atomic Energy of Conodo Limited hos openings for Chemicol Engineers for their exponding progrom on otomic power development.

The work will be moinly the development of fuel preporotion ond processing methods, cost onolysis ond equipment development.

Condidotes must hove o good ocodemic bockground, preferobly with some groduote troining. Some industriol experience is essentiol. The responsibilities ond solory depend on the quolificotions of the condidote.

Stote porticulors including oge, moritol stotus, educotion, ond experience in first letter to File 4A, Atomic Energy of Conodo Limited, Cholk River, Ontorio.

with applicants having suitable qualifications. Applicants should include day and evening telephone numbers, home addresses and details of qualifications. Please reply to File No. 5179-V.

MECHANICAL ENGINEER with 5 years or more experience in materials handling. Age 28-35. Must be Canadian citizen and must be registered professional engineer in Canada or qualified. Position headquarters in Minneapolis, Minnesota, with heavy travel in Canada. Prefer man with materials handling or packaging experience in food industry, but can consider others. Position offers good salary opportunity and permanence. Reply giving complete information regarding personal history, education, and experience. File No. 5184-V.

A RECENT GRADUATE MECHANICAL ENGINEER, bilingual is required by a large Western Ontario firm. This position involves travel and would be best filled by a young man who likes people and is interested in the sales and service of diesel engines. File No. 5186-V.

GRADUATE MECHANICAL ENGINEER with steam plant experience preferably in a central station utilizing pressures of 850 P.S.I. and temperatures of 900 degrees. Opportunities for advancement are excellent for right man interested in career in Latin America with a Canadian electric utility. Location Maracaibo, Venezuela. Housing provided. Salary open depending on experience and qualifications. File No. 5190-V.

MECHANICAL PLANT BETTERMENT ENGINEER, required by operating division of supervisory-consulting organization, for public utilities located eleven Latin American countries. Mechanical engineering graduate preferred with 5 to 10 years experience operation and betterment of steam electric plants. Diesel experience helpful. Some travel. Knowledge of Spanish desirable not necessary. Location N.Y. Reply giving age, education, experience, personal particulars, minimum salary expected. File No. 5192-V.

MECHANICAL DESIGN ENGINEER required in Bathurst, New Brunswick, who has graduated from a recognized Canadian University and who has had two years experience in the machine shop and steel fabricating industry. Duties will include development and design of earthmoving and industrial equipment. Reply giving details of education, experience, and age together with salary range required. File No. 5196-V.

DESIGN ENGINEER required by a firm in Hamilton, Ontario for development and product design of sheet metal working machinery such as presses, shears and roll forming machines. Applicant must have at least four years of machine design experience and preferably a graduate engineer. He must be able to design and develop such equipment with a minimum of supervision. Replies should outline qualifications, experience, age and salary expected. File No. 5200-V.

YOUNG MECHANICAL ENGINEER for work in connection with process plant. Previous experience in industry is not essential but it is possible that the successful applicant may be required to spend a short initial training period with our parent companies in England. Organization is part of a large world-wide engineering organization. File No. 5202-V.

MAINTENANCE ENGINEER required for new 12,000 BPD refinery at Winnipeg to be directly responsible to mechanical superintendent for all maintenance problems, materials, and scheduling and supervision of maintenance personnel and shop. Preferably mechanical engineer with five to ten years experience in general refinery engineering, maintenance and metals inspection, and with potential for future promotion. Remuneration will be negotiated. Send full details of previous experience and responsibility, and recent photograph to File No. 5204-V.

MECHANICAL ENGINEER as plant engineer for large plant manufacturing fibre conduit pipe at Cornwall, Ontario; three or four years mechanical engineering experience with some knowledge of machine design; starting salary $400-$450 per month. File No. 5212-V.

MISCELLANEOUS

CIVIL AND MECHANICAL ENGINEER required preferably with a few years of relevent experience and with good academic records for positions as research officers. To work on the dissemination of technical information to the construction industry and to study in the field new materials and techniques as used in construction. The ability to write clear reports to bridge the gap between research and industry is important. To undertake studies leading to the specification and assessment of materials and components for application in housing. Opportunities for study of the technical aspects of house construction will be provided. Salary will depend on training and experience. Applications with full details of education and experience should be sent to File No. 5091-V.

SENIOR GEOLOGIST, required by Saskatchewan Department of Mineral Resources. Applicants require University graduation in geology or petrology as well as several years professional geological experience and membership in C.I.M.M. and Association of Professional Engineers to take charge of geological survey parties for approximately six months each year and to prepare reports and other duties the remaining six months. File No. 5112-V.

A GRADUATE CHEMICAL OR MECHANICAL engineer for technical services work in marketing department of major Canadian oil company, Toronto office. Good technical background in petroleum fuels, lubricants and associated products essential, plus ability to make successful customer contacts and sales meeting presentations. Interesting prospects for advancement and liberal employee benefit plans. Give all information in first instance. All replies confidential. File No. 5125-V.

SALES ENGINEER with experience in combustion, oil burning equipment and lines related to boiler room equipment required by established engineering company located in Montreal. Write giving full details of experience and salary desired. File No. 5128-V.

A FIRM LOCATED IN Montreal requires the services of a graduate engineer who is experienced in the fields of water conditioning and purification, sewage and industrial waste treatment. A bacteriological background would be of advantage. File No. 5130-V.

TORONTO AFFILIATE of world-wide concern engaging in extensive and varied research has immediate requirement for experienced patent attorney or agent to organize a patent department. In addition to supervising Canadian prosecutions and making infringement and validity investigations, appointee will maintain liaison with overseas patent department and will work in close co-operation with personnel engaged in licensing activities. Applicants should submit complete résumé of personal data. All replies will be treated confidentially. File No. 5136-V.

TWO ENGINEERS WANTED. Electrical or mechanical. Must be graduate of Canadian or U.S. University. Experience not necessary. State full particulars and preference for production or design. Independent company located mid-western Ontario city. Full benefits. File No. 5138-V.

SALES ENGINEER required by company located in Montreal engaged in water and liquid conditioning engineering. Duties include both sales estimating and service work. Dealings are generally in the pulp and paper industry, utilities and general manufacturing field. Stationed in Montreal to travel in the Province of Quebec and the Maritimes. Salary dependent on the experience of the individual. full employment benefits with hospitalization, pension. File No. 5145-V.

MAJOR OIL SERVICE COMPANY operating in several locations in the Western Provinces requires several graduate engineers immediately. The positions offered involve field work, travelling and irregular hours. The salary schedule and employee benefits are excellent, the work has variety and several opportunities for advancement are available. The company is the leader in its field and well established on a world-wide scale. No previous experience is necessary, however an interest in fundamental electricity is desirable. Applicants must be 20 to 30 years of age and should supply a transcript of university marks with their reply. Please give age, education, experience and other qualifications. Minimum salary is $375.00. Complete job and company description available upon request. File No. 5146-V.

PRINCIPAL PETROLEUM ENGINEER required by Sask. Department of Mineral Resources. Competition No. c.c 3510. Salary range $481-$566 per month. Applicants require university graduation in engineering plus extensive field and office experience in the oil and gas industry. To take charge of the development division of the petroleum and natural gas branch. File No. 5149-V.

OPPORTUNITY FOR AN ENGINEER, if you have had ten or more years of experience in a pulp and paper mill, or in the sale of industrial equipment or some combination of the two, we have an opening in sales engineering that would be very interesting to you. We are a well established manufacturer of pulp and paper mill equipment. Living conditions in our centrally located city are considered very desirable. This is a senior position suitable for a serious and ambitious man who expects and warrants liberal remuneration. Our present staff have been advised of this advertisement. Your communication, outlining your background will be treated in confidence. File No. 5152-V.

LARGE ESTABLISHED paper company requires graduate mechanical, civil and electrical engineers with necessary experience to undertake investigations, preliminary designs and estimates for expansion of existing mills and new projects which may be contemplated. Good opportunity for qualified men with pulp and paper mill experience. Office located in Montreal. Replies should state age,

MECHANICAL ENGINEER

For plant engineering work in the viscose royon industry.

Duties will include investigotions, reports, design, ond supervision of plont engineering octivities, including maintenonce, olterotions, ond new instollotions.

Must be o groduote engineer, oge 26 to 35, with several yeors of procticol experience in plont engineering work. Must have the obility to toke over leodership of o group ond be prepored to moke his own decisions ond be responsible for them. Preferobly should also hove hod full or portial trode opprenticeship troining in industrial shop or plont. Position will be permonent, ond offers excellent opportunity for odvoncement to the right mon. Applicotions should contoin oll necessory personol doto, ond full informotion about previous engineering experience, and should be oddressed to:

Personnel Monoger,
Courtoulds (Conodo) Limited,
Cornwoll, Ontorio.

QUEEN'S UNIVERSITY

Department of Civil Engineering

KINGSTON, ONTARIO, CANADA

Applications are invited for the following positions in the Department of Civil Engineering, Queen's University, Kingston, Ontario, Canada.

LECTURERS: Should have at least two years experience following graduation in Civil Engineering. Master's Degree advantageous but not essential. Municipal and sanitary engineering experience desirable. May be required to instruct in any civil engineering subjects and must be prepared to specialize in municipal or sanitary engineering and hydraulics. Excellent facilities for research.

ASSISTANT PROFESSORS: Should have Master's Degree in hydraulics or related fields and several years experience following graduation in Civil Engineering. Will be required to lecture in hydraulics and to instruct in general civil engineering subjects. Will be expected to take an interest in research in hydraulic engineering.

GRADUATE-ASSISTANTS: Must be acceptable as students for Degree of Master of Science and should complete work for this Degree in two years. Will be expected to spend half time during academic session as demonstrators or assistants on research projects. Regulations governing graduate studies are contained in the Graduate Calendar which may be obtained from the Registrar of the University.

GENERAL CONDITIONS: Academic work occupies a period of approximately eight months. Staff members are free to engage in consulting or other professional activities during the remainder of the year. Alternatively, they must be engaged in research during this period but so far it has not always been possible to arrange for additional remuneration.

SALARIES: (All subject to revision).

Lecturers	*$3,000-$4,200*
Assistant Professors	*$4,000-$5,200*

Graduate-Assistants (Academic period — 7 months — September 15th to April 15th) Salary — $1,500.

Graduate-Assistants will act as instructors at Field Survey Schools in first half of September and second half of April — $150.00 each School.

Graduate-Assistants working in research projects will probably be expected to work full-time during summer months and will be paid accordingly.

Applications: To be submitted not later than June 15th, to Professor S. D. Lash, Department of Civil Engineering, Queen's University, Kingston, Ontario, Canada.

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qualifications, experience and salary expected. Interview will be arranged with prospective applicants. File No. 5153-V.

RESEARCH ENGINEER, required by Sask. Department of Mineral Resources. Salary range $326-$397 per month. Requirements recent graduate in ceramics, chemical or geological engineering, to carry out lab and pilot scale experimental work, field exploration, and economic survey dealing with the nonmetallic or industrial minerals of the Province. Good pension plan and conditions of employment. For further information and application forms contact P.S.C. Legislative Bldg., Regina. File No. 5154-V.

SALES ENGINEER, wanted with several years of sales experience preferably in petroleum chemical, steam power plant or pulp and paper industries. Required to handle all sales aspects relating to heat transfer equipment for major firm engaged in design of same. Would involve travel, principally in Eastern Canada. Location in Montreal. Salary and expenses. File No. 5157-V.

RECENT GRADUATE IN MECHANICAL OR chemical engineering required for Montreal East Refinery. One or two years' basic experience required with plant utilities such as steam, air and water. Knowledge of plant electrical systems useful but not essential. Position provides excellent opportunity for professional experience and promotion. Duties after suitable training period, will include such matters as performance studies on steam boiler plant, steam engine and turbines, pumps, air compressors, condensers and similar mechanical equipment, economic studies on efficient usage of plant utilities; preparation of estimates and layouts for extensions to plant utility systems. Salary dependent on experience and qualifications. Applications will be treated confidentially and should be addressed in writing with full particulars to File No. 5159-V.

INDUSTRIAL ENGINEER with work standards experience in foundry, machine assembly type of operation. Assignments will include development and installation of major programs as well as development of procedures and personnel. We are seeking a man with a degree in engineering or applied science, between 28 and 35 years of age. Location: Ontario. File No. 5162-V.

YOUNG TECHNICALLY TRAINED men for industrial engineering subdivision, which includes tool engineering, production engineering, work standards, and plant layout and material handling. Location: Ontario. File No. 5162-V.

PLANT MANAGER PREFERABLY 25 to 35, required by an Alberta firm specializing in precast concrete. Applicants must be university graduates in civil engineering or mechanical engineering, with a minimum of three years experience, preferably in manufacturing or in reinforced concrete. Will be required to supervise and direct all activities of a branch plant, reporting directly to the general manager. Salary open, with advancement dependent largely upon administrative ability. Reply giving full personal particulars, education, interests and recent photograph. File No. 5166-V.

INDUSTRIAL ENGINEER, man with experience in job methods work and the installation of inactive systems for Montreal manufacturing company. Engineer with experience with management consultant firm would be considered. File No. 5167-V.

YOUNG SALES ENGINEER, preferably 1955 graduate required as sales engineer by manufacturer of complete line of heating and ventilating equipment and centrifugal pumps. Training period for experience in Canadian or U.S. offices. Head Office in Ontario. File No. 5169-V.

DEPARTMENT OF NATIONAL DEFENCE, Ottawa, urgently requires inspecting officer. Under direction to be responsible for the direction of inspection of the manufacture and filling of artillery ammunition stores (shell); to lay down inspection requirements and proof conditions covering the manufacture and filling of all shell stores; to set standards of workmanship and finish; to recommend acceptance or rejection of concessions or other departures from drawings and specifications. Graduation in engineering or applied science from a university of recognized standing, and/or qualifications that would permit membership in a Provincial Association or the Corporation of Professional Engineers. File No. 5175-V.

TECHNICAL WRITERS REQUIRED with a university degree in science or engineering. The ability to express technical information in clear concise English and to read wiring diagrams, schematics and mechanical drawings is essential. Positions offer varied experience, future security and an opportunity for advancement. Please reply stating age, experience, educational qualifications and salary expected. File No. 5177-V.

NATIONAL RESEARCH COUNCIL, division of Building Research, Ottawa, requires a physicist or engineering physicist, to assist with the Division's Fire research program. Qualifications: applicants must be graduates from a recognized university. Salary commensurate with qualifications. The program is intended to reduce the toll of life and the immense property loss which arise from fires in all kinds of buildings in Canada. A wide general scientific knowledge and originality and versatility in experimental work are more desirable than any advanced specialization; but an interest in measurement of thermal radiation and flame temperatures, in unsteady-state heat transfer and in statistics would be an advantage, and the capacity to write reports which are clear to the public is indispensable. File No. 5183-V.

AN EXPANDING CANADIAN company has openings for engineers of university graduate or equivalent status preferably with gas turbine experience in the following fields. Experience in gas dynamics problems desired and the ability to assume responsibility for organizing and executing details programs for the development of gas turbine combusters and related equipment. Vibration engineers with previous experience preferred in vibration problems on gas turbine blading and engine structures. The work will include direction of laboratory, test house and flight vibration tests in addition to analysis of test data. Location Ontario. File No. 5185-V.

A DIESEL LOCOMOTIVE manufacturer in Western Ontario requires recent graduates, electrical and mechanical department. This position will involve design, development and testing of the locomotive and its components. Experience not essential. File No. 5186-V.

MECHANICAL OR ELECTRICAL ENGINEER, recent graduate, required as project engineer for expanding progressive company of engineering contractors specializing in industrial combustion applications. After a brief training period he will make surveys, estimates, proposals and become responsible for design, installation and operation. Location: Montreal and vicinity. Salary commensurate with qualifications. Please reply stating experience or background. File No. 5197-V.

ELECTRICAL OR METALLURGICAL ENGINEER, recent graduate, required by machine tool house to train for service and sales of technical production machinery in the plastics, electronic and metallurgical field. Location Montreal. Territory Eastern Canada. File No. 5209-V.

MECHANICAL OR CIVIL ENGINEERS required by a large metallurgical company located in Southern Ontario as designing draftsmen. Some experience required in either plant layout, reinforced concrete structural steel or materials handling. Please reply giving details of experience and salary required. File No. 5213-V.

ENGINEER REQUIRED with 5-10 years experience in production control covering stores functions, physical inventory operations, and dispatch and/or scheduling functions. Engineering degree preferred but experience in production control probably more essential. Position requires supervision of staff of approximately 100. Salary range $6,000-$7,500 depending upon experience. Location Montreal. File No. 5214-V.

RELAY ENGINEER to undertake system studies and provide relay settings for all generation and transmission plant of young B.C. utility with headquarters in Victoria. Reply stating age, experience, education, salary expected. File No. 5215-V.

SITUATIONS WANTED

CHEMICAL ENGINEER, M.E.I.C., age 35, 10 years experience in research, development and production desires position as assistant sulphite superintendent or control superintendent in pulp and paper mills. File No. 660-W.

MECHANICAL - ELECTRICAL ENGINEER, P.Eng. Jr.E.I.C., Polytechnique 1948, fluently bilingual, married with two children. 2½ years engineer draugthsman, equipment installation and plant services layout; 4 years plant engineering, supervising chemical plant electrical and process instrumentation design, construction and maintenance, equipment preventive maintenance program, pressure vessel work, safety and fire protection. Experience includes industrial electronics, hydro-electric

sub-stations distribution and relay protection. Desires responsible position in Montreal area. File No. 1097-W.

INDUSTRIAL ENGINEER, Jr.E.I.C., B.A.Sc., Toronto 1950. Excellent background of Industrial Engineering experience having specialized in the installation and maintenance of various systems of wage incentive. Specifically occupied with time study, job evaluation, methods and cost reduction proposals. Particularly conversant with the Budgetary Control System. Qualified to move on to position of greater responsibility with progressive Southern Ontario or Quebec company, providing greater opportunity for advancement. Single, 32, car owner, willing to travel or relocate. Fluently bilingual. Post-graduate courses. Available on one month's notice. Résumé on request. File No. 1721-W.

EXECUTIVE ENGINEER Mechanical graduate P.Eng. Ontario and Quebec, M.E.I.C., age 39, married, with wide and diversified Canadian experience in engineering design, construction, maintenance, industrial, manufaeturing and business field. Accustomed in dealing with management and personnel (technical and otherwise.) Capable administrator and organizer, aggressive, tactful. Would consider position offering responsibility, scope and future. Eastern Canada preferred. Available by arrangement. File No. 1793-W.

GRADUATE ENGINEER, 1945, age 32, bilingual, diversified industrial experience combined with sales engineering in various fields such as pneumatic process instrumentation, chemicals, fuels. Excellent knowledge of all aspects of fuel utilization, combustion, heating, steam and power plant engineering. Seeks technical position with Canadian basic industry in sales, service or manufacturing. Montreal resident, but will locate anywhere. File No. 2554-W.

EXPERIENCED ENGINEER, M.E.I.C., would furnish structural designs and quantity estimates in steel, concrete or wood, for architects or others requiring only occasional work of this type. File No. 2672-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng. (Ont.) B.Sc. (Queen's) 1941, age 38, 13 years experience in manufacturing methods, process engineering, production engineering of high precision components, plant layout and engineering—desires position as plant engineer or mechanical superintendent; available immediately. File No. 3272-W.

MECHANICAL ENGINEER, M.E.I.C., with 12 years experience in the design, construction, operation and management of a wdie variety of process plants across Canada. Seeks interesting and challenging job preferably located in Montreal. Good organizer, age 34. File No. 3405-W.

GRADUATE ENGINEER, 32, married, no children. Four years experience in heavy industry production control and planning last three as division production manager in a large Canadian firm. Desires employment of a similar nature with opportunities for advancement. File No. 3424-W.

MECHANICAL and ELECTRICAL ENGINEER, Jr.E.I.C., graduated 1949 from Vienna University; married, 2 children; 3½ years in Canada, perfectly bilingual; experience covers: heating, air conditioning, drying and piping with consulting engineer and contractor; as junior engineer, field supervisor and project engineer; equipment, instrumentation, process and service piping for complex chemical plant, as draftsman and mechanical engineer; layout, detailed planning, supervising the erection of complete electrical system and equipment for large cement plant, as chief of electrical section; good organizational capabilities and experience in dealing with management, staff, suppliers and contractors; seeks responsible and challenging position in industry, plant or with consulting engineer; first class references. File No. 3945-W.

CIVIL ENGINEER, Jr.E.I.C., (McGill) with 4 years experience on highway construction, surveys, soils and foundation engineering for bridges and heavy structures wishes employment with a small company undertaking construction of bridges, buildings and roads. File No. 3988-W.

ELECTRICAL ENGINEER, Jr.E.I.C., U. of Manitoba, 1950, 29 years of age, Test Course, 2½ years design of mercury arc rectifier controls, 5 months automotive plant engineering, 9 months supervisory capacity in hydroelectric generation. Will consider any location. File No. 4021-W.

METALLURGICAL ENGINEER, Jr.E.I.C., P.Eng., B.Sc. (Chemistry), B.E. Nova Scotia Technical College 1952. Married, age 32. Experience includes one year as chemist in control laboratory of a non-ferrous smelter; one year as assistant welding engineer with a steel fabricator, and approximately one year with a research firm on ore preparation and reduction of ores. Desires technical position with firm located in Ontario or Quebec. File No. 4128-W.

CIVIL AND INDUSTRIAL ENGINEER, B.Sc., P.Eng., M.E.I.C., age 31, married. Experienced in planning of major industrial expansions and plant improvements, including reports, estimates, and design (civil and mechanieal). During 5 years in pulp and paper industry, reaching supervisory capacity, have obtained broad office and field experience in diversified structural design, plant engineering and organization. Have done extensive studies in concrete mix designs and concrete structures. Seeks responsible position with industrial organization. Locate in any major city in Canada. File No. 4171-W.

GRADUATE ENGINEER, B.Sc. 1951, Jr.E.I.C., P.Eng. (Ont.), age 26, married. Two years experience with consultant on municipal projects and two years mechanical handling seeks position in mechanical handling, plant engineering or general industrial engineering. File No. 4207-W.

PROFESSIONAL ENGINEER, consulting, academic, food, beverage industries, 36, B.A.Sc. electrical, M.S. mechanical engineering, power field (3), University lecturing (3), consultative capacity preliminary survey, design, erection, supervision, refrigeration, cold storage plants, breweries, air conditioning systems, processing, industrial in Canada, South America, Asia (5). Working knowledge French, Spanish, German. Willing to travel or relocate, no preference to location, domestic or foreign. File No. 4240-W.

MECHANICAL ENGINEER, B.Sc., P.Eng., Ont., single, with 8 ycars experience; 5 years plant engineering, maintenance and design specializing in application of instrumentation, agitation and related chemical plant services and equipment; 2 years project engineer with large chemical company, design and installation stainless steel plant equipment; past year with refinery organization piping and pressure vessel design. Seek scope for initiative in project design, engineering sales or field work utilizing experience. Travel not objectionable, prefer Ontario, Montreal, or U.S.A. File No. 4248-W.

CONSTRUCTION ENGINEER, P.Eng., Jr.E.I.C. McGill 1951, married, 26 years old. Two years structural design experience in structures for industrial plants and warehouses. Extensive construction experience consisting of supervision on the erection of warehouses and other commercial projects. Piping layout supervision. Considerable office experience in estimating, quantity takeoffs and the preparation of plans for tendering purposes. Presently employed, available upon two weeks notiee. File No. 4273-W.

INDUSTRIAL SALES ENGINEER, graduate mechanical engineer, senior, experience in diversified machinery and tools, good appearance and personality, bilingual, seeks position only in the industrial sales field suitable to qualifications and possibilities, on salary and commission basis. File No. 4300-W.

CIVIL ENGINEER, 35, Veteran, married with two children, Jr.E.I.C., P.Eng., B.Sc., with 5 years varied experience—1 in design, 1 in supervising building construction and 3 in management seeks responsible position in Western Canada. Would prefer Junior partnership or associateship. File No. 4358-W.

CIVIL ENGINEER, M.A.Sc., Jr.E.I.C., P.Eng. (Man.) graduate 1952. Age 26, single, Two years experience on heavy building construction. Resident engineer on construction of water treatment and sewage disposal plants complete with distribution systems. Related summer experience with water works and private disposal systems. Would like to hear from employer in Canada or U.S.A. who requires a capable worker. References available from all previous employers. Will be available early summer. File No. 4415-W.

SALES ENGINEER, four years experience in technical sales promotion, advertising, catalogue writing, marketing, and administration. Chemical engineer, P.Eng. (Que.), Jr.E.I.C., University of Saskatchewan 1950. Age 27, married. Seeking interesting, responsible sales position. File No. 4516-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng., B.A.Sc. honours degree, electrical engineering University of Toronto 1950. One ycar experience in municipal engineering, one year with industrial electrical contractor as field engineer on construction. Three years experience in paper and board industry, operation, maintenance, construction, hydroelectric plant operation. Seek position in heavy industry or manufacturing. Would locate in one month in Canada. File No. 4545-W.

YOUNG ELECTRICAL ENGINEER, Jr.E.I.C., invites offers of challenging position requiring initiative and responsibility and providing incentive and opportunity. Graduated from University of Manitoba in 1950, age 27, married with one child, Jr.E.I.C. Has heen 4½ years with electric utility and has gained experience in maintenance of electrical equipment, operating problems, estimating, and supervision. More details available on request. Presently employed. File No. 4603-W.

MECHANICAL ENGINEER, age 33, married, no children, University of Toronto 1943, veteran. Ten years industrial experience, four years design, engineering, manufacturing, production and purchasing, six years application, marketing, sales and service. Experience covers power plant equipment, pumps, feed water conditioning apparatus, boiler controls, materials handling equipment, electric hydraulic and pneumatic eontrol systems, petroleum products, mining machinery and power transmission machinery. Presently employed but desire challenging work for aggressive firm with opportunity for administrative and/or management career in sales, service or manufacturing. Would prefer Ontario, Alberta or British Columbia. Particulars willingly supplied to interested employers. File No. 4604-W.

MECHANICAL ENGINEER, M.E.I.C., age 34, married. 10 years experience in drafting, piping layouts, estimating, inspection and plant maintenance in petroleum refinery. Desires position in industrial plant or refinery. Location Alberta or British Columbia interior. Available on one month's notice. File No. 4637-W.

METALLURGICAL ENGINEER, Master of Science degree in Met. Engr., B.Sc. (Hons.) in chemistry, P.Eng., Jr.E.I., Diploma of the National Foundry College, England in Foundry Management and Technology. Applied experience in almost every phase of metallurgy—heat treatment; foundry work—non-ferrous, cast iron; steel melting and rolling; machining; writing standards, etc. Will take full charge of all assignments. Seeks position with a consulting firm, or as a group leader or supervisor in the manufacturing development and engineering field. Location and size of company not important. File No. 4648-W.

CIVIL ENGINEER, M.E.I.C., Sask. '36, is seeking field training on large construction projects. Age 41, married, three children, good health. 8½ years with R.C.A.F.; 7½ years with a prairie eonstruction company specializing in commercial and institutional buildings; 3 years with Central Mortgage and Housing Corporation. Availahle immediately. Training and employment summary with the Institute. Past experience mainly office and administrative. File No. 4678-W.

METALLURGICAL ENGINEER, B.Eng. (1950), M.Sc. (1951), Jr.E.I.C. Age 28, married, two children. Experience: research work in melting and testing tetanium alloys; production, heat treating and testing of steel, plant engineering. Presently supervisor of metallography, physical testing, experimental heat treatment and metallurgical investigations in the laboratory of a large company. Fluently bilingual. Desires work in metal industry, production or research, ferrous or non-ferrous. Will accept position anywhere in Canada or U.S.A. File No. 4679-W.

CHEMICAL ENGINEER, McGill, 1945. Age 31, single, with 5 years experience in pulp and paper; quality control, production and development. Desires responsible position in chemical or allied field in Montreal area. Available immediately. File No. 4681-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.) B.A.Sc. Toronto 1949, 31 years old, married, six years experience mechanical and structural design of industrial buildings, materials handling plateworks, piping, heating and ventilation. Desires permanent position with responsibility and opportunity for advancement. Available on one month's notice to present employer. File No. 4683-W.

CIVIL ENGINEER, S.E.I.C., S.I.C.E., B.Sc. (Hons.) Leeds University 1954. Age 22½, married. Experience in centrifugal pump design, road construction and design, estimating. Has done soil mechanics lab. work and prestressed concrete design. Desires position in S.W. Ontario in soil mechanics and structural design with outdoor work. At present employed in Toronto. Available on 2 weeks' notice. File No. 4686-W.

MECHANICAL ENGINEER, 1953 Manitoba graduate, Jr.E.I.C., single, returning to Canada in December from two years work training on Athlone Fellowship with British turbine manufacturer. Desires to apply for design or manufacturing position, preferably related to power generation industry. Location: Manitoba, Ontario or Quebec Provinces. File No. 4687-W.

CIVIL ENGINEER, P.Eng. (Man.), M.E.I.C., Jr.A.S.C.E. Single, age 27. Graduate U. of M. 1951. Two years experience as resident engineer and field engineer on defence construction projects. One year as structural steel and miscellaneous iron estimator. Presently employed as town engineer in a community with a population of 22,000. Desires a position with a construction or consulting firm. Location immaterial. Available on one month's notice to present employer. File No. 4688-W.

CHEMICAL ENGINEER, P.Eng., M.E.I.C., graduated from the Polytechnic Institute of Bucharest, Rumania, 1949. 31 years old, married, two children. Experience one year as Professor Assistant at the University in Rumania, one year as chemist in Greece with textile company, one year with soap company in Canada, two years with a chemical company in Canada. Desires position in Toronto area. Available one month's notice. File No. 4692-W.

MECHANICAL AND METALLURGICAL ENGINEER, P.Eng., graduate 1946. Age 36, varied experience: mechanical design, materials and processes, heat treatment, casting, forging, welding, sales. Presently employed as executive responsible for technical and administrative problems. Seeks senior position with wide scope for initiative. File No. 4693-W.

ELECTRICAL Jr.E.I.C., McGill 52, presently employed, experience includes utility and power project work, switchgear and control design, and contracts, industrial rectifier sales, and control work on D.C. drives. Interested in consulting or manufacturing in or around Montreal and would be available on one month's notice. File No. 4694-W.

ELECTRICAL ENGINEER, P.Eng., Jr.E.I.C., age 29, married. 3½ years sales experience, 2 years installation and maintenance electrical equipment in mines. Toronto area preferred. File No. 4698-W.

MANAGEMENT MEN. Can you use an electrical engineer, P.Eng., Jr.E.I.C., Assoc. Mem. A.I.E.E., B.Sc.E.E. 1949, who offers an excellent switchgear application background coupled with aggressive sales and administrative ability. Test course graduate. Age 28, married. Recently completed two years of evening discussion courses in Business Management. Currently employed in responsible supervisory sales capacity with large manufacturer. Capable of contacting and negotiating effectively at management and executive levels. All replies will be given careful consideration. Please reply to File No. 4699-W.

ELECTRICAL ENGINEER, P.Eng., Jr.E.I.C., Ass. A.I.E.E., 1952 honour graduate, desires position with firm of consulting engineers, architects, or electrical contractors. Also very interested in design of motor and other industrial control circuits. File No. 4701-W.

GEOPHYSICIST, graduate of engineering physics University of Toronto, Jr.E.I.C., age 27, married, one child, with three years experience in magnetic and electromagnetic surveys desires employment with future leading to position of responsibility not necessarily in geophysics. File No. 4703-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng., with 7 years' experience including manufacturer's test course, industrial control design, industrial apparatus application engineering, and engineering management, graduate Queen's, Canadian born, desires permanent position with opportunities for advancement in return for hard work and proven ability. File No. 4705-W.

ENGINEERS

with 2 or more years experience required for rapidly expanding chemical company

1—CIVIL 1—ELECTRICAL 1—MECHANICAL

Good opportunity and permanent position with central engineering office in downtown Toronto

Top salary for right men. Start immediately.

5 day week

Applications will be confidential

File Number 5230-V

CIVIL ENGINEER, Jr.E.I.C., M.Eng., McGill, age 34, 5 years diversified experience includes 2 years experience in laboratory testing soils steel and concrete, and concrete design, 2 years R.C. and pile foundation designs, reviews R.C. and steel structures, soil investigations and soil reports. Pressure vessel designs. Has aptitude for report writing and indeterminate structural problems. Seeks employment with consultant, growing firm or growing construction company where knowledge, ability and hard work will eventually lead to responsible position or partnership. File No. 4706-W.

MECHANICAL ENGINEER, 26, Canadian citizen, Canadian degree, varied experience in Canada, British heavy engineering training under Athlone Fellowship. At present in heavy Swiss engineering plant. Working knowledge of French and German, experienced traveller, single. Seeks to use experience to best advantage upon return to Canada in September. File No. 4709-W.

METALLURGICAL ENGINEER, Jr.E.I.C., B.A.Sc., 1952, R.C.A.F. veteran, married. Employed since graduation in materials department of large manufacturing firm; engaged chiefly in selection of materials and processes. enquiry into new materials and processes, collection of data, specification writing, etc.; small amount of shop and laboratory experience. Good background of industrial experience before graduation. Seeking employment in a metallurgical industry or closely related field. Opportunity to assume increasing responsibility with increased experience is an important consideration. File No. 4710-W.

MECHANICAL ENGINEER, B.Eng., M.E.I.C., 31, married with one son. RCNVR Engine Room Artificer. Summer experience as machinist, millwright, construction foreman, stationary engineer. Four years power engineer industrial power plant including steam power generation, refrigeration etc. Experience with oil and coal fired (chain grate, spreader, and P.F.) units, turbogenerators etc. including installation and repair. Recently completed eleven months as assistant chief engineer of copper mine in Middle East. Seeks position anywhere in Canada or U.S. where ability to accept responsibility and make decisions will be utilized to better advantage. Complete résumé on request, available for interview end of May. File No. 4711-W.

MECHANICAL ENGINEER 1943, McGill, desires position of senior responsibility in design, project, development or plant maintenance. Past experience: 2 years engineering teaching; 10 years on plant layout, machinery foundation, design of process piping, plant services, steam plants, combustion work, industrial furnaces, structural design building construction, field supervision. Also holder of B.A. degree, married, 2 children, and thoroughly bilingual. File No. 4713-W.

ELECTRICAL ENGINEER, B.Sc., P.Eng. (Ont.), Jr.E.I.C., age 40, 1951 graduate, plant engineering, instrumentation, and administrative experience, seeks position in engineering sales. File No. 4714-W.

CIVIL ENGINEER, Jr.E.I.C., P.Eng. graduate N.S.T.C. 1952, age 27, married. Three years experience with construction company mainly in field work and supervision of residential and heavy construction projects. One year in residential construction including housing reinforced concrete, streets, water and sewer lines, sewage disposal plant, central heating. Two years experience in heavy construction on large concrete lock project including steel piling, cofferdams, mass earth and rock excavation. Good references available. Desires responsible position with opportunity for advancement. File No. 4715-W.

CHEMICAL ENGINEER, B.Sc., Alberta, 1948, Jr.E.I.C., married. Seven years experience in development and production in metallurgical industry. At present in charge of development group working closely with production. Capable of carrying production problems to completion with a practical viewpoint. Have had recent experience in new plant start up in foreign country. Desires position leading to responsibility, in Western Canada or Ontario. Available August. File No. 4716-W.

CHEMICAL ENGINEER, B.Sc. degree Wayne University in Detroit (1955), age 27, married, student member A.I.Ch.E. seeking a position in plastics, rubber, petrochemical or paper industry. Available June. File No. 4717-W.

GRADUATE ENGINEER, Civil, Jr.E.I.C. McGill 1950 with extensive experience in railroad maintenance and considerable experience in allied works desirous of obtaining employment anywhere. Would seriously consider municipal engineering. Available on reasonable notice to present employer. File No. 4718-W.

ENGINEERING PHYSICS, M.E.I.C., B.Sc. (Sask) 1946, age 32, married, one child. Three years research and development; one year materials handling; 5 years chief engineer large Western municipality. Considerable top level experience on planning, design and construction of: roads, sewers, dykes and drainage, waterworks, town planning, budget preparation and control purchasing, and personnel work. Locate anywhere in Canada in an interesting and challenging position. File No. 4719-W.

MECHANICAL ENGINEER, M.E.I.C., & P.Eng. Ontario. Age 46, married. Eleven years diversified experience in design and development engineering in oil refinery and chemical plants including power house and process piping design. Eleven years in plant engineering in the plastics and chemical industry. Accustomed to dealing with management and personnel (technical and otherwise). Capable of organizing and administering. Interested in a position where capabilities will be fully utilized, and opportunity for advancement is available. File No. 4720-W.

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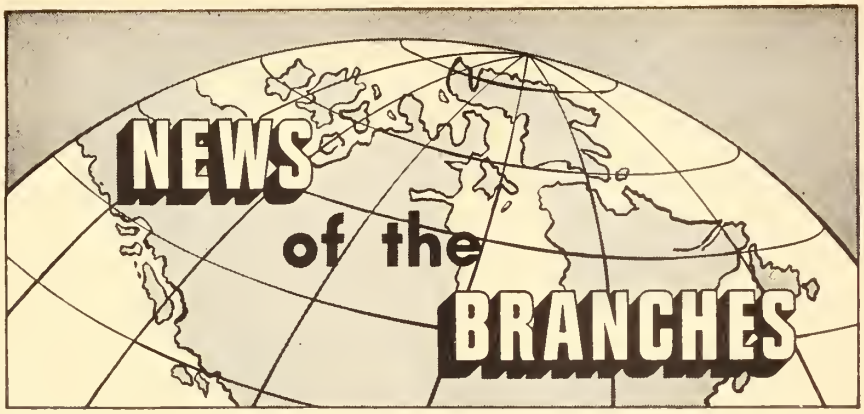

Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Cornwall

L. H. Snelgrove, M.E.I.C.,
Secretary-Treasurer

W. Rothwell,
Branch News Editor

G. R. Griffin Speaks on Pressure Vessels

On Thursday evening April 14, the Cornwall Branch heard G. R. Griffin of the General Electric Co. Ltd. speak on "The Design of Pressure Vessels". The meeting was held in the assembly room at the Howard Smith Paper Mill under the chairmanship of Jack Morris.

Mr. Griffin was introduced by Ben Stidwell. His subject was treated under two general headings. First, he outlined the different governing bodies, legislation, codes and specifications that must be followed in the design of a pressure vessel. Secondly, he discussed some of the design problems and requirements giving special attention to the latest codes and their amendments.

Specifications

It was pointed out that a knowledge of the subject covered by the first section is essential to all engineers who are asked to design, install, purchase or write purchase specifications for a pressure vessel, for unless something is known of the codes that govern design an engineer cannot expect to even purchase let alone design or manufacture a special pressure vessel and have it do the job as well as meet the letter of the law.

For the definition of a pressure vessel the Statutes of Ontario (Boiler and Pressure Vessels Act 1951 S.I. (U) (ii)) was quoted as an "unfired vessel or apparatus other than a boiler that may be used for containing, storing, distributing, transferring, distilling, processing or otherwise handling any gas, vapour or liquid under pressure".

Not only are boilers classified separately from pressure vessels but in some localities a different code or standards making body is followed for the design of boilers than is followed for pressure vessels while different legislature groups may control the requirements for boilers and pressure vessels.

The speaker explained to some length the difference between regulations (or codes) and a statute (or law). The regulations or codes, as prepared by such groups as CSA or ASME, being nothing more than a guide to be followed and therefore do not become mandatory until they are adopted by a Provincial or Federal statute such as the Ontario "Boiler and Pressure Vessel Act 1951".

Design and Manufacture Procedure

The procedure for the design and manufacture of a pressure vessel for use in the province of Ontario was given as follows. The vessel is designed based on information in the ASME code (Section VIII) as well as the CSA regulation B-51 and the design submitted to the Chief Inspector of the province for approval and registration before commencing construction. In submitting a design, it is necessary to forward three copies of all drawings as well as three copies of the "Manufacturer's Specifications".

The Boiler Inspection Department, after checking the design returns one copy of the drawing with their approval stamp on it, as well as a registration number usually referred to as the Canadian Registration Number. The vessel can now be manufactured after arranging with the Boiler Inspection Department for inspection of the vessel at any stage of construction desired by the inspector. Upon completion of the vessel the inspector gives a final inspection and witnesses the hydrostatic tests on the vessel.

The inspector may ask to see the radiograph or X-ray films, if any are called for in the design and he may also ask to see the identification card of any welder working on the vessel.

Manufacturer's Affidavit

Once the vessel has been inspected and tested the manufacturer must fill out a Manufacturer's Affiidavit on the special form provided by the Boiler Inspection Department. On this form, it is necessary to give the description of the vessel, the Canadian Registration Number, the name and address of the ultimate owner, the names and addresses of the welders and the date of their last test, the material used and its makers name as well as other particulars. When completed, this form must be signed by the foreman of the shop and sworn to before a notary or Justice of the Peace. Upon receipt of this affidavit the Boiler Inspection Department issues a Certificate of Inspection which must be forwarded to the ultimate owner and displayed by him near the vessel.

The speaker went on to explain the procedure necessary for a manufacturer building a vessel in one province to be used in another province and explained the use of the registration number to identify the provinces in which the design has been registered.

ASME Code

In the second part of his talk, Mr. Griffin discussed the ASME code in general and the ASME Code Section VIII and its application in the design of pressure vessels in particular.

During the question time, the speaker answered a large number of questions from the members present which was an indication of the interest shown in the subject of the address.

At the close of the meeting, Mr. Griffin was thanked by Don MacEwan.

Edmonton

R. B. Kerr, Jr.E.I.C.,
Secretary-Treasurer

P. H. Buckland, M.E.I.C.,
Branch News Editor

Trans-Canada Gas Pipe Line

On the evening of Wednesday, March 23, 1955, the Edmonton Branch had its regular dinner meeting. The speaker for the evening was James C. Sacs, assistant to the president of Trans-Canada Pipe Lines Ltd. Mr. Sacs' talk for the evening covered highlights of the gas pipe line proposed by his company.

Mr. Sacs is a native Albertan and a graduate of the University of Alberta. He was with the Royal Canadian Navy during the war and spent five and one-half years overseas. After the war he took a post graduate course at the Harvard Law School and graduated from the Harvard Graduate School of Business Administration. Mr. Sacs was introduced by Paul H. Buckland of the Edmonton Branch.

Venture's Magnitude

Mr. Sacs first emphasized the magnitude of his company's proposed venture to transport natural gas from Alberta to eastern Canada by pointing out the following facts: The order to be placed for pipe will be the largest single pipe order ever placed. It will be the longest pipe line in the world. It will transport approximately 4.35 trillion cubic feet of gas during its life time. This is about equivalent to four St. Lawrence seaway projects on a B.t.u. basis.

He pointed out that there were four main types of pipe lines; namely, natural gas, crude, products and gathering. This type of transportation, although not as well publicized as some, has in fact a greater mileage in the United States than the railroads.

Volume Expected

To illustrate the size of the volumes of gas which Trans-Canada would handle, Mr. Sacs compared their expected movement of 500 million cubic

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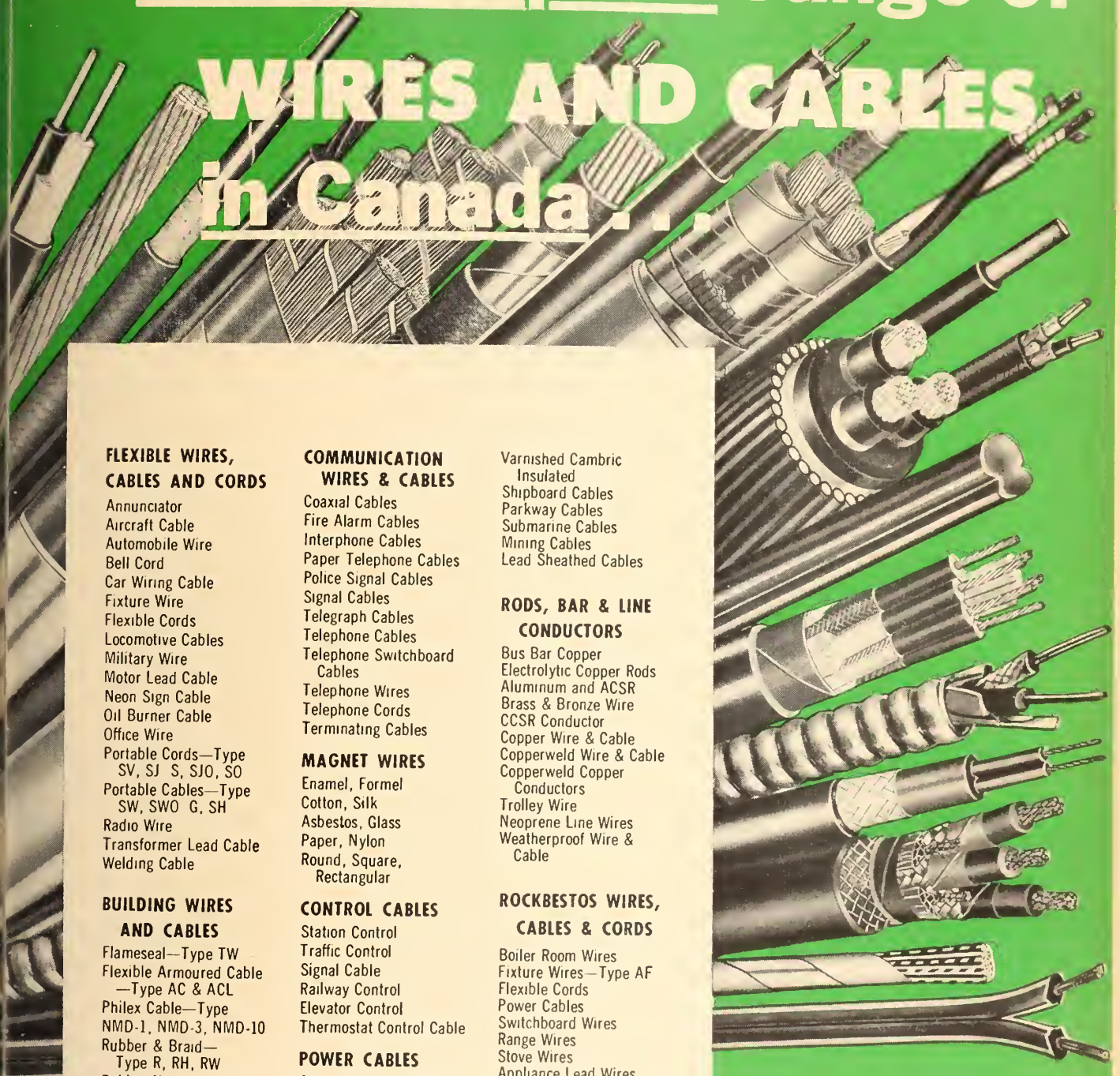

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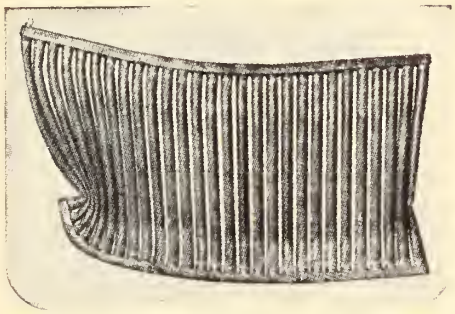

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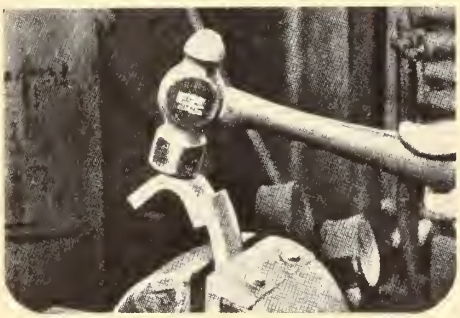

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feet per day with the 350 million cubic feet per day which represents the peak of present Alberta gas production. The whole line will cost ultimately from $300,000,000 to $350,000,000. The line as proposed will be 34 in. O.D. from a point on the Alberta-Saskatchewan border to Winnipeg. It will have a 24 in. lateral line from there to the United States border at Emerson and a 30 in. line from Winnipeg to Toronto. The company has already installed a 20 in. line from a point on the United States border near Niagara to Toronto. This line is presently being used to develop the Toronto market from United States gas sources. However, when the line to Toronto is completed, the flow will be reversed and the Niagara area will then be supplied with Alberta gas. The line from Toronto to Montreal will be 24 in. O.D.

At present, Trans-Canada has an agreement with Union Gas Co. of Canada Ltd. of Chatham, Ontario, to supply 300 billion cubic feet over a twenty year period. This agreement is particularly attractive as Union Gas is prepared to take larger volumes in the summer than in the winter. This is quite the reverse of most gas agreements since demands are much higher in the winter, but Union has natural storage facilities in Dawn Township just north of Chatham. Trans-Canada has an agreement to deliver up to 100 million cubic feet per day to Emerson for United States consumption.

The problem of gathering the gas in Alberta will be handled by the Alberta Gas Trunk Line Co. Ltd. They will gather the gas from various fields and deliver it to Trans-Canada at the Alberta-Saskatchewan boundary.

Alberto's Reserve

Although the pipe line plans to market 4.35 trillion cubic feet of gas, Mr. Sacs emphasized that the present Alberta gas reserve was 13.4 trillion. With this reserve increasing at a rate of 1.5 trillion cubic feet a year, it is obvious that Alberta has no worry about a plentiful gas supply.

Mr. Sacs said that present plans for financing the line were going ahead, but depended to a great extent on guaranteed markets. He further stated that since the Alberta gas fields were spread out over such a vast area that it was likely that the Canadian gas producer might not expect as high a price as his United States counterpart. In closing, Mr. Sacs restated the company's decision to delay the project for a year until arrangements can be made to finance the line.

Mr. Sacs was thanked for the Edmonton Branch by J. A. Sirdevan.

Hamilton

A. F. BARNARD, JR.E.I.C.,
Secretary-Treasurer

R. R. PACKER, JR.E.I.C.,
Branch News Editor

Students' ond Juniors' Popers Night

"Science and Religion—Can They Be Reconciled?" by B. A. Warren was the first paper delivered at the Hamilton Branch annual Students' and Juniors' Paper Night.

Mr. Warren pointed out some of the biblical interpretations which have been a source of conflict between science and religion, and suggested that historical and scientific facts be considered the

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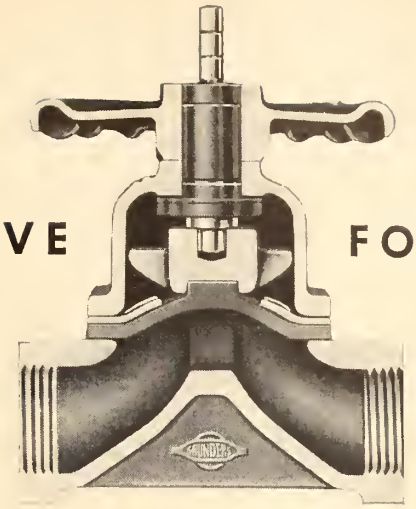

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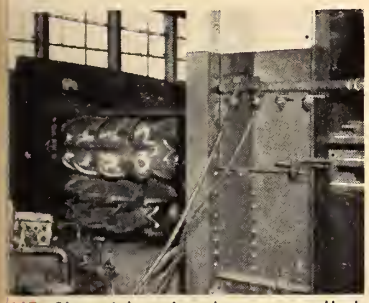
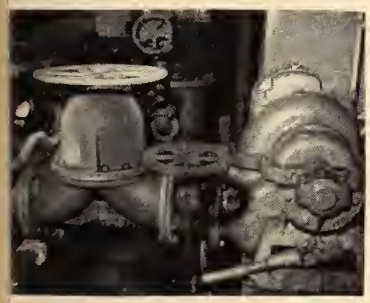
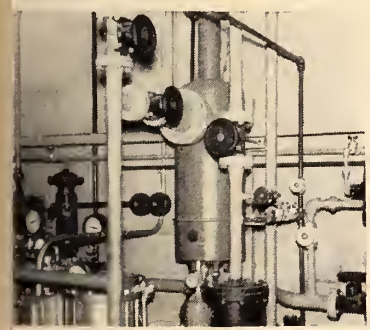


AIR—Six quick-acting, lever-controlled Grinnell-Saunders Diaphragm Valves maintain leak-proof air control at Dominion Engineering Works, Ltd., Montreal, Quebec.



WATER—12" Grinnell-Saunders Diaphragm Valve handling water at the Canadian International Paper Company Mill, La Tuque, Quebec.



GAS — 12 Grinnell-Saunders Diaphragm Valves ranging in size from ¼" to 1½" on Hydrogen Gas lines. Oxygen, Nitrogen, Acetylene and Propane lines also use these valves at this Canadian General Electric Company plant at Guelph, Ontario.

Credit the tight closing diaphragm with providing important advantages. The diaphragm lifts high for streamlined passage, in either direction; closes tightly for an absolute seal, even when scale lodges on the valve weir.

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Grinnell-Saunders Diaphragm Valves offer other advantages too. Bodies, linings, and diaphragm materials are available to meet most service conditions. The only part that ever needs replacing is the diaphragm, which can be changed in minutes without removing the valve body from the line. In downtime and overtime saved—in maintenance and repair work avoided—you are dollars ahead when you rely on Grinnell-Saunders Valves.

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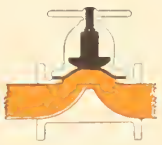

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field of science, and matters of an ethical and moral nature be left to the field of religion. He believed that science can further religion in the presentation of accurate historical facts, and that religion, in turn, can explain the futility of a scientific approach to certain concepts. While science, itself, is limited in its attempt to explain the source of some things, religion, on the other hand, has benefited by such outstanding scientists as Galileo and Darwin who established religious truths by scientific investigation.

With the advance of science, Mr. Warren said, it is not only the responsibility of religion but also of persons advocating technological improvements to keep in mind the restricted and monotonous life to which the individual is subjected in industry.

Mr. Warren came to the conclusion that science and religion only seem to differ; they really do not have to be reconciled in that they have always gone hand in hand.

Motor Test Method

"The Speed-Torque Determinations of the Acceleration Method" by A. F. Barnard gave a method of motor test used by Canadian Westinghouse. Before explaining the acceleration method he pointed out the disadvantages of other methods, such as brake with overheating due to long runs at low speeds, and size limitation which is also a problem with dynamometers.

The basis of the acceleration method is Newton's second law which relates force to mass and acceleration.

By electrically determining motor speed, voltage applied, and time on an oscillograph, values may be found from which a speed-torque curve may be drawn knowing that torque varies as voltage squared.

On a graph was shown the subtraction of a speed-torque loaded motor curve from the curve for an unloaded motor to give the speed-torque load curve.

One of the many advantages of this system is that installed equipment may be tested. The size is not prohibitive as even the new 55,000 hp. pump motors for Sir Adam Beck were tested by this method. The only disadvantage is that a large amount of power is required to test large motors.

Self Protecting Distribution Transformers

The third speaker, P. J. C. Locke, also represented Canadian Westinghouse and talked on "Completely Self Protecting Distribution Transformers."

The construction of conventional distribution transformers consisting of tank, oil, core and coils was compared with the C.S.P. transformer which, besides being better constructed, had lightning arrestors on the primary side, co-ordinated air gaps and circuit breakers on the secondary side.

These protective devices were explained by showing their protection against three typical electrical stresses, high winding to tank, low winding to the tank, and the high winding to the low winding failures.

The advantage of current overload circuit breakers over fuses is that short overloads that will not damage the transformer are allowed by the circuit breakers but not by fuses while they still give protection for long periods of continuous service. Other important devices were discussed, such as signal lamps which warned utilities when transformers were being used to capacity indicating they should be replaced by larger transformers.

Precision Investment Casting

W. B. Jennings from the experience drawn from his own company described "Precision Investment Casting." Casting was defined as the scientific approach to an ancient art. The Romans made chariot wheel hubs by casting.

There are two main types of molds in investment casting for making the wax cores—low melting metals, such as bismuth where the double shrinkage of the wax and bismuth must be considered, and steel molds.

Three stick molds were shown by which three parts of a wax core were assembled to make one complex shape core. After attaching runners and a header for better distribution of the molten metal, the core is next placed in a metal can filled with a plaster of paris surry, or investment. The investment is cured at from 180 degrees Fahrenheit to 200 degrees. The wax or plastic core must have no ash content. After curing, the wax core is burnt out of the investment in an oven at 1,400 degrees for 14 hours, leaving a cavity in the investment. A variety of metals may be poured and various cooling rates employed to obtain the required results. The investment is broken away to obtain the parts from which the gates are removed.

The advantages of investment casting are that its tooling cost is less than die casting, and sand or plaster casting, but handling cost due to the multiplicity of operations is high. The accuracy and finish are good, equalling die casting. Tool maintenance is low because of the low temperature and pressure used. The greatest advantage is the complexity of shape which offers a challenge to any design engineer.

After the judges' decisions were announced, the prizes were presented as follows: R. C. Mitchell, chairman of the Judges Committee, presented the first prize to B. A. Warren. W. A. Wheten, past-president, awarded the past-president's second prize to W. B. Jennings, and F. M. Milne presented the third prize to A. F. Barnard. P. J. C. Locke will also be presented with a certificate for his paper.

Kingston

E. C. Reid, M.E.I.C.,
Secretary-Treasurer

G. C. Monture Addresses Joint Meeting

Members of the Kingston Branch of the Chemical Institute of Canada, the Kingston Branch of the Engineering Institute of Canada, and the Kingston Metallurgical Society and their ladies were addressed at the annual joint dinner meeting on Tuesday evening, March 15, by Dr. G. C. Monture. Dr. Monture is chief of the mineral resources division, mines branch, Department of Mines and Technical Surveys. He has travelled widely on behalf of the Government of Canada, and has recently returned from a trip to Malaya where he was one of a team of experts sent on a mission for the International Bank. Dr. Monture is also a member of the University Council of Queen's University.

British Moloyo

Dr. Monture pointed out that British Malaya ranged from about one degree north of the equator to about six degrees north. It is almost exactly 180 degrees removed in longitude from this section of Ontario. Perhaps the best known centres are Singapore, at the southern tip of the Malay peninsula, which is independently governed and Kuala Lumpur, the capital of British Malaya.

The climate is tropical with temperatures ranging from 100 degrees during the day down to 75 degrees at night. The speaker told how he noticed, at first with surprise, that when he happened to leave a briefcase sitting on the sidewalk at noon it cast no shadow. Rain is plentiful and occurs every day, usually in the form of a short but heavy fall in mid-afternoon. The climate is all dominated by monsoons which occur at regular intervals twice per year. These winds and rains are particularly strong along the north coast where they sweep in from the China Sea.

Custom and Habits

Dr. Monture went on to describe the people of the country. They can be divided into well defined groups. There are the Malays, who are native to the country, the Chinese and Indians who have come and settled in large numbers, the Europeans who are of course a minority, and the aborigines who inhabit the jungle. Dr. Monture contrasted the custom and habits of these peoples. He stressed the industrious nature of the Chinese which was coupled however with a sort of political indifference. The Malays were by comparison more inclined to be easy-going and to have a serene attitude. There were several major religious groups as well although these were divided mostly along racial lines. Buddhists, Confucians, Hindus and Mohammedans were all present. Dr. Monture spoke warmly of all these racial groups, and of the way in which the life of the country moves on in spite of the constant threat to the life of the individual and to the economic life of the country which guerrilla raids impose.

Government

He described the system of government and the conscientious attempt of the British authorities to defeat the Communist threat not only by military action which is at best difficult, but by a program of planned improvement of the economy of the country and by efforts to show the people that their general standard of living is better than any in all of southeast Asia. The speaker pointed out that the number of guerrillas is relatively small. The country depends largely upon rubber plantations and upon tin mining however, and in both of these industries the workers were particularly subject to guerrilla attack. The difficulty of successfully combatting their attacks was greatly increased also by the security afforded them by the jungle.

Nevertheless the success to date of countermeasures while costly has been such as to allow the production of rubber and tin actually to increase.

The speaker closed his talk with a series of illustrations which showed for the most part methods of mining tin in Malaya. These were followed by a short motion-picture film depicting various aspects of life in the country.

Dr. Monture was thanked by Mr. W. J. Babe, chairman of the Kingston Branch of the Chemical Institute. A copy of the work "De Re Metallica" suitably inscribed in honour of the occa-

sion, was presented to Dr. Monture.

Those at the head table included Principal and Mrs. W. A. Mackintosh of Queen's University, Dr. Monture, Dean and Mrs. D. S. Ellis, Dr. R. H. Hay, chairman of the Kingston Metallurgical Society, who also acted as chairman at the dinner, Mrs. Hay, Mr. and Mrs. W. J. Babe, Professor C. H. R. Campling, chairman of the Kingston Branch of the Engineering Institute of Canada, and Mrs. Campling.

The dinner was held in Wallace Hall in the Students' Memorial Union at Queen's University.

Lethbridge

P. Harding, jr.e.i.c.,
Branch News Editor

R. D. Hall, jr.e.i.c.,
Secretary-Treasurer

R. Travers Is Guest Speaker

On Saturday, February 16, the Lethbridge Branch met in the banquet hall of the El Rancho restaurant under the chairmanship of E. A. Lawrence. The musical entertainment was supplied by Mrs. Brown at the piano and Mr. Brown at the violin, with Miss Helen Findlay providing three vocal solos.

Mr. James Haimes was paid special tribute by G. Brown for the work he has done in the Lethbridge Branch through the years. M. Mitchell mentioned the forthcoming annual meeting of the Professional Engineers of Alberta at Calgary where one of the subjects to be discussed is the possibility of teaching more mathematics in local schools.

The guest speaker, R. Travers, was introduced by A. L. H. Somerville. Mr. Travers, as radio officer with the Department of Transport took as his subject, "Taking the Guess out of Flying".

Aviation has advanced tremendously in the last 15 years and this advancement has followed the improvements of electronics. When the bush pilot hit poor visibility he had to land as soon as possible and possibly spend days in the bush before the weather cleared. With the commercial airlines the customers demanded more security in transportation with the result that highly efficient air navigation instruments had to be developed.

Air Navigation Instrument

Radio range stations, which operate in the 200-400 kilocycle band, are installed at 122 Canadian airports linking major cities of the Dominion in a network of airways. Five steel masts, 125 ft. high, radiate field patterns that resemble two figures "8". The intersection of the lobes produce characteristic signals that enable the pilot to fly directly from one point to another without reference to the ground, or in other words, to navigate by instruments alone.

The instrument landing system is an electronic system that takes over from the radio range network and makes it possible for the pilot to make a blind landing. It is a four dimensional conception in that it provides information aurally and visually informing the pilot of his distance above ground, his distance from the runway, and his lateral alignment to the runway. It continually changes this information in accordance with the passage of time as the aircraft approaches its point of touchdown.

Two of the four buildings required for an approach contain fan marker transmitter which operate at 75 megacycles. The outer marker is approximately four miles from the runway, whereas the middle marker is about one-half a mile distant. Specially shaped antennae radiate a field pattern that resembles an open fan and when the aircraft slices through the thin dimension of the fan, the pilot is alerted by means of flashing lights and high pitched notes emitted by the transmitter.

Localizer Transmitter

The localizer transmitter provides lateral guidance. Two modulation lobes, 90 cycle and 150 cycle at carrier frequency of 110 megacycles intersect along the centre line of the runway and its extension into space. The aircraft receiver separates the two modulation components by means of a filter network. The modulation is converted into d-c. components and whichever is the stronger manages to deflect the needle of the ILS instrument. The result is that if the aircraft drifts to the right of the course the needle will point to the left and vice-versa. The pilot must fly in the direction the needle points in order to return to the centre line of the runway.

The Glide Path Transmitter radiates at 330 mcgacycles two modulation envelopes which intersect in such a way as to provide a glide angle of 2½ degrees. So long as the pilot maintains this angle of descent the needle of his instrument will remain horizontal and he will land on the runway. Otherwise he will be instructed to fly up or fly down by the needle whichever his error may be.

By keeping his two needles crossed the pilot is enabled to land in conditions of very poor visibility.

Montreal

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Publicity Chairman

Industrial Meteorology

On February 1, 1955, at a meeting chaired by H. J. Racey, the guest speaker was Dr. Irving P. Krick, whose subject was "Industrial Meteorology".

The practice of industrial meteorology had its inception in the middle 1930's when Dr. Krick as head of the Department of Meteorology at the California Institute of Technology and his colleagues in that Department organized the world's first firm of meteorological consultants.

Research

The first efforts of the group were directed to research into a main weather requirement of business and industry—long range weather outlooks.

First, the 45 years of synoptic weather charts then on record were analyzed and classified into eleven basic weather types, each with a life cycle of six days. Further research showed that each basic type was controlled and selected by the position and orientation of the Pacific anti-cyclone which lies between California and the Hawaiian Islands. The more or less regular oscillations of this control cell can be extrapolated for some months ahead, thus permitting extended forecasts for any part of North America. The method is unique in two respects: first, the long period for which outlooks can be obtained, and second, the actual timing of the sequence of weather events which can be specified during the forecast.

Industrial Application

The final problem of the consulting meteorologist is the translation of the sequential pattern of the forecast weather to actual effects on the client's problems and operations at a particular geographic location.

The first major application of meteorology to business was in the motion picture industry where light conditions are so important for outdoor photography. Major fields of application are now utilities, especially hydro-electric and natural gas utilities, construction, marketing of weather sensitive products such as fuel oil, soft drinks, etc., oceanography, air survey, forest operations.

Precipitation Forecasts

The main hydro-electric interest is in long range precipitation forecasts for reservoir draw-down operations, while the natural gas application is the one to two weeks' demand situation to allow ordering and transmission of the gas from the gas fields. In construction the forecasts are used to specify the number of operational days to be expected for different classes of work based on weather criteria for limits for each class, for concrete protection, from either frost or rain-mark, movement of heavy equipment, pipe line laying, etc. Weather sensitive products require long range forecasts for production planning and shorter range forecasts for promotional efforts and timing of advertising.

A completely new branch of applied meteorology is that of weather modification.

Cloud Seeding

The discovery by Drs. Schaefer, Langmuir and Vonnegut of General Electric that dry ice and then silver iodide would nucleate supercooled clouds was made in 1947. Since then a great effort all over North America and in a dozen foreign countries has yielded increasing evidence that cloud-seeding to increase natural precipitation is a thoroughly sound process, technically and economically.

Inefficient experiments using dry ice dispersed from an aeroplane were soon displaced by large scale seedings from a planned network of ground-based generators operated in accordance with the dictates of skilled meteorological analyses of the storm structure, vertical and horizontal wind-flown and moisture distribution aloft.

The basic principle of cloud-seeding is the fact that nature precipitates water in our latitudes, speaking broadly, by the ice-nucleation process. Natural ice nuclei are inactive above about —15° C. to —20° C. Silver iodide, on the other hand, is active at temperatures up to —4° C. This immediately makes available a whole section of the cloud system of any given storm for nucleation and resulting precipitation.

There are various methods of vaporizing the silver iodide to produce the desired number and proper size of crystals. Some methods burn a solution of silver iodide (in acetone) in a hydrogen or butane flame; others burn sized foundry coke impregnated with a solution of silver iodide in acetone.

No. 3 in a series of discussions on truck equipment

What "Made in Canada" Means to Canadian Truck Operators

C. W. WOOD
General Manager

We at Phil Wood Industries believe that it is vitally important that Canadians manufacture as much as possible of the goods and equipment they use. Our thinking on this is two-fold.

In the first place when goods are manufactured in this country maintenance of service parts and facilities is much easier. Phil Wood customers, for example, never lose valuable time waiting for some needed part to be shipped into Canada. All of our equipment is made here and service is instantly available whenever and wherever it is needed.

We feel, too, that an entirely Canadian industry is vitally necessary to the continued growth of Canada's economy. That's why, in addition to manufacturing Canada's most complete line of hoists and bodies, Phil Wood Industries has also led in the development of needed, specialized hydraulic equipment.

For example, to help our basic industries do a better job, Wood has engineered rugged, heavyweight hydraulic log loaders, rock bodies and oil field bodies. Because we are a Canadian firm familiar with Canadian conditions these units are built to stay on the job day in and day out regardless of terrain or weather conditions.

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So you see, for the manufacturing, engineering, and development of specialized hydraulic truck equipment there is no need to go outside Canada's borders. You can get the best there is right here.

You are always sure when you specify Wood, that you are getting equipment unequalled anywhere. Remember, too, that Wood Service is immediately available from coast to coast.

Available in sizes capable of handling loads up to 4000 pounds the versatile Wood Tailgate Loader steps up efficiency—reduces handling time and costs.

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Vaporizing Methods

There are two primary considerations in a choice of vaporizing methods; first, the temperature of vaporization, and second, the stability of the crystals produced, in ultra-violet light and under normal atmospheric thermal action. The most efficient vaporizing temperature is approximately 2,500° F. This temperature is easily attained in a properly designed coke furnace, whereas other methods in general use vaporize at lower and less efficient temperatures. Recent research has demonstrated that the silver iodide crystals produced from the coke apparatus are resistant to deactivation to a very satisfactory degree as compared with hydrogen or butane generation.

In essence the success or failure of a cloud-seeding operation depends directly on the quality of the meteorological analysis and the control exercised. The seeding agent must reach the cloud masses at the proper elevations (temperatures) over the target area and the air currents with each are, of course, continually shifting with height and with time as the storm moves across the area.

Before establishing a generator network for a program, it is necessary to analyze all the various types of storms in historical records to decide what are the frequencies of occurrence of storms of various types in the region. Obviously different storms must be seeded by different generators, since the wind directions and vertical motions vary from one storm type to another. Finally, after the generator network has been laid out, the problem is to analyze each new storm as it approaches so that the operational instructions may be passed to the generator operators for the proper sequence of vaporization and release to be carried out.

Future Developments

The author's weather modification company, Water Resources Development Corporation, Denver, Colorado, has operated in sixteen of the United States, in three Canadian provinces, and in six foreign countries in Europe, the Middle East and Africa. The results of these operations which now total close to 300,000 generator hours (equivalent to thirty years operation) have justified the belief that this revolutionary new field of weather modification is a thoroughly practical one in a business sense with a high benefit to cost ratio. It holds forth enormous promise for the future, with many new developments being actively pursued, of which two hail suppression and lightning suppression are already yielding very satisfactory evidence of success.

From Slow Motion to Supersonics—Observations of Fluid Flow

What goes on inside a raindrop? Why do airplanes "stall"? What slows up a bullet? These questions may not seem relevant one to the other, but an eminent specialist from the National Research Council, Dr. D. C. MacPhail, assistant director of the mechanical engineering division told the Montreal Branch, and showed them by slides, how there is a close relation between a lot of things that the average layman does not realize. The title of his talk was "From Slow Motion to Supersonics—Observations of Fluid Flow" and he told the engineers how increasingly import-

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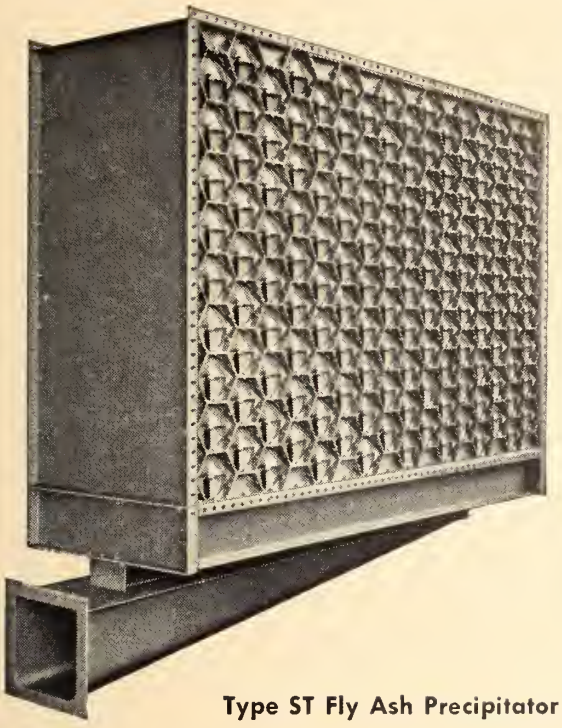
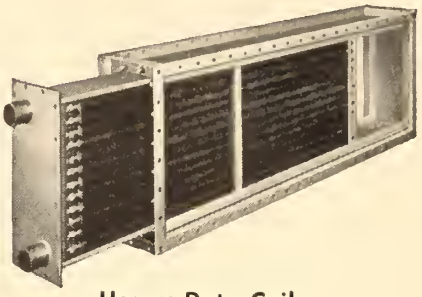
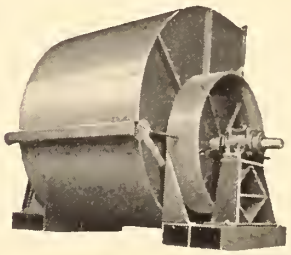


Type ST Fly Ash Precipitator



Heavy Duty Coils



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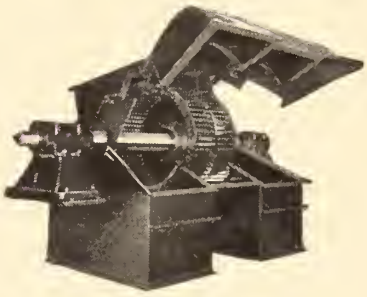
There are many advantages in using Canadian Sirocco Type ST Precipitators for fly ash problems. Unique in design, simple in operation and low in maintenance cost, these units contribute materially to over-all power plant efficiency.

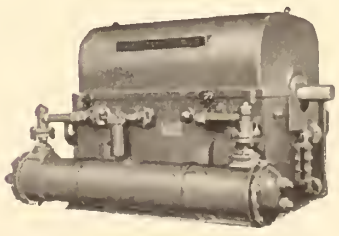
They automatically maintain high efficiency over the entire boiler load. Even at reduced loads, when fly ash is more difficult to remove, the Type ST Precipitator is relatively more efficient.

In addition, all element cells are die-formed, interchangeable and housed in a single, compact casing. Type ST units are flexibly designed to fit the job. They may be shipped for field assembly, or semi-assembled. They're available in a wide range of sizes to meet a variety of needs.

If you have a fly ash problem, why not call in a Canadian Sirocco Field Engineer and work your needs out together? He has a wealth of experience behind him and excellent firsthand data at his disposal on Fly Ash Precipitators as well as on Canadian Sirocco Heavy Duty Coils, Mechanical Draft Fans and Gyrol Fluid Drives for fan control. Simply contact the nearest Canadian Sirocco Branch Office — conveniently located in all principal cities.



Sirocco Induced Draft Fans



Gyrol Fluid Drives for Mechanical Draft Fans

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ant knowledge of the behavior of fluids in motion is in modern engineering design.

Dr. MacPhail showed that when a raindrop starts to fall it is spherical, then as it comes in contact with the wind it takes on the shape of a doughnut, and if a sudden gust of wind hits it the rain drop is practically turned inside out and looks like an upside-down goldfish bowl—a hollow thin shell. Tests prove that the same thing goes on with a drop of oil in an engine—as the draft strikes it it gets turned over and inside out so that the material in the oil is well mixed. The turbulence in the firebox of a locomotive is most useful as it helps combustion to proceed quickly and completely by breaking up the fuel.

But when turbulence upsets the streamline that is flowing past the wings of an airplane, through sharp turning or other cause, the smooth motion of the air which keeps the plane in the air is destroyed and the machine stalls or loses altitude. Dr. MacPhail illustrated this by showing photographs which traced smoke and nylon threads in the streamline passing an airplane's wing, and showed how the orderly flow of the streamline is interfered with when the speed of the plane is too slow or there is a sharp change in direction.

Supersonic Flow

Dealing with supersonic flow, Dr. MacPhail showed slides of shock waves from electric sparks, which makes the thunder when lightning flashes, and also the blast from a gun muzzle when the gases come out. These observations were made by the shadow method of observing shock waves. The lecturer wound up by showing slides of a photograph of a bullet in flight, which revealed two things—first the formation of a shock wave in front of the bullet, and second the eddies of a shock wave in the wake of the bullet, similar to the waves at the bow and stern of a ship. It is these shock waves that slow up the speed of the bullet.

This meeting which was one of a series of experimental 5.30 after work meetings was presided over by R. L. Dunsmore, chairman of the branch. Refreshments costing 75c were served until 6.15 at which time the meeting officially started.

Ungava—1955

On February 15, 1955, the Montreal Branch heard Dr. C. Dufresne, supervising geologist for the Iron Ore Company of Canada, speak on the Ungava Development.

Dr. Dufresne briefly mentioned the history of the development dating back to 1890 when iron ore was first reported in the area. Very little exploration work was done until 1945 when it became apparent that the Mesabi range in the States was rapidly being depleted. New mining methods large markets and the growth of air transport hastened the decision to explore the potentialities of the area.

By 1950, 450,000,000 tons of high grade iron ore had been outlined and a contract was let for the construction of the 350 mile Quebec North Shore and Labrador Railway, running from Seven Islands to Knob Lake.

The railway was completed early in 1954, together with a car dumper and loading dock at Seven Islands. Seven bridges, two tunnels and two hydro-electric generating stations were also included in the construction program.

Following these introductory remarks, Dr. Dufresne showed a very interesting film entitled "Iron Ore in 54" which covered the construction of the railroad, dock facilities, and the Manihek hydro development near Knob Lake. He also showed a series of colour slides on the development of the townsite at Scheffeville and the various open pit mining and stripping operations presently under way on the ore bodies. It is interesting to note that all the commercial quality ore proved to date covers an area of approximately two square miles. Present known depths of the ore bodies range to 600 ft.

Natural Gas for Canada

The speaker, Dr. G. S. Hume, on the February 24 meeting, was introduced by the meeting chairman L. E.

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Mitchell. Dr. Hume discussed the present and future competitive position of Western Canadian natural gas shipped by pipe line against oil, and coal from Western Canada, U.S.A. and elsewhere and natural gas from other areas in various market areas of Canada and United States.

Pipeline Advantages

Oil by pipeline has a considerable transportation advantage over coal by rail from Western Canada to Toronto. Natural gas by pipeline over the same distance could be transported for a rate similar to coal, which, the speaker felt, would enable it to compete successfully with coal and possibly in certain applications with oil in the Ontario market.

Western oils are now supplying all British Columbia and the Prairie provinces, and are also reaching Sarnia and Northwestern U.S.A. as an ever increasing fraction of the total supplied to these areas. Western oils do not, however, reach the Montreal refinery areas due to the better competitive position of South American tanker transported oils, which reach Montreal harbour in summer and are piped in from Portland, Maine in Winter.

It was pointed out that in spite of somewhat larger capital outlays required pipe of large sizes were usually more economic in the long run due to lower pumping costs, which would become even more pronounced with increased demand.

The speaker described the tremendous gas fields in northeastern British Columbia, and the plans for a pipeline to Vancouver and Northwestern U.S. (Westcoast Transmission Line). Opposition by U.S. interests rendered the line dubious, but apparently a deal has now been made and the line will go through in a much larger scale than originally planned tied up with a large American pipeline network from New Mexico.

The Trans Mountain Pipeline, which carries Alberta oil, now supplies British Columbia and partly supplies a refinery in the state of Washington. Soon another refinery in this state will be partly supplied by Trans Mountain.

Northern Ontario Route

The Trans Canada pipeline has also encountered difficulties. Northern Natural Gas Company wants to tap the line at Emerson, Manitoba, and U.S. permission has not yet been granted. Also much discussion over the route through Northern Ontario is taking place and it is felt at present better to take an 80 mile longer northerly route by Hearst and Kapuskasing near highway 11 through the clay belt than by the C.P.R. over northern Lake Superior. This would be in the national interest by serving Northern Ontario, and would have the additional and necessary advantages of a convenient access road and cheaper construction.

Whether or not the Trans Canada pipeline would serve Montreal area is not too clear. Ontario has some old gas fields which can be used as reservoirs which make the line more feasible there. These fields are now active but held back with respect to consumption; if the Trans Canada pipeline were to become a reality they could be allowed to expand.

The Tennessee Gas Company is at present hooked in with the Ontario system. This company has large reservoirs in New York State, and if they could be tied in with Trans Canada on a storage interruptible basis, being supplied in off-peak periods of summer week ends at a fixed annual quantity a larger pipeline could be justified with resulting economies all the way along for Trans Canada.

Refrigerated Barges

A new development which appears feasible, according to the speaker, is the transportation of gas at high density and very low temperature in refrigerated barges. A U.S. company proposes to supply Chicago in this manner from Louisiana gas fields via the Mississippi. It is claimed cheaper than pipeline transportation.

If this is feasible, it will most certainly have a tremendous impact in transportation of middle-eastern gas to

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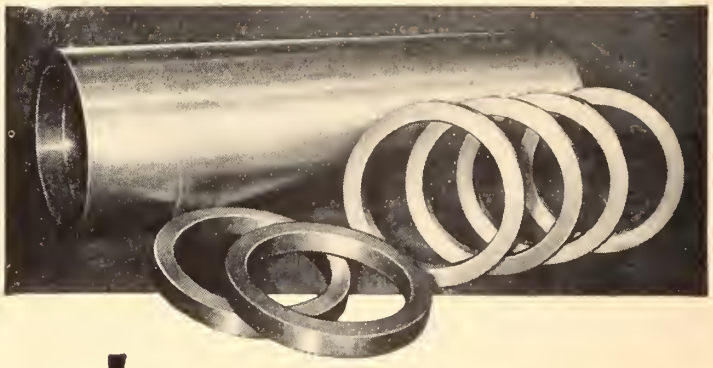

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This is the Otis Electronic Zone of Detection (Illustrated in phantom) This zone extends in front of the leading edges of both hoistway and elevator car doors from floor to shoulder height. When a passenger enters this zone of detection the electrical effect of the passenger's body energizes a series of electronic tubes. The tubes in turn permit the passage of current to operate the relays that control door operation. The result? The doors politely and obediently reverse before they can touch the passenger. This zone travels with the car and provides double-door protection at each floor.

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Otis Electronic Elevator Doors—*with the electronic zone of detection*—need stay open at floor calls only long enough to permit a single passenger to leave or enter the car. Then they start closing. This alerts other passengers to step lively.

However, as long as *the electronic zone of detection* (as illustrated in phantom) senses the presence of other passengers in the doorway, both hoistway and elevator car doors keep reversing politely and obediently without touching the passengers. Then they start closing again. And the instant the last passenger has entered or left the car the doors are closed—*and the car speeds away!*

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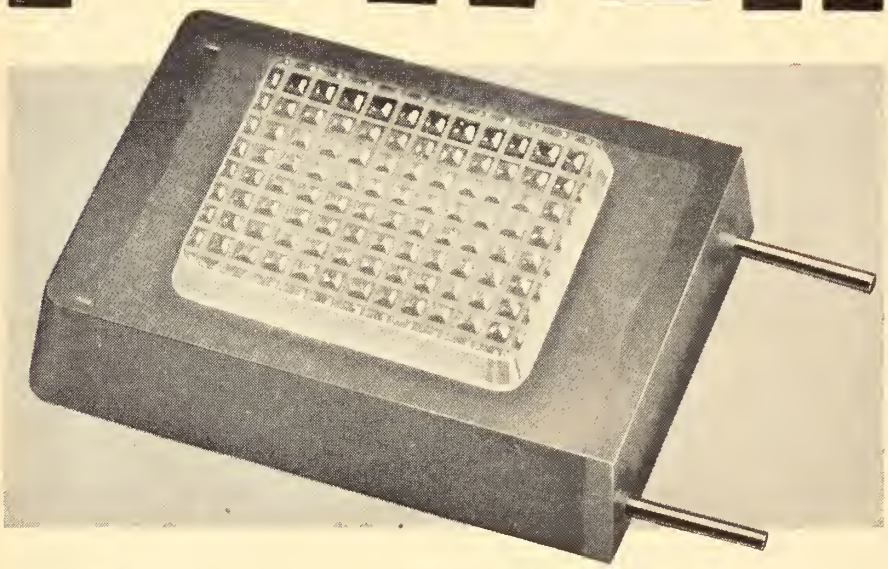

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Wavelength at max. response	5100 angstroms
Dark resistance	10 to 1000 megohms
*Sensitivity at 1 ft. candle (100 volts)	0.15 to 0.4 amp/lumen
Capacitance	20-30 mmfd
Rise-time at 50 ft. candles	5 m. sec
Decay-time at 50 ft. candles	10 m. sec

*Measured with a 2854°K colour temperature tungsten lamp.

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Europe and Great Britain. It could also conceivably affect the eastern Canadian market in competition with natural gas.

Atomic power, the speaker stated, will probably be making quite an impression on the economy before 25 years have passed and at such time may be competing with gas.

The speaker was thanked by the meeting chairman, and a question period opened. The question period was lively. Apparently gas is being used as fuel for road transport in Alberta. Propane and butane are stripped before it is piped, and they become very cheap surplus.

A vote of thanks was moved by R. L. Dunsmore. The meeting chairman again thanked the speaker and adjourned the meeting which was sponsored by H. N. Young.

Current Limiting Fuses

A joint meeting of the Engineering Institute and the American Institute of Electrical Engineers on March 7, 1955 heard an address by D. L. Dickson, vice-president of Eastern Electrical Supply Co. on "Current Limiting Fuses". Mr. Dickson was introduced to the meeting by R. N. Coke who acted as chairman of the meeting for the evening.

Mr. Dickson, whose company represents the British Manufacturer E.M.P. Electric Ltd. in Canada, stated that several manufacturers of current limiting fuses were in the market but that all used similar methods to obtain the current limiting feature.

The need for a C.S.A. specification to cover current limiting fuses in the 250 volt and 600 volt classes from 600 amperes to 3000 amperes was stressed. Differences in physical dimensions of various manufacturer's fuses should be permitted by C.S.A. specification.

Mr. Dickson then showed slides to illustrate how the current limiting feature was obtained.

Low Voltage Fuse

The fuses in the 600 volt and below class consist of a powder filled, hermetically sealed, glazed ceramic cartridge. The fuse element is of pure silver welded to the end contacts and is surrounded by the powder. The end caps are of copper and are compressed onto the cartridge. There are two forms of these fuses. One has graded elements that blow at approximately 135 per cent of continuous rated current. The second has an overcurrent element which causes an additional time delay and is used primarily for short circuit protection.

High Voltage Fuse

The high voltage fuse used above 600 volts has similar construction with the exception that the silver fuse wire is wound on a special form made of high temperature material. The powder used is made of quartz. The fuse wire has small beads attached at intervals to obtain arc initiation at low fault currents.

During blowing the arc causes the silver to volatize and this causes a chemical reaction with the quartz, the material formed being an insulator. The formation of this insulator where a conductor previously existed causes the arc to be extinguished. The quartz also acts to conduct heat away from the arc.

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FACING up to the fact that her reserves of easily workable coal will, it is estimated, last for about 200 years at the most, Britain has begun to construct a thermal reactor capable of producing electrical power in industrial quantities.

Constructional work in connection with this epoch-making scheme is now in hand at Calder Hall and it is forecast that the completed station, and a breeder reactor which is also to be built, will result in the generation of 50,000 kilowatts.

The building of this, the world's first atomic electric generating station, has been entrusted to Taylor Woodrow. Here is new and unique evidence of the way in which this firm is, both in Britain and abroad, Building for the Future . . .

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Striker Pin

A feature of this fuse which can be incorporated is the addition of a striker pin which is forced out by the gas formation at considerable pressure. The pin can be used to operate a trip bar which will initiate a trip signal to secondary breakers and prevent single phase operation.

Mr. Dickson showed slides of test oscillograms for various low and high voltage fuses as well as slides showing their use.

The current limiting fuse is especially valuable for anode protection in mercury arc rectifiers. The application of the fuses should be made with care since the loop forces acting are considerable. A straight connection should be made from the bus bar to reduce loop forces acting on the fuse to a minimum.

Considerable discussion and questions followed Mr. Dickson's address. R. A. Boyd thanked Mr. Dickson on behalf of the audience. The meeting was arranged for by R. H. King.

Air Pollution

Sir Hugh E. C. Beaver, described the pollution situation in Great Britain in terms of concentrations of impurities in the air and how they varied with respect to geography and season and their effect on health. His address took place on March 17 under the sponsorship of W. H. Gauvin and the chairmanship of E. D. Gray-Donald.

Sir Hugh outlined the historical background of anti air pollution measures over a period of around 200 years, describing particularly epidemics of smog, and the effects on legislation. He gave his opinions on why no obvious improvements had come about in the past as a result of these measures.

Economic Loss

He evaluated the economic loss to the country in terms of extra washing, fuel losses, time lost from work due to bronchitis and similar afflictions, but did not attempt to evaluate the effects of loss of sunlight.

Many health statistics were quoted of both normal versus abnormal smog periods and of deaths due to bronchitis, etc., in Great Britain compared to other countries less severely afflicted with smog.

The work of his committee and various sub-committees with respect to smog conditions and the proposed "clean air act" were discussed with respect to both industrial and domestic combustion and the recommendations connected with these. The constructive and positive approach to the problem was stressed.

A brisk question period followed. The chairman thanked Sir Hugh and the meeting adjourned.

Modern Trends in Layout and Design of Paper Mills

On March 31, A. M. Hurter of Stadler, Hurter & Company, consulting engineers, addressed the Montreal Branch on the subject of "Paper Mill Design."

Mr. Hurter stated that since there had been little change in paper mill machinery in the past ten years it was possible to design a modern mill with machines ten years old on an obsolete mill with present day equipment. The economies of operation due to modern design result largely from increased use of automatic controls, the use of continuous processing in place of batch operation and the improved efficiency of materials handling and maintenance made possible by a well considered layout.

Mr. Hurter showed slides of applications of controls to stages of the process and said that the trend would be toward linking of these stages by control systems.

The present trend in mill design was to handle the raw material required for twenty-four hour operation in one shift and provide sufficient "in process", storage for the other two shifts.

Central Corridor Plan

Older mills suffer severely from the physical restriction of waterwheel and steam drive layout and are very difficult to increase in capacity as a result. Some modern southern mills are built on a scattered plan with departments occupying separate buildings in a large plant area. The design which the author favoured for this climate is the central corridor plan with the departments arranged in sequence along both sides of a ten to fifteen foot corridor which carries interdepartmental traffic and services. Each department is then free to expand outwards without expensive rearrangement of other departments. This design is also the most practical to heat and operate in this climate. The author concluded with a question period. The meeting was sponsored by P. J. Kunstler and G. Midgley was chairman.

Electrical Research

At a joint meeting of the American Institute of Electrical Engineers and the Montreal Branch, B. G. Ballard gave a brief history of the National Research Council and described some of the unclassified projects on which the division of radio and electrical engineering of N.R.C. is engaged. Mr. Ballard is vice-president (scientific) of the National Research Council, director of its division of radio and electrical engineering, vice-president of the Engineering Institute of Canada, a director of C.S.A. and chairman of the C.S.A. approval board. In 1946 Mr. Ballard was awarded the O.B.E. for his work on the development of minesweeping equipment during the war.

Research a National Asset

Mr. Ballard said that research is both a stimulant and an economic asset and is essential to the maintenance of our position as an industrial nation. He recalled with amusement that when the Council was created during the first world war to assist in defence problems, an appropriation of $650,000 for staff and laboratory was refused by the senate and the whole idea was described by a senator as "absolute nonsense". Today with a staff of over 2,000 people the National Research Council has an annual laboratory budget of $11,000,000 besides the $3,000,000 spent for grants in aid of research.

An illustrated lecture on the work of the radio and electrical section covered N.R.C. contributions to radio astronomy, induction heating for medical use, an electronic organ, radar tracking of meteors and a cheap radio homing device for small boats.

The meeting was arranged by A. M. Forster and presided over by F. L. Lawton.

Railway Signals

On Monday evening March 21, 1955 Eric Stevenson presented a talk on the subject of railway signals. Mr. Stevenson stressed that railway signals is a field of conservative approach. Changes come slowly since devices and methods must be reasonably well tried and proven before being adopted.

Train Control Systems

There are two great types of train control systems. The first of these is called the "Time Table and Train Order System". In this system the trains are separated by time intervals which may be varied by "train orders" given to the crews. A dispatcher will generally be given about 150 miles of track to supervise, and assuming a siding every seven or eight miles, about 30 trains a day can be handled over this stretch of track.

The other system is called the "Manual Block System". In this system there is an operator at each end of a geographical block. The operator, in effect, opens or closes the gate at each end of the block, Trains are thus separated by distance. This system is best adapted to application of signals.

Track Circuit

A "track circuit" uses the rails as part of an electrical circuit to determine if a given length of track is occupied or not, which way the train is going, etc. The basic track circuit was developed by Dr. Robinson but there are now a great variety of circuits in use.

The track circuit applied on the manual block becomes the automatic block system. Further development of this system coupled with the use of polarized track signals led to the modern system of centralized track control.

The aim of centralized track control is to reduce the problem by means of signals so that it is within the mental grasp of the dispatcher and to provide

The Editor invites discussion

of papers

appearing in the *Journal*

An Important Announcement by

THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND

concerning

AMALGAMATED ELECTRIC CORPORATION LIMITED, TORONTO

The General Electric Company Limited of England has purchased over 99 per cent of the shares of Amalgamated Electric Corporation Limited, Toronto.

This substantial investment is made at a time when the Canadian electrical industry is passing through a difficult period and it is an indication of the unshakeable confidence which the British Company has in the future of Canada in general and in the electrical industry of Canada in particular, and also of the Company's intention to play a full part in the development of this vital industry in the service of Canada.

By this action Amalgamated Electric Corporation Limited now has at its disposal research and development facilities unsurpassed in the world, and will be able to draw on the experience and skill of the United Kingdom Organization which provides employment throughout the Commonwealth for 65,000 people.

The management of the Canadian Company will remain in the hands of those already holding office and the United Kingdom Organization wishes it to be known that the Company is to remain essentially Canadian in outlook and practice and no effort will be spared to sustain and enlarge the friendships which have already been built up over the years by Amalgamated Electric Corporation Limited.

the means whereby he may exercise control.

This was followed by a discussion of crossing protection systems. Here track circuits are used to detect approaching trains and start the familiar wig-wag on flashing lights.

The meeting ended with a question period. Mr. Stevenson was thanked by Mr. Steele.

Transistors—A Semi-Conductor Development

On Monday evening February 7, C. L. Roach presented an interesting discussion on "Transistors—A Semi-Conductor Development".

A short history of the development of the transistor was given. The first type developed was the point contact type which consists of two metal points a few thousandths of an inch apart bearing on a tiny wafer of germanium. Junction type transistors were then developed. These consist of a wafer of "P Type" or "N Type" germanium in close contact with a wafer of "N Type" or "P Type" respectively on either side.

P and N stand for positive and negative. P and N types of germanium are produced by introducing minute amounts of certain impurities to chemically pure germanium. P type germanium has an excess of "holes" whereas N type has an excess of electrons. A hole may be defined a point in the crystal structure normally occupied by an electron but from which the electron has been removed. Under influence of applied voltages these holes may migrate through the crystal structure. The operation of a transistor as an amplifier or oscillator was described in terms of holes and electrons.

Demonstrations were given to illustrate some of the outstanding features of transistors. One of these demonstrations showed the minute amount of power required to operate a transistor. An electric battery was made by chewing a piece of blotting paper and then inserting it between two coins. Enough power was produced by this battery to operate the transistor.

The meeting concluded with a question and answer period.

Northern New Brunswick

G. J. Melanson, jr.e.i.c.,
Secretary-Treasurer

J. O. Flower, jr.e.i.c.,
Branch News Editor

A general meeting of the Northern New Brunswick Branch was held recently in the New Florence Hotel at Campbellton, with Chairman G. A. Kirner presiding and 23 members present.

The secretary reported on the Branch's financial standing. Plans for the Annual Meeting were discussed, and it was tentatively decided to hold the June meeting at the Kent Lodge, Bathurst.

Highway Design

Upon completion of the Branch business, T. Turgeon introduced the first speaker of the evening, A. R. Bonnel, district highway engineer for Restigouche. Mr. Bonnel, whose experience includes highway engineering, wharf and general construction work in many parts of the world, gave a very interesting and instructive paper entitled "Some Problems of Highway Design in the Province of New Brunswick."

He outlined the history of road-building in New Brunswick, from the gravel roads of the early 30's to the high speed roads of today, and touched briefly on the requirements and maintenance problems of different types of roads in use today. Mr. Bonnel then gave an interesting word picture of the roads of the future, how they should be built, their particular requirements, and the financing of these new roads. He then summed up his paper with the main problem of highway design, which is to build suitable roads at lower cost. An interesting and informative discussion period followed, when problems of particular highways in New Brunswick were discussed.

Tropicol Fish

The chairman thanked Mr. Bonnel, and then called on D. C. MacCallum to introduce the second speaker of the evening, J. O. Flower of Dalhousie, who spoke on "The Care and Breeding of Tropical Fish".

Mr. Flower has been breeding tropical fish as a hobby for some time, and has over 1,000 fish of 20 varieties of his own. He gave a short history of the tropical fish hobby, and a comparison between tropical fish and goldfish, and then discussed the requirements for starting a tropical fish aquarium in the home.

Mr. Flower went on to discuss various kinds of tropical fish, and their breeding habits, illustrating his talk with oil-paintings of each of the fish discussed. An informal and lively discussion period followed. The chairman thanked the speaker, and the meeting was adjourned for refreshments.

ENERGY
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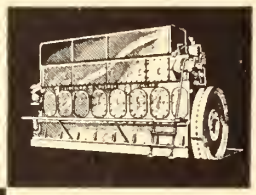
Diesel engines and gas turbines (depending on local requirements) are the most efficient forms of prime mover for the world's industries to-day and when these power units bear the name 'Ruston', with the reputation for sheer reliability, long-life and the stamina for the toughest duties, then they top the list for investigation.



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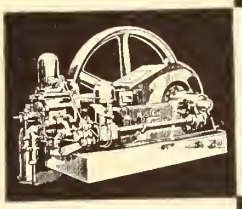

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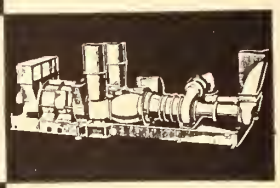

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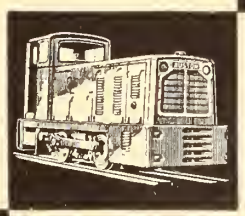

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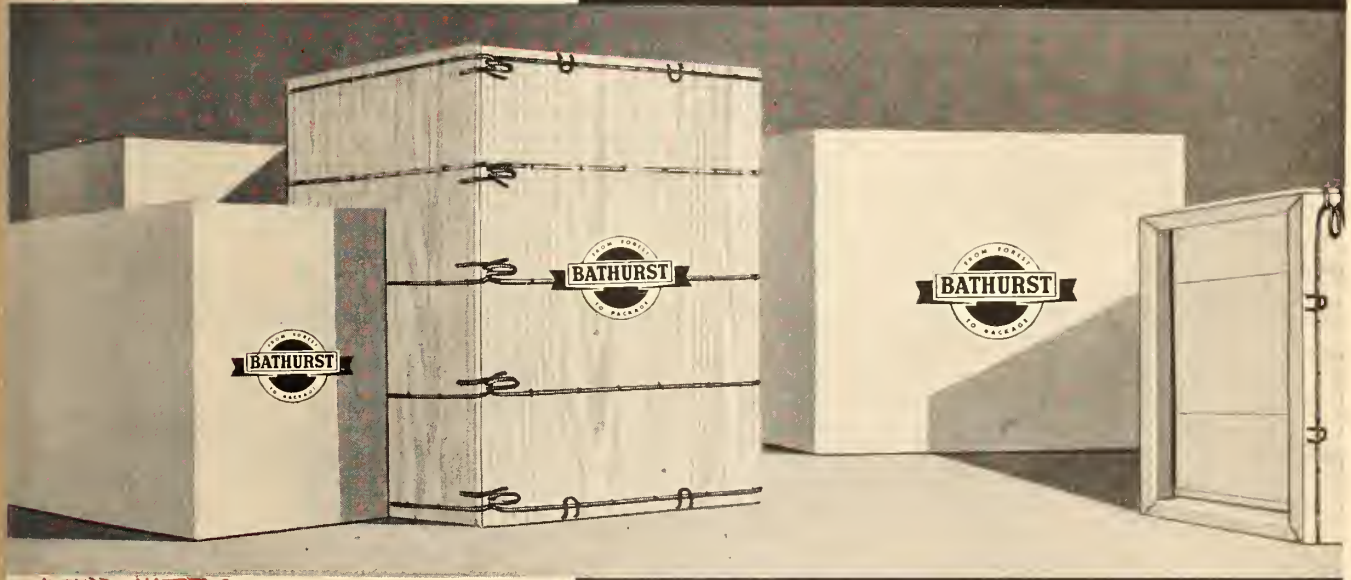

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Ottawa

GORDON A. SUTHERLAND, M.E.I.C.,
Secretary-Treasurer
CARL B. CRAWFORD, JR.E.I.C.,
Branch News Editor

Dr. S. H. Russell Guest Speaker

An illustrated talk outliuing the extraordinary precautions which must be taken when working with radioactive materials was given to the Ottawa Branch on March 10, 1955, by Dr. S. H. Russell, design division, Atomic Energy of Canada Limited, Chalk River, Ontario. Dr. Russell's topic was "Problems in Designing Radioactive Chemical Plants".

Dr. Russell compared the radioactive generator to the more conventional coal fired generator. He noted that in conventional plants the waste product is an inert ash while in radioactive plants the waste product consists of fission products which must be removed during operation. This waste material will include some useful fuel which may be reclaimed. Much research on the reprocessing of this material has taken place.

Radiation Hazard

The radiation hazard is, of course, the most difficult problem in the operation of radioactive chemical plants. Much special shielding is required to protect the operators. In the absence of shielding the operator must remain more than 1,000 feet from the furnace. It was pointed out that a 6 inch concrete shield will reduce radiation to about 1/10 of the initial value.

The design of remote control valves was used as an example of the necessity of designing against human failure. The speaker stressed that any failure in the mechanical equipment might lead to disaster. Problems in operations and in maintenance are equally important. Provision must be made to protect both people and materials from the effects of radiation.

The plant is divided into various areas in order of intensity of radioactivity. These are, in increasing order of intensity, the operating area, maintenance area, and radio active equipment area. This arrangement simplifies problems of ventilation and operation.

Dispasal Operatian

The methods of disposing of contaminated equipment and material was given special attention. In replying to several questions the speaker outlined some interesting details of the disposal operation. He noted that this was one of the most important problems under study at the present time.

The speaker was introduced by R. F. Legget, chairman of the Ottawa Branch. Head table guests included R. J. Henry, vice-president of Eldorado Mining and Refining Limited; Dr. H. Sheffer, superintendent. Defence Research Chemical Laboratories; H. W. Smith, radioactivity division, mines branch; Dr. I. E. Puddington, director, Division of Applied Chemistry, National Research Council; and F. C. York, General Manager of the Ottawa Hydro.

W/C P. F. Peter Discusses Guided Missiles

An illustrated talk of much interest on "Guided Missiles" was given to the Ottawa Branch on March 24, 1955 by Wing Commander Paul F. Peter of the armament engineering branch of the Royal Canadian Air Force.

W/C Peter explained that a guided missile is "an unmanned vehicle moving above the earth's surface whose trajectory or flight path is capable of being altered by a mechanism within the vehicle". The high performance characteristics required in terms of speed, range, accuracy and damage potential were related to the challenging engineering problems which they present.

Essential Parts

To illustrate the fundamental principles of guided missiles, W/C Peter used a short film. The four essential parts of a guided missile were shown to be the air frame, the propulsion unit, the guidance and control mechanism and the warhead. Speed ranges of the finished product vary from sub-sonic to trans-sonic to super-sonic and the aerodynamic problems in each range were discussed. Principles of operation of the solid fuel rocket engine and the liquid fuel engine were illustrated. The various methods of trajectory guidance were explaiued.

Perfarmance Characteristics

W/C Peter noted the fantastic performance characteristics that are claimed for guided missiles such as speeds of more than 200 miles a minute at altitudes than 200 miles a minute above the earth. He pointed out that these performance characteristics introduce a whole new family of engineering problems such as aero-dynamic heating, extremely high loading on structures, and the requirement of large forces to deflect control surfaces. The solution of these problems requires special materials, new structural designs and special power servo-systems. He then illustrated the need for reliability of the combination of many complicated sub-systems of the final product.

W/C Peter was introduced by the Branch chairman, Robert F. Legget, who noted with pleasure the many interests that were represented at the head table and in the audience.

Head table guests included Commodore W. G. Ross, director general of Naval Ordnance, R.C.N., Group Captain E. B. Hale, director of Armament-Air, R.C.A.F., Col. G. A. Waldock, director, Armament Development, Canadian Army.

Highway Problems in Ontaria

In a prepared talk delivered to the Ottawa Branch on April 14, 1955, W. J. Fulton, director of planning of the Ontario Department of Highways, outlined some of the problems associated with highway planning and explained the modern planning methods used by the Ontario Department.

Mr. Fulton explained the origin of Ontario's 74,000 miles of road. In 1916, the most important roads were brought into a provincial highway system and roads of lesser importance were left to the administration of the counties. In these early years modern traffic requirements were not anticipated and the main problem confronting highway engineers was the provision of a good road surface.

Contralled Access Highways

It was realized some years ago that the province would require a nucleus of controlled access highways to handle the anticipated traffic. In preparing for the construction of controlled access highways much preliminary planning was done. It was necessary to study present traffic needs and to predict future needs; to determine the necessity of by-pass highways; and to study the origin and destination of traffic. It was also necessary to study safety characteristics such as pavement width and the effect of roadside obstacles, as well as to study driver behaviour; and to study hourly, daily and monthly traffic variation. These studies proved the real need for controlled access highways.

Population Served

Since controlled access highways cost from three to eight times as much as ordinary highways the location of them is of prime importance. Population studies showed that most of the provincial population was in the south eastern and south western sections of the

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province and vehicle density was much greater in the south western section. Therefore, it was decided to build controlled access highways from Windsor to the Quebec border, from Toronto to Niagara Falls and north from Toronto to Barrie. This controlled access system will include 672 miles of highway. Part of it is built, part is under construction and the remainder is in the planning stages. An indication of the proportion of the population served directly by the limited access highway system is evident from the fact that 66 per cent of the provincial population and about 70 per cent of the motor vehicle registration is within 10 miles of the controlled access system. It is expected that the controlled access highways will attract 12 to 15 per cent of the total traffic although they include less than 1 per cent of the highway system.

The speaker was introduced by R. F. Legget, chairman of the Ottawa Branch. Head table guests included V. S. Currie of the department of planning and works, City of Ottawa; Brigadier J. P. Carrière, chief engineer, Department of Public Works; W. L. Cassels, civil engineer, Ottawa; J. L. Shearer of the Ottawa Suburban Roads Commission; and Dr. L. Austin Wright, general secretary, Engineering Institute of Canada.

Saint John

J. W. G. Scott, M.E.I.C.,
Secretary-Treasurer
G. E. Graham, M.E.I.C.,
Branch News Editor

Dr. I. R. Tait Guest Speaker

On Tuesday, April 19, 1955, the regular meeting of the Saint John Branch was held in the Royal Hotel with T. C. Higginson in the chair.

Mr. Higginson introduced the guest speaker, Dr. I. R. Tait, M.E.I.C., vice-president of the Engineering Institute of Canada. Dr. Tait, consulting engineer to Canadian Industries Ltd., spoke on "The Impact of New Plastics on Engineering".

He said that the manufacturing of plastics is a large and complicated subject. Late discoveries are finding new uses for materials which have been available for some time. Plastics are new to engineering.

Plastics are man made materials which are produced under control conditions with controlled characteristics. They can be made into many shapes readily such as films, rods, sheets, coatings, etc.

Plastics fall into two groups. Thermo plastic and thermo setting. Thermo plastics are softened by heat while thermo setting, once heated cannot be softened.

Plastics can be modified by the addition of other materials to derive new characteristics and to extend their usefulness.

History of Plastics

The history of plastics started in America about ninety years ago when John Foster Hyatt started to search for materials to replace ivory in billiard balls. Celluloid was the first of the true plastics. In 1910 a second, bake-lite, was discovered.

Plastic production has increased from six million pounds in 1922 to two billion eight hundred million pounds in 1954; 470 times as much as in 1922.

Plastics were first considered as sub-

President Visits University of Manitoba Students

(Top) President Stephens addresses the students of the University of Manitoba during the Winnipeg Branch meeting on March 23. Left to right: L. A. Bateman, Branch councillor; G. B. Williams, immediate past chairman; C. P. Haltalin, councillor; President Stephens; J. Hoogstraton, chairman; C. S. Landon, secretary; and N. S. Bubbis, Branch councillor. (Middle) Presentation of Branch Thesis Prizes. Left to right: Prof. W. F. Riddell, civil engineering; B. T. Ellis, second year; Prof. N. M. Hall, mechanical engineering; W. O. Fraser, fourth year mechanical; Prof. N. A. Williams, electrical engineering; K. J. Kramer, fourth year electrical. (Bottom) President presents E.I.C. Prize awarded to Grant Earl Sims, in absentia. Mike Schioler accepts the award on behalf of Mr. Sims.

stitutes for natural materials, but are now interesting fields in their own right. They have caused a revolution in some engineering fields.

In the future, it is expected that new techniques will develop plastics which can stand high temperature and have many new properties.

Dr. Tait was thanked for his interesting talk by A. G. Watt.

St. Maurice Valley

L. A. Pattison, Jr.E.I.C.,
Secretary-Treasurer

J. K. Murphy, Jr.E.I.C.,
W. M. Wood, M.E.I.C.
Publicity

R. A. Parsons Addresses Branch

R. A. Parsons of the Shawinigan Engineering Company was the guest speaker at the April 14 meeting of the Three Rivers Group, St. Maurice Valley Branch held in Three Rivers in the Flambeau Room, St. Maurice Hotel.

Grand Falls Potential

Mr. Parson's subject outlined his Company's investigation of the water power potential at Grand Falls on the Hamilton River in Labrador. River flow during the summer attains 140,000 cubic feet per second but the winter flow has never been determined because of severe frazil ice conditions. It is, however, thought to be about 8,500 to 10,000 cubic feet per second. The river drains an area of 30,000 square miles of very flat countryside. In the vicinity of Grand Falls, the Hamilton River drops 1,000 feet in a distance of approximately 20 miles, including a 250 foot drop at the Falls itself, and a further 250 foot drop in the rapids above the Falls.

Present thinking on the hydro development possibilities envisage the diversion of water at a point well above the rapids to a point just above the Falls by means of a series of rock cuts and low dykes. This would enable the installation to take advantage of the maximum possible head. The investigation included a study of the underlying rock strata of the region which is mostly granite and gneiss.

Expedition Organized

The warm season in this area is only four months long, beginning about June 1 and ending about September 30. As a result, the expedition had to be very carefully organized and most supplies brought in during the month of April, with an Advance Party arriving early in May to set up camp sites and distribute the supplies. Thus, when the Main Party arrived on June 1, they were able to begin work almost at once. All supplies were flown in in Beaver aircraft from Seven Islands to which point they had been shipped by railway. Transportation around the site was done mostly by helicopter but sometimes by canoe. Use was made of notes made by explorers of the region many years ago, and although they were sketchy in many respects they were still of great value in speeding up the work.

The party had a 100-watt transmitter for communications and by means of this it was possible to contact Montreal within a few minutes during good weather.

Vegetation and Animal Life

Although average temperatures are only about 10 F. below those prevailing in the St. Maurice Valley, vegetation is rather sparse consisting mainly of stunted spruce and caribou moss with a very small poplar here and there. Animal life includes mostly caribou, bears and several small animals, and the rivers and lakes contain speckled trout and Ouananiche, with a good number of whitefish in the Hamilton River itself.

Mr. Parsons concluded his speech by showing colour slides of Grand Falls, the camp sites, the Hamilton River watershed and the surrounding countryside, and he also exhibited samples of the wood and rock in this area. The speaker was thanked by Nesbit Gray and introduced by A. T. Farmer, both of the city of Three Rivers.

Sudbury

A. D. Finlayson, Jr.E.I.C.,
Secretary-Treasurer

A. Eldridge, M.E.I.C.,
Branch News Editor

Members' Night

Thursday, March 24, was members' night at the Sudbury Branch and a dinner meeting was held at the Sudbury Granite Club. The Branch chairman, Frank Orange, announced that Russ Eaton, the representative on the Council, had been named chairman of the Nominating Committee of the Institute; also, that the next meeting would be the annual meeting.

The first member to present a paper was George Green of the Imperial Oil Company, who spoke on "Recent Developments of the Petroleum Industry". Mr. Green first gave a history of the development of oil and of motivation. The first method of refining was the batch still which was followed by the pipe still giving better control. The modern method is with the fractionating tower where cracking results in several thousand compounds. Considerable detail was given on the catalytic cracking process.

The gasolene commonly used is a blended mixture balanced to meet specifications which, in turn, are not static. Various balances are possible and the octane number is found by the co-operative fuel research engine. Mr. Green then described the methods of testing gasolene mixtures and some of the problems of octane requirements. The gas turbine engine, of course, will change the octane picture considerably.

Mr. Green closed with a short discussion on the gas pipe line.

Rural Electrification

The second member to present a paper was Jim Twiss who addressed the meeting on "Rural Electrification".

In Ontario rural electrification has had a comparatively slow development until recently. However, with interconnected power sources and suburban development this has now been changed. In the past nine years the number of people served has increased from 140,000 to 390,000 and this number should increase as farmers realize more and more the value of power to them.

The speaker gave a summary of some of the devices now used or being developed. For example there are flood-lights for yards, lights for poultry houses, germicidal and ultra-violet for research on greenhouses and pest control. In the field of heat there are indoor crop curing and the growing of off-season vegetables. Irrigation, fans, tools, etc. require electric motors. There is a broad field for development and Mr. Twiss felt that electrification in the future would bring unlimited changes to farming.

There was an extensive question period for both papers and the speakers were then thanked by Al Cameron.

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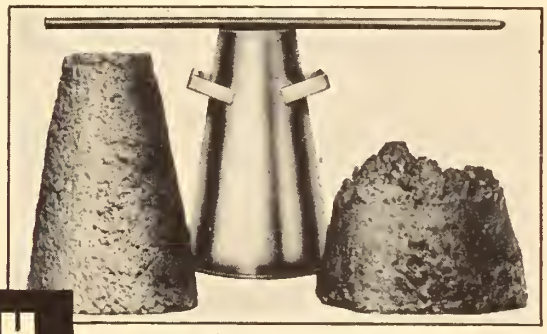

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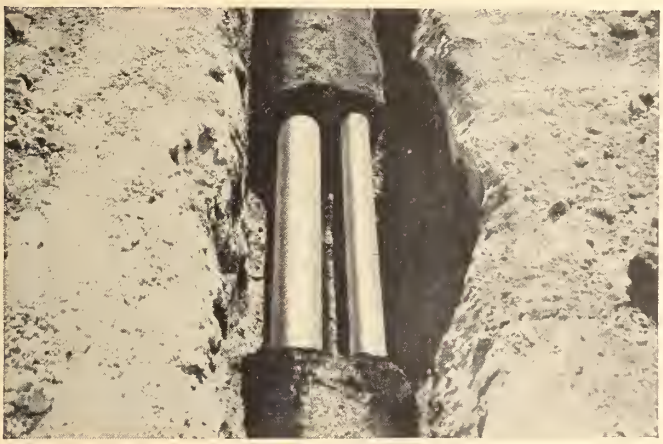

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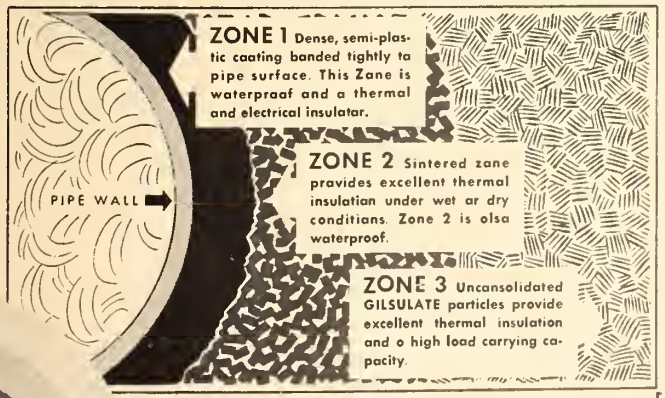

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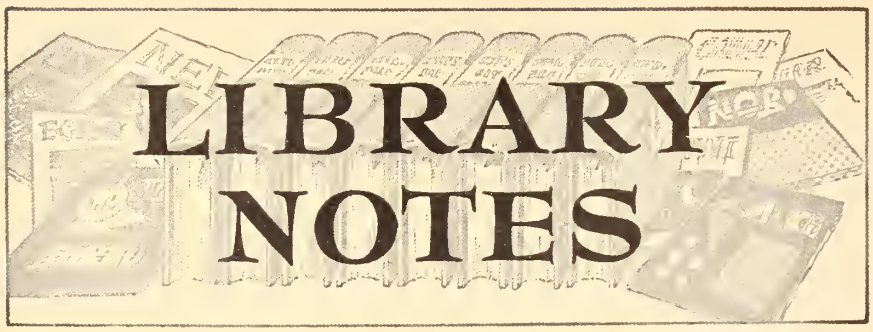

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Your local government: a sketch of the municipal system in Canada. D. C. Rowat. Toronto, Macmillan, 1955. 148 pp., $2.50.

The author of this book on local government, although a political scientist, has written in a non-technical manner for the layman.

He outlines the history and present operation of Canadian local government, with the idea of showing what it should do, and whether it is best organized to carry out its functions. As George S. Mooney, the Director of the Canadian Federation of Mayors and Municipalities points out in his introduction, democracy is based in the last analysis on a firm and stable system of municipal government, and it is the responsibility of Canadians to keep this base strong.

In his first chapter, the author traces the history of municipal government in Canada, which, as he points out, is a very short history. Saint John was the first town to obtain self-government, this being in 1785, but it was not until the 1830's that any further grants were given.

In the following chapters are outlined the various types of municipal government, their composition, functions, and finances.

The problem of centralization is dealt with, and the author raises the question of just how many of the municipal functions should be taken over by provincial or even federal agencies. He points out that while provincial control and agencies may be efficient, there is often not the slightest doubt that more effective results are obtained by municipal authorities managing local affairs.

The author brings forward many other problems, including those of the too small municipality, provincial grants, taxation etc.

Anyone interested in municipal affairs should read this enlightening book, which will surely also create an interest in the subject where there has previously been none. —S.C.

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BOOK NOTES

Prepared by the Library The Engineering Institute of Canada

* Review provided through the courtesy of the Engineering Societies Library in New York.

Abstracts of the literature on semiconducting and luminescent materials and their applications, 1953.

Sponsored by the Electrochemical society, comp. by Battelle memorial institute. New York, Wiley, 1955. 169 pp., spiral binding, $5.00.

In this bibliography the principal source of references has been the abstract journals, although the entire publication has been reviewed where possible. In the case of some foreign references no abstract was available. Unpublished papers given at society meetings are also included.

The bibliography is arranged by materials: germanium; silicon, carbon and diamond, oxides, sulfides, halides, organics, etc., and applications are always made a subheading under the material concerned, for example, transistors are found under germanium. The last section lists references on Semiconductor theory.

Subject and author indexes are also included.

Advanced mathematics for engineers, 3rd ed. H. W. Reddick and F. H. Miller. New York, Wiley, 1955. 548 pp., diagrs., $6.50.

In this new edition there have been changes made in the text and in the number and types of problems presented. Among the important additions are two articles on numerical methods for solving ordinary and partial differential equations, an account of Legendre's equation and a section on Laplace transforms and their applications.

As in previous editions the introductory chapter discusses the common types of ordinary differential equations. This is followed by a comprehensive treatment of operational calculus, Fourier series, partial differential equations, vector analysis, elliptic integrals, gamma and Bessel functions, and functions of a complex variable.

The emphasis continues to be on physical applications by including, with each main topic, problems relating to the four major fields of engineering: civil, mechanical, electrical and chemical. Answers are given to all the problems.

Definitions, statements of physical laws, theorems, problems and the physical units used are presented in a precise and clear-cut manner.

***Agricultural process engineering.** S. M. Henderson and R. L. Perry. New York, Wiley, 1955. 402 pp., illus., $8.50.

Engineering elements of the following unit operations, processes, devices, and procedures are treated: size reduction; cleaning and sorting; drying and dehydration; concentration by evaporation; refrigeration; mixing; materials handling; air conditioning; steam generation and use; heat transfer; pumps and fans; plant layout; work simplification; and instrumentation.

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Aide-mémoire Dunod électrotechnique générale, 4e éd. Maurice Denis-Papin. Paris, Dunod, Montreal, Fomac, 1955. 178 pp., diagrs., $2.25.

This pocket reference work covers the general applications of electricity.

The information is grouped under six headings including electrostatics, magnetism and electromagnetism, d.c. dynamos and motors, etc. The seventh section supplies physical definitions and formulae, and the eighth gives illustrations of wiring for motors and domestic and industrial apparatus.

This material is further supplemented by mathematical definitions and a variety of tables of general use.

All is well indexed.

Aide-mémoire Dunod mathématiques générales, 5e éd. Maurice Denis-Papin. Paris, Dunod, Montreal, Fomac, 1955. 2 vols., $2.25 each vol.

This general reference work on mathematics is divided into two volumes.

Volume one deals with algebra, geometry, trigonometry, analysis, and the calculation of probabilities. Analytical geometry, calculus, and tables of functions are covered in the second volume to which is appended a section giving general physical and mathematical data.

The work contains a bibliography and is well-indexed.

Aide-mémoire Dunod métrologie générale. Maurice Denis-Papin et Jacques Vallot. Paris, Dunod, Montreal, Fomac, 1955. 2 vols., diagrs., $2.25 each vol.

The two volumes in this reference work contain information on dimensions, units and symbols connected with general metrology. The authors make frequent use of mathematical equations, formulas and tables. Volume I is of a general nature while the second volume deals with electrical and magnetic units, thermal and optical units and others such as acoustical units. An interesting section at the end of this volume describes the metrology of ancient times and measurements used in foreign countries.

American men of science: a biographical directory, 9th ed. **v. 1 Physical sciences.** Jacques Cattell, ed. New York, Bowker, 1955. 2180 pp., $20.00 (U.S.).

In keeping with the trend of the present age the number of prominent men engaged in scientific fields has expanded enormously. An outstanding indication of this fact is illustrated in the appearance of the newest edition of the biographical dictionary, "American Men of Science", founded in 1906. Since the publication of the 8th edition the number of entries has increased by 50% in each category so that, for the first time, the dictionary appears in three volumes. Volume 2, listing those connected with the Biological sciences, and volume 3, covering the Social sciences, will appear in 1955 and 1956, respectively.

The present volume contains the names of all living Americans and Canadians who have contributed to the advancement of these divisions of the physical sciences: physics, mathematics, chemistry, biological chemistry, meteorology, oceanography, optics, acoustics, and research engineering. The biographical sketches include the scientist's full name, position, education, professional background, special fields of research, membership in professional societies, birth date, marital status and number of children. There are over 44,000 scientists listed, including 15,000 who did not appear in previous editions.

This valuable new edition will be of the utmost assistance to administrators in science and industry, newspaper editors, librarians and many others.

***Analysis of statically indeterminate structures.** J. I. Parcel and R. B. B. Moorman. New York, Wiley, 1955. 571 pp., diagrs., $9.50.

A more extensive treatment than usual is accorded the subject in order to make the book useful to practicing engineers as well as undergraduate and graduate students. The first part of the book is a detailed exposition of basic theory, covering deflections by the method of work and by special methods; slope deflection; and moment distribution, including the new method of moment distribution in which sidesway takes place automatically as joints are balanced in the normal rotation process. The second part of the book deals with applications of theory to continuous girders and trusses, frames, arches, and suspension bridges. Numerous worked out examples are given.

***Automatic voltage regulators and stabilizers.** G. N. Patchett. Toronto, Pitman, 1954. 335 pp., illus., 50/-.

The subject is broadly defined to cover any device for maintaining automatically a constant or predetermined voltage at some point, whether on large power systems or in small electronic appliances. The three sections of the book deal with principles, electromechanical regulators, and regulators with electric and electronic circuits only. Both continuous and discontinuous types are treated. Over six hundred references are listed at the end of the text.

Cams: design and layout. Louis Kasper. New York, Chemical publishing company, 1954. 101 pp., diagrs., $3.50 (U.S.).

The author of this little book claims that it avoids the usual extremes of being too complicated or of lacking in detail. The examples of design and layout discussed cover all those cases which occur frequently in industrial uses of cams.

Following two general chapters there are sections on reciprocating, rotating and cylindrical cams, wiper cams, rocker cams and rolling levers, rectangular-motion cams and sleeve cams.

The book may serve as a reference work, or as a manual of cam design and layout.

Circuits and networks. Glenn Koehler. Toronto, Macmillan, 1955. 349 pp., diagrs., $6.50.

The author has based this textbook on his experience in teaching a course in circuits and networks. It is assumed that the reader is already familiar with the theory of alternating current.

Some of the topics covered are network theorems, properties of simple frequency selective circuits, fillers, attenuators and equalizers, transmission lines, and transformers and reactors. In these last chapters especially the author has tried to show that certain of the basic fundamentals of circuits and networks are applicable to the fields of both communications and power.

Problems are included, as well as references for further reading on topics not fully covered in the text.

Conversion factors and tables, 2nd ed. O. T. Zimmerman and Irvin Lavine.

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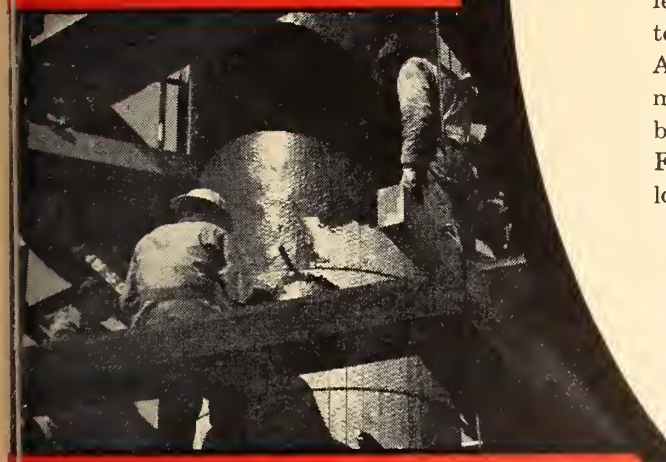

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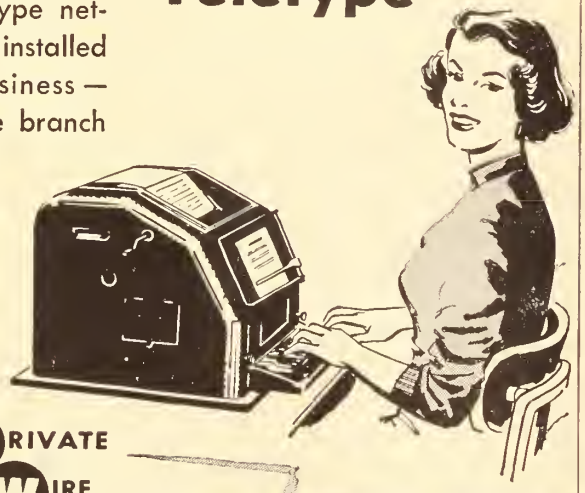

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Dover, Industrial research service, 1955. 501 pp., $5.50 (U.S.).

This second edition of this almost pocket-sized book is nearly twice the size of the first edition which appeared in 1944.

Half of this useful book is devoted to conversion factors for United States, British and Metric units. The material is arranged alphabetically, and ranges from Abamperes to Years (sidereal). One new section is devoted to foreign conversion factors, in which the information is grouped by country. There are conversion tables for such things as temperatures, pressure, viscosity, and hardness. Many of these tables are new with this edition.

The design of cylindrical shell roofs. J. E. Gibson and D. W. Cooper. Toronto, British Book Service, 1954. 186 pp., illus., $6.00.

The authors' aim has been to clarify the method of designing shell roofs. While they present the necessary mathematical theory the emphasis is on the use of the derived equations.

After a general treatment of the theory of cylindrical shells the text follows through the complete problems raised by specific types, with and without edge beams. Only a simple long shell is designed completely, but the extension of the method to the design of multi-shells should follow automatically from the listed design equations. The last three chapters discuss the design of reinforcement for shells, matrix operation, and general shell theory and multi-shells. An important section concerns the theory of prestressed edge beams, a recent and important development in the field of cylindrical shell roofs.

Elements of food engineering. v. 2 Unit operations—1; v. 3 Unit operations—2. M. E. Parker, E. H. Harvey and E. S. Stateler. New York, Reinhold, 1954. v. 2: 360 pp., illus., $8.50 (U.S.); v. 3: 241 pp., illus., $6.75 (U.S.).

Volumes 2 and 3 of this book were originally intended to be one but were divided because of the great amount of text needed to describe the unit operation in food engineering. Because of this fact they present a unified, coordinated discussion of unit operations grouped according to specific function.

Volume 2 discusses those operations involved in assembling, preparing and converting raw materials. The section on assembly of raw materials contains a chapter on materials handling which is subdivided into harvesting, transporting, receiving and the engineering aspects of materials handling, and a chapter on the separating and grading of materials.

The five chapters devoted to the preparation of raw foodstuffs describe such unit operations as cleaning, separating, disintegrating and pumping.

Such aspects of raw material conversion as mixing, heating and refrigeration conclude Volume 2.

This discussion of conversion is continued in Volume 3 with the operations involving evaporating and distilling, dehydration and drying, and controlling of the raw materials.

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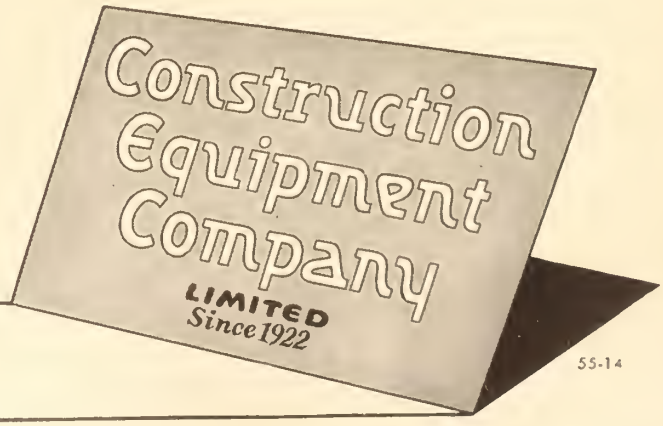

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cerned with the treatment of final products. One chapter describes coating, decorating and forming methods, while the concluding chapters cover the packaging of solid and liquid foods and the machinery used in packaging.

Flexure devices; pivots, movements, suspensions: a bibliographical survey. P. J. Geary. London, British scientific instrument research association, 1954. 44 pp., diagrs., 10/6.

This is the first of a series of bibliographical surveys on instrument parts and covers the period from 1900 to date. It includes references to flexure pivots, parallel movements, twin strip mechanisms, buckling strip devices and the sine spring. The introduction indicates the advantages and limitations of these devices. There are digests of 28 selected texts of major importance and annotated lists of 128 other texts of lesser importance.

Géologie des barrages et des aménagements hydrauliques. M. Gignoux and R. Barbier. Paris, Masson, 1955. 344 pp., illus.

Intended for both engineers and geologists, this book shows how the roles of each are related in the construction of dams.

The authors give numerous examples of the geological problems posed in designing dams, discussing actual structures, most of which are located in south-east France or North Africa. There is an alphabetical index to these dams.

Among topics covered are topographic conditions, earth movements, rock foundations, diversion tunnels, underground water supply, and borings.

There is an extensive bibliography, most of the books and articles included being in French. The book is illustrated with photographs, diagrams and maps.

Graphic representation. Eugene Paré, Frank Hrachovsky and Eliot Tozer. Toronto, Macmillan, 1954. 35 pp., $3.60.

This manual of graphics problems was class-tested for two years at the Illinois Institute of Technology and at Northeastern university. Not intended for use in the training of professional draftsmen, it was prepared for students whose education should include a knowledge of graphics as the universal language of scientists and engineers.

The problems cover essentials of multiview drawing, pictorials and drawing techniques where emphasis is placed on freehand technique and blueprint analysis. There is a unique coverage of the graphic presentation and interpretation of data as visual aids in scientific and business analysis reports. Some problem sheets stress the use of the geometric method as a separate analytical tool while others show it as a device to supplement the mathematical method in order to make scientific statistics more valuable.

Kempe's engineer's year-book for 1955, 60th ed. B. W. Pendred and C. E. Prockter, eds. London, Morgan, 1955. 2 v., diagrs., 75/-.

Since there was a complete revision of the 1954 edition of Kempe's year-book the changes in the present edition are of a more minor nature. There is additional information about shell moulding in the chapter on Foundry practice; about geared couplings in the section on Shafts and couplings; and about preparing rolls in the chapter on Forging hammers. The chapters on Electronic engineering, Explosives, and Flow metering and mechanical testing have been enlarged a certain amount.

The year-book remains a standard reference work in all branches of engineering.

The Macmillan world gazetteer and geographical dictionary, ed. by T. C. Collocott and J. O. Thorne. Toronto, Macmillan, 1955. 792 pp., $6.95.

The editors of this gazetteer have used their own judgment and sense of usefulness rather than any set criterion in selecting the entries to be included. Thus while all the continents and every country in them are described in terms of their physical structure, administrative and economic setup, size, history, etc., the cities, towns and topographical features of the world covered are those which are most likely to interest the English-speaking population. The length and details of coverage are also governed by this interest.

Most entries are fairly short and there is an almost excessive amount of abbreviation used but this is necessary in a one-volume geographical dictionary. Alternative names and foreign equivalents as well as pronunciation are given after the main entry. An important part of the gazetteer is the Supplementary Index where are gathered cross-references in the form of variant names or alternative spellings plus a large number of brief items which are not found in the main text.

Articles on climates, currents, winds, and volcanoes will interest meteorologists and geologists.

In concluding we note that the editors listed the population of Montreal as less than that of Toronto, evidently they have fallen victim to propaganda!

Magnetic amplifiers. H. F. Storm. New York, Wiley, 1955. 545 pp., illus., $13.50.

One of a series written by General Electric Company specialists this volume discusses the static type of magnetic amplifiers and is concerned mostly with single-phase amplifiers. Material is arranged in logical sequence, beginning with the ordinary saturable reactor and progressing to such higher forms as the self-saturated magnetic amplifier.

There are chapters devoted to the related fields of a modern theory of magnetism, characteristics of magnetic materials, magnetic testing, manufacture of saturable reactors, and properties of metallic rectifiers. There is also a section describing peaking transformers, voltage stabilizers, nonlinear resonance circuits, and reactors for large mechanical rectifiers. Six chapters cover the applications of magnetic amplifiers from the earliest to the latest fields.

Magnetic amplifiers are represented in servo-block diagram form, suitable for immediate integration into a servo system.

The problems involved in a study of this subject are here approached from fundamental, physical principles, avoiding mathematical complexity. The book was written for practicing electrical engineers and senior students of electrical engineering.

Problems of business management: American opinions; European opinions. Organization for European economic co-operation. Toronto, Ryerson, 1954. 85 pp., $0.75. (Technical assistance mission No. 129).

This little publication originated in a conference of representatives from nine European countries and four American experts who had previously visited Europe to discuss the problems of top management. These four general topics were the basis for the talks: top management attitudes, subordinate management training, market research and human relations. This is an analysis of the full report which has been published in a limited edition.

Proceedings of a symposium on concrete shell roof construction, held 2-4 July, 1952. P. J. Witt, ed. London, Cement and concrete association, 1954. 258 pp., illus., 30/-.

Because of the variety of professional men attending this Symposium—architects, engineers, contractors, and mathematicians—and the international representation, these proceedings will hold an important place in the literature of concrete shell roof construction.

The book is divided into three main subjects: the architectural aspects; design and research; construction and framework. The architectural subjects include domes, vaults and the development of shell roofing. The design and research section contains articles on existing methods for the analysis of concrete shell roofs, flexibility coefficient methods and their application to shell design, and the combination of shells and prestressing. The economic aspect of design and construction is discussed as well as details of specific structures.

A valuable part of the book is the extensive bibliography on all aspects of shell roofs, arranged chronologically, and covering the period 1828 to 1954.

* **The radio amateur's handbook,** 32nd ed., 1955. West Hartford, American radio relay league, 1955. 768 pp., illus., $3.50.

A standard reference manual covering the entire field from basic theory to practical constructional details, and including comprehensive and up-to-date vacuum-tube data tables. This edition, revised in the light of recent developments, contains new information on VHF radio transmitters and a considerable amount of new tube data. A large catalog section features the equipment of leading manufacturers.

References on fatigue, 1953. Philadelphia, A.S.T.M., 1954. 34 pp., $1.85 (U.S.) (A.S.T.M. special technical publication No. 9-E).

Some 250 references to articles published in 1953 dealing with fatigue of structures and materials are listed in this publication. Brief abstracts of the articles have been included when readily available. It is not an exhaustive list but is extensive enough to be of interest to those working in this field.

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ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES

By JOHN I. PARCEL, Consulting Engineer, and ROBERT B. B. MOORMAN, Syracuse University.

Presents the most complete account of the basic theory of deflections and statically indeterminate structures available in English today; then offers the practical and authoritative coverage of the problems structural engineers face. Design office procedures are used to solve problems in continous girders, frames, arches, secondary stresses, and suspension bridges.

1955 571 pages. 431 illustrations. $9.50

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By J. H. WESTING and I. V. FINE, both of the University of Wisconsin, and Members of the Milwaukee Association of Purchasing Agents, associated with the National Association of Purchasing Agents.

This important book covers the fundamental principles and policies of industrial purchasing and the broad procedures of current practice, a much-needed addition to the literature in this underdeveloped field. The book's authorship, divided between teachers and executives actively engaged in the field, ensures an ideal balance between business experience and academic analysis. Features highly useful innovations such as chapters on traffic, public relations, and management of purchasing personnel. Presents material not previously available.

1955 421 pages. Illustrated. $7.50

PRINCIPLES OF ELECTRIC UTILITY ENGINEERING

By CHARLES A. POWEL, The Massachusetts Institute of Technology.

This book provides a complete, concise coverage of the *entire* electrical utilities field from corporate structures to government controls; and from sources of energy and transmission to financial returns. Written by an author with 43 years of experience in all phases of power engineering and based on a course of lectures at The Massachusetts Institute of Technology.

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ENOUF PUBLISHING CO., Montreal, Que.

UNIVERSITY OF TORONTO PRESS Toronto, Ont.

References are arranged in the form of catalogue cards which can be cut apart for filing according to any desired plan.

Safety in industry: an introduction to the protection of personnel. D. J. Macfarlane. London, Iliffe, 1955. 71 pp., illus., 7/6.

The articles in this book originally appeared in MACHINE SHOP MAGAZINE, and present an introduction to the subject.

Topics covered are the control of dust and fumes, the dangers of rotating machinery, and the need for guards on them, and on presses. Skin diseases and the protection of the eyes are considered, and other chapters cover protective clothing, and the importance of good lighting and flooring.

The many illustrations increase the interest and value of this little book.

* **Shell molding and shell mold castings.** T. C. Du Mond. New York, Reinhold, 1954. 128 pp., illus., $2.00 (U.S.).

A concise survey of how the process works and the advantages to be obtained from its use, made to enable the potential user to evaluate the method and to determine where such castings can best be used. Consideration is given to cost designing, comparison with other processes, equipment, materials, and applications. A brief bibliography is appended.

The statesman's year-book for 1954, 91st ed. S. H. Steinberg, ed. Toronto, Macmillan, 1954. 1608 pp., $6.75.

It is always a rather startling experience to examine a new edition of the Statesman's year-book and realize anew the vast amount of information which it contains. From the maps and comparative statistical tables of population, resources and production at the front of the book to the diplomatic representatives of Yugoslavia at the end there is a wealth of data on all countries of the world.

An important section is devoted to the make-up of the main international organizations. Geographically the year-book is divided into the British Commonwealth and Empire, the United States, and other countries listed alphabetically. Each country is described in terms of constitution and government, area and population, religion, education, social services, finance, production, industry and commerce, money, weights and measures. Books of reference on each nation are also included.

* **Storage batteries,** 4th ed. G. W. Vinal. New York, Wiley, 1955. 446 pp., illus., $10.00.

A comprehensive and up-to-date treatment of scientific principles, materials of construction, manufacturing processes, theory of reactions, operating principles, and important industrial applications. In this edition obsolete material has been eliminated, all chapters have been revised, and some parts entirely rewritten in order to include information on such changes in the industry as improved lead alloys, increased use of plastic containers, American production of nickel-cadmium batteries, and many other important topics. The bibliographies which are given after some of the chapters have been brought up to date.

* **Transitors: theory and applications.** Abraham Coblenz and H. L. Owens. Toronto, McGraw-Hill, 1955. 313 pp., illus., $7.20.

The basis of this volume is a series of articles published in ELECTRONICS, March 1953—January 1954, now considerably revised and expanded for book publication. In its present form it provides an essentially practical treatment of transistors, showing principles of operation, how they are made, and how they are applied in electronic circuits. Theory is presented with a minimum of mathematics and with emphasis on applications, and information is included on manufacturing processes, testing, and use of both silicon and germanium transistors. Chapter bibliographies are provided.

The world almanac and book of facts, 1955. Harry Hansen, ed. New York, World-Telegram, 1955. 896 pp., $1.10 (U.S.).

As most readers know the World almanac covers events in the United States in particular and those occuring throughout the world which are of international interest and which affect the American citizen.

Facts about the American government and its leaders, the work of Congress, results of elections, and internal security measures against subversive elements are useful to many Canadian users of the Almanac. The section on sports is a popular one and there is also information on religious festivities, cost of living, publishing highlights, medicine, theatre, radio and television. Colleges and universities, associations and societies, foundations and art galleries are listed.

Of wider interest are the reports on the Korean war, the structure of the United Nations and marine disasters since 1855.

This fascinating book is a must for any bookshelf.

BOOKS RECEIVED

Angewandte Nomographie, Teil I. Fritz Kiessler. Essen, Girardet, 1952. 135 pp., illus., 18 DM.

Basic electronics. Van Valkenburgh, Nooger & Neville, Inc. New York, Rider, 1955. 5 volumes, illus., $2.00 (U.S.) per vol., $9.00 (U.S.) per set.

Baumaschinen-Wartung. Heinrich Ilsemann. Berlin, Ernst, 1955. 86 pp., illus., 9.80 DM.

Behavior of metals under impulsive loads. J. S. Rinehart and John Pearson. Cleveland, American society for metals, 1954. 256 pp., illus., $5.50 (U.S.).

Big dam foolishness; the problem of modern flood control and water storage. E. T. Peterson. New York, Devin-Adair, 1954. 224 pp., illus., $3.75 (U.S.).

The Canadian who's who, v. 6, 1952-1954. Toronto, Trans-Canada press, 1954. 1175 pp., $27.00.

Control-system dynamics. W. R. Evans. Toronto, McGraw-Hill, 1954. 282 pp., figs., $7.00.

Cours d'électrotechnique; 3ième partie. Centrales réseaux, applications diverses. Edgar Gillon. Paris, Dunod, Montreal, Fomac, 1954. 568 pp., illus., $16.20.

Cours de résistance des matériaux. J. Courbon. Paris, Dunod, Montreal, Fomac, 1955. 782 pp., illus., $29.60.

Design of machine elements, 3rd ed. V. M. Faires. Toronto, Macmillan, 1955. 550 pp., illus., $7.50.

Deterioration of materials; causes and preventive techniques. G. A. Greathouse and C. J. Wessel, eds. New York, Reinhold, 1954. 835 pp., illus., $12.00 (U.S.).

Development of the guided missile, 2nd ed. K. W. Gatland. London, Iliffe, 1954. 292 pp., illus., 15/-.

Elasticité et anélasticité des métaux. C. Zener. Paris, Dunod, Montreal, Fomac, 1955. 174 pp., figs., $10.25.

Electric power stations, v. 1, 4th ed. T. H. Carr. Toronto, British Book Service, 1954. 605 pp., illus., $12.00.

The elements of probability theory and some of its applications. Harald Cramér. New York, Wiley, 1955. 281 pp., $7.00.

A history of mechanical inventions, rev. ed. A. P. Usher. Cambridge, Harvard university press, Toronto, Saunders, 1954. 450 pp., illus., $11.75.

How to install TV antennas. S. L. Marshall. New York, Rider, 1955. 124 pp., illus., $2.50 (U.S.).

Industrial dust; hygienic significance, measurement, and control, 2nd ed. Philip Drinker and Theodore Hatch. Toronto, McGraw-Hill, 1954. 401 pp., illus., $12.50.

Manufacture and application of lubricating greases. C. J. Boner. New York, Reinhold, 1954. 977 pp., illus., $18.50 (U.S.).

Materials of construction; their manufacture and properties, 6th ed. A. P. Mills, H. W. Hayward, and L. F Rader. New York, Wiley, 1955. 650 pp., illus., $7.50.

Métallurgie structurale théorique. A. H. Cottrell. Paris, Dunod, Montreal, Fomac, 1955. 330 pp., figs., $11.00.

Pathologie et thérapeutique du béton armé, 2ième éd. Henry Lossier. Paris, Dunod, Montreal, Fomac, 1955. 156 pp., illus., $4.00.

Picture book of TV troubles; v. 2 Vertical sweep & deflection circuits. John F. Rider laboratory staff. New York, Rider, 1955. 91 pp., illus., $1.80 (U.S.).

Professional engineering registration laws; a compendium. A. L. McCawley, comp. Washington, National society of professional engineers, 1954. 614 pp., $8.75 (U.S.).

A professional look at the engineer in industry. Engineer-in-industry committee. Washington, National society of professional engineers, 1955. 124 pp., $3.00 (U.S.).

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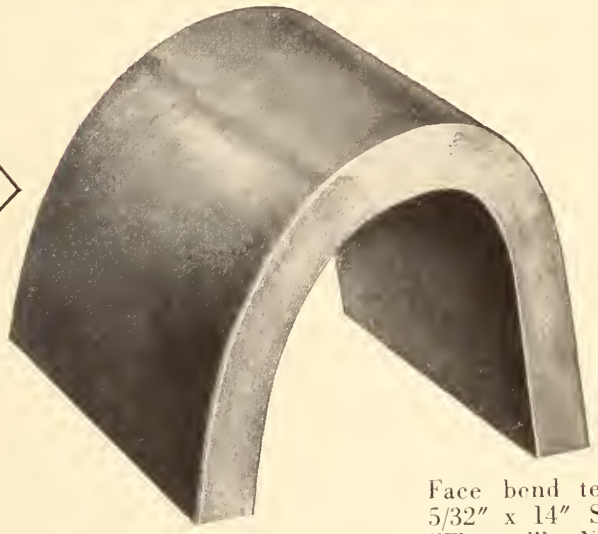

Face bend test, using 5/32" x 14" Stelco 624 "Electrod". Note crack-free appearance.

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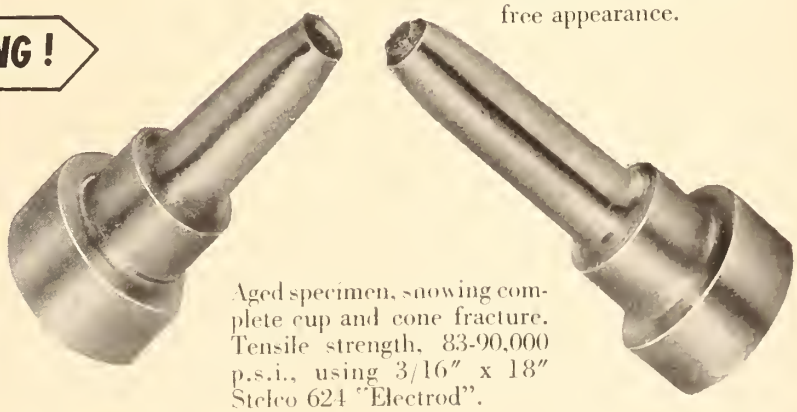

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Profitable small plant management. M. H. Gotterer. New York, Conover-Mast, 1954. 318 pp., illus., $5.50 (U.S.).

Steel designers' manual. C. S. Gray and others. London, Crosby Lockwood, 1955. 909 pp., figs., tables, 50/-.

The TVA; an approach to the development of a region. G. R. Clapp. Chicago, University press, Toronto, University press, 1955. 206 pp., map., $3.50.

Tape recorder manual, v. 1, 1950-1954. John F. Rider laboratory staff. New York, 1955. 286 pp., illus., $4.50 (U.S.).

Théorie et pratique du séchage industriel, 6ième éd. Paul Razous. Paris, Dunod, Montreal, Fomac, 1955. 322 pp., illus., $11.00.

Time-saver standards, 3rd ed. Architectural record. New York, Dodge, 1954. 888 pp., illus., $12.50 (U.S.).

Titanium in iron and steel. G. F. Comstock. New York, Wiley, 1955. 294 pp., illus., $6.00.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

American society for testing materials, Papers: Symposium on color of transparent and translucent products.

American society for testing materials. Special technical publications:

STP No. 159—Symposium on radioactivity; an introduction.

STP No. 165—Symposium on effect of cyclic heating and stressing on metals at elevated temperatures.

American water works association. Tentative standard specifications:

B703-54T—Fluosilicic acid. C602-54T—Cement-mortar lining of water pipelines in place—sizes 16 in. and over.

British electrical and allied industries research association. Technical reports:

No. A/T141—Behaviour of cellulose acetate films under tropical conditions, by N. J. L. Megson and V. E. Yarsley. No. G/T288—Airblast circuit breakers. A statistical study of the variation in performance in repeat tests of a single-break experimental unit with axial blast, by F. O. Mason. No. G/T293—The effect of series resistance on the characteristics of capacitive spark discharges, by H. G. Riddlestone. No. L/T311—Altitude correction factors for sparkover voltages of insulators and rod gaps, by A. M. Thomas. No. L/T313—Nomograms and line charts for humidity correction factors applicable to flashover tests on insulators, by A. M. Thomas. No. S/T61—Blowing of fuses in distribution systems during thunderstorms, by J. L. Miller.

Canada. Department of mines and technical surveys. Geographical branch. Memoirs:

No. 2—The boundaries of Canada, its provinces and territories, by N. L. Nicholson.

Canada. National research council. Division of building research:

Strain measurements on the temporary road deck for the Toronto subway, by W. R. Schriever. (Research paper No. 14).

Acoustical factors in architectural design, by T. D. Northwood. (Technical paper No. 23). Government sponsored research—a Canadian view, by R. F. Legget.

Canada. Department of public works. Dominion fire commissioner's office. Reports:

Statistical report of fire losses in Canada, 1953.

Canadian automobile chamber of commerce:

Facts and figures of the automobile industry, 1954 edition.

Engineers council for professional development:

Twenty-second annual report, 1954.

Institution of mechanical engineers. Advance papers:

Report on investigation into the failure of two 100-MW. turbo-generators, by Sir Claude Gibb.

Metropolitan water district of Southern California:

Sixteenth annual report, 1954.

National fire protection association. Proposed standards:

No. 31-PR5—Installation of oil burning equipment.

Ottawa, Ontario:

Centenary of Ottawa, 1854-1954.

Tin research institute:

Some recent advances in tinplate manufacturing processes, by W. E. Hoare.

United States. Highway research board. Bulletins:

No. 96—Load-carrying capacity of frost-affected roads.

STANDARDS REVIEWED

British standards, British standards institution, 2 Park Street, London, W.1. British standards are available from the Canadian standards association, National research building, Ottawa, Canada.

B.S. 2051: part 4:1954—Steel nipple pipe fittings for brazing. 4/-.

This standard provides for the complete dimensional standardization of steel nipple fittings for brazing, of sizes from ⅛ in. to 1½ in. inclusive, meant for use with fractional outside diameter sizes of tubes. Unified threads and unified hexagons have also been specified for these fittings.

It also states requirements regarding materials, dimensions, workmanship, hydraulic test, test for porosity and identification marking, and also gives maximum design pressure for these fittings.

Illustrations of fittings and tables of dimensions are also provided.

B.S. 2519:1954—Glossary of terms and notation for toothed gearing. 6/-.

This glossary provides definitions for terms commonly used in all applications of toothed gearing. It also gives a standard notation which includes the symbols required for use in the theory and practice of gear engineering. Terms and definitions are grouped in eight sections and there is a complete index.

The committee responsible have endeavoured to include all the terms required in practical use. One section gives definitions for all the common types of errors in gear cutting. The section giving geometrical definitions contains 20 pages of illustrations.

B.S. 2539:1954—Preferred dimensions of reinforced concrete structural members. 2/-.

This standard specifies the preferred dimensions of shuttered faces of reinforced concrete structural members, except light precast members.

A standard range of preferred sizes for cross-sectional dimensions is given whenever practicable. Preferred dimensions for individual structural members are provided for use where it is impracticable to use the standard range of dimensions.

In large building schemes where much repetition occurs it has been found that the key to lower formwork costs lies in the standardization of formwork sizes. The recommendations in this standard are, therefore, specifically limited to the dimensions of shuttered faces of structural members since an essential preliminary to the standardization of formwork sizes is the standardization of these dimensions

B.S. 2542:1954—Recommendations for the use of bitumen emulsion for roads. 4/-.

These recommendations have been drawn up to replace B.S. 433:1931, which has been withdrawn. They establish general rules of procedure in the use of bitumen emulsion for road construction and maintenance.

The standard covers the application and use of bitumen emulsion for preparing and treating road surfaces, and also includes recommendations regarding contractual considerations and equipment. It does not include the use of bitumen emulsion for such purposes as soil stabilization, roofing work, etc.

B.S. 949: Addendum: 1954—Unified thread taps. 7/6.

To permit full interchangeability between Unified threads made to British and American Standards, B.S. 1580, 'Unified screw threads' was recently revised to permit the production of external threads with flat crests and internal threads having appropriate clearance at the root.

It was therefore necessary to change the minimum major diameter of Unified taps and the revised limits for dimension are given in this addendum. The limits selected not only ensure the necessary clearance at the root of the nut, but also provide reasonable tap life and comply with gauging requirements.

Underwriters' laboratories of Canada, Toronto 16.

C58—Standard for underground storage tanks for hazardous liquids—December 1954. 2nd ed.

This standard covers the basic requirements for the construction and performance of underground storage tanks for hazardous liquids, and includes Specification no. 54 for underground storage tanks for petroleum products.

Illustrations are given covering shell seams, heads and head joints, pipe connections, etc., and tables are given covering dimensions, capacity, thickness of material used in construction, etc.

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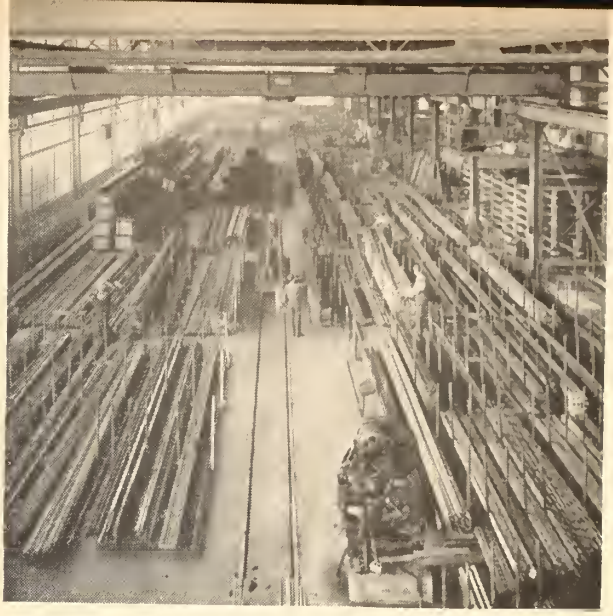
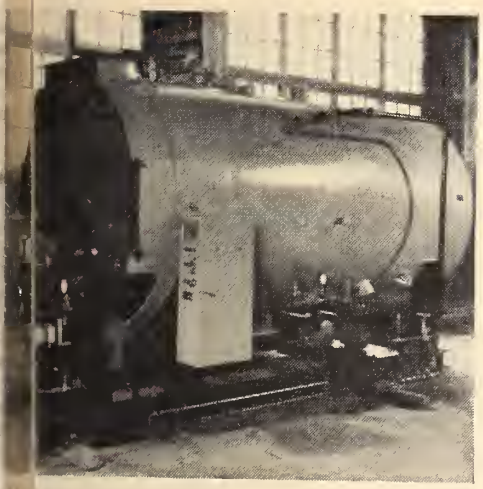


TORONTO, ONT.: Warehouse steel of all types is immediately available from nine strategically located warehouses across Canada — like this one in Toronto



HRST, N.S.: We recently introduced a new type
ch Dry Back boiler for use as a "packaged
"This one was built by our subsidiary. Robb
ring Works Ltd.

HAMILTON, ONT.: First permanent "wavestack" television antenna in the world; designed by RCA Victor Co. Ltd. in conjunction with Dominion Bridge and built in our main plant. It was erected by our Ontario Division.

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Business & Industrial Briefs

A Digest of Information

received by

The Editor

Appointments and Transfers

Dominion Engineering Appointment. Philip H. Goldsmith, former general sales manager of Pusey & Jones Corporation of Wilmington, Delaware has joined the staff of Dominion Engineering Works, Limited, Montreal, in the capacity of sales manager, Paper Machinery Division.

Mr. Goldsmith joined Pusey & Jones in 1939 to supervise the development and sale of cylinder and fourdrinier papermaking machines and their accessories. He owns many patents in the papermaking field. Installations of his design including high-speed cylinder machines and flow distributors for cylinder and fourdrinier papermaking machines are now in operation in the United States and Canada.

After attending the U.S. Naval Academy and the University of Michigan, he became engaged in general construction work, and in 1928-29 was resident engineer during the construction of Sylvia, N.C., and Lynchburg, Va., paper mills of the Mead Corporation.

He remained at Lynchburg as superintendent of maintenance and in 1930 he entered the field of paper machine design and sales with Black-Clawson Co. of Hamilton, Ohio, leaving in 1937 to set up private practice. During the years 1937-39 he operated from New York City as consulting engineer to the papermaking industry.

Mr. Goldsmith is a member of the American Society of Mechanical Engineers, the Technical Association of the Pulp and Paper Industry, the Delaware Society of Professional Engineers.

●

New C-I-L Works Manager. — D. W. Marshall has been appointed works manager of the chemicals plant of Canadian Industries (1954) Limited at Copper Cliff, Ontario. A native of Toronto, Mr. Marshall is a graduate of the University of Toronto Schools with B.A.Sc. and M.A.Sc. degrees in chemical engineering. Following three years of active army service in World War II, he taught chemical engineering at the Ajax division of the University of Toronto and at Queen's University. He joined C-I-L in 1950 as a development assistant in the company's Hamilton, Ont. chemicals works. Two years later he was transferred to the Shawinigan Falls, Que. chemicals plant as development supervisor, becoming liquid chlorine supervisor in 1954.

Mr. Marshall is a member of the Chemical Institute of Canada and of the Association of Professional Engineers of Ontario.

●

Federal Government Announcement. The Rt. Hon. C. D. Howe has named William H. Huck as an assistant deputy minister, Department of Defence Production. Mr. R. M. Keith, formerly deputy financial adviser, succeeds Mr. Huck as financial adviser.

Mr. Huck was born in Kitchener in 1914 and received his chartered accountant's degree there in 1942. He entered the Government service in 1942 with the Cost Inspection and Audit Division, Department of Finance. In 1947 he was appointed director of the manufacturing section (Assessments Branch) of the Department of National Revenue. He joined the Department of Defence Production as deputy financial adviser on January 1, 1953, becoming financial adviser on May 1, 1954.

Mr. Keith was born in Peterborough in 1909 and received his bachelor of commerce degree from Queen's University in 1935. For several years he was employed by the Great West Life Assurance Company, Winnipeg, as a member of the comptroller's branch. During the war years he served with the Royal Canadian Navy, attaining the rank of Commander (S). He was appointed financial secretary to the Canadian Embassy in Washington in 1947 and was transferred to Ottawa on Treasury Board staff in 1951. He came to the Department of Defence Production on loan from Treasury Board in January, 1953, and assumed the duties and responsibilities of deputy financial adviser in May, 1954.

●

Assistant to Vice-President At Alchem. W. C. Heim, vice-president, Alchem Limited, has announced the appointment of Mr. R. G. Mondoux as assistant to the vice-president effective February 1955. Mr. Mondoux commenced employment with Alchem Limited in April, 1949, as service engineer with the Industrial Department. In April 1950 he was appointed field engineer in the Ontario District. In January 1953 he was made district engineer and Ontario Office Manager. This position he held until his recent appointment.

●

President of Toronto Electric Club.— E. W. McLeod, chief electrical inspector, consumer service division, Ontario Hydro, has been elected president of the Electric Club of Toronto. Mr. McLeod, who joined the Commission in 1919, has been an active member of the Electric Club of Toronto since 1925. He was assistant approvals engineer in Hydro's Research Laboratory until his appointment in 1945 as assistant chief electrical inspector. Two years later, he became chief electrical inspector.

Founded in 1916, the Electric Club of Toronto provides an opportunity for those in the electrical industry to get together at weekly luncheon gatherings to hear speakers on topics of general interest.

●

John Inglis Montreal and Toronto Managers.—J. F. Watt has been appointed manager of the Montreal Branch of the Refrigeration and Air Conditioning Division of the John Inglis Co. Limited.

After graduating in 1923, Mr. Watt was with the York Corporation, and later with Canadian Ice Machine Co. He is from a family of specialists in his field, and is considered a leading authority due to experience gained over a period of thirty years in this kind of industry.

C. B. Davies has been appointed manager of the Paper Machinery Division of the John Inglis Co. Limited, Toronto.

Mr. Davies also brings to his new position a wealth of experience in the pulp and paper industry. Graduating with a B.Sc. (chemical engineering) from McGill in 1923, he has been associated with this work for an equal length of time. He has been employed with the Kimberley Clark Corporation, the Abitibi Pulp and Paper Co. Ltd., and The E. B. Eddy Company, where he was mill manager of the pulp and newsprint mills.

Prior to his new appointment, Mr. Davies was mill manager of Irving Pulp and Paper Ltd. During the war, he served in the R.C.E., retiring with the rank of major.

He is a member of the Technical Section of the C.P.P.A., of the Technical Association of the American Pulp and Paper Industry, and is a past chairman of the New York-Canadian Division of the American Pulp and Paper Mill Superintendents Association.

●

British Ropes Expansion. — Appointment of a resident field representative for the Prairie Provinces, and introduction of all-new lines of wire rope sleeves and braided wire slings, are the latest steps announced by British Ropes Canadian Factory Ltd., in its fast-moving expansion program.

Earl C. Lathrop, Jr., who has extensive factory training and on-the-job experience in the selection, use and care of wire rope and wire products has taken charge of field service for Alberta, Saskatchewan and Manitoba, and east to the Lakehead.

With headquarters at Edmonton, Mr. Lathrop also will act as field consultant throughout the same areas for Western Canada Ropes Limited, a subsidiary company which specializes in custom engineered "Marathon" drilling lines for the petroleum industry.

He also represents Grandview Industries Limited, a new division of British Ropes, established for the production of plastic pipe using the trade name "Cobra," and molded plastic fittings.

Ross C. Imrie

Eagle Pencil Appointment.—The appointment of Ross C. Imrie as sales manager of The Eagle Pencil Company of Canada Limited has been announced by Charles G. Easton, vice-president and general manager.

Mr. Imrie has been with the company for the past sixteen years except for a period during the war when he served with the Royal Canadian Navy. Mr. Imrie has had wide experience in the selling and merchandising of all the company's pencil products and is well-known to the trade throughout Canada.

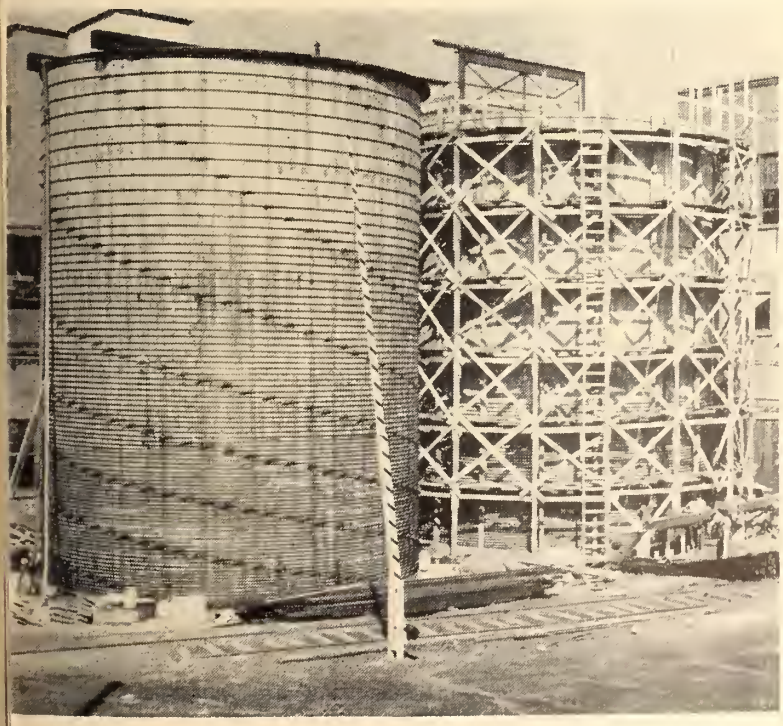
●

Director of Canada Iron Foundries. — D. W. Ambridge, C.B.E., has been elected a member of the Board of Directors of Canada Iron Foundries, Limited. Mr. Ambridge is President and General Manager, Abitibi Power and Paper Co. Ltd.; President, Provincial Paper Ltd.; Chairman of the Board, Alaska Pine & Cellulose Ltd.; Director: Montreal Trust Co., Canadair Ltd., Canada Steamship Lines Ltd., and the National Industrial Conference Board.

●

Company President. — Raymond Concrete Pile Company, Limited, foundation and heavy construction firm, with headquarters in Toronto and district offices in Montreal and Vancouver, announced recently the election of Wesley C. Pietz as president and managing director.

Mr. Pietz succeeds Julian A. Dickinson who has been president and managing director of Raymond Concrete Pile Company, Limited since 1953. Mr. Dickinson will continue as president of Raymond International Company, Limited, of Toronto, and will have the responsibility for special construction projects in Canada and other areas.



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WOOD PIPE & TANKS

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Union Carbide Appointments.—Ewart Greig, president, Union Carbide Canada Limited has announced the appointment of David W. Kennard as traffic manager and Harold J. Scarth as manager of purchasing. Messrs. Kennard and Scarth will co-ordinate traffic and purchasing matters for Union Carbide Canada Limited and its Divisions which include Bakelite Company, Carbide Chemicals Company, Dominion Oxygen Company, Electric Metallurgical Company and National Carbon Company.

●

Robbins L. Elliott. — The Department of Public Works has announced that Robbins L. Elliott has been appointed to the position of assistant director of Property and Building Management Branch, following his successful candidacy in a country-wide competition recently held by the Civil Service Commission.

Mr. Elliott was private secretary to the Honourable Robert H. Winters, from January 1, 1949 to September 17, 1953 in the Departments of Reconstruction and Supply, and Resources and Development; and the Minister's executive assistant since September 18, 1953 until the present time, in the Department of Public Works.

Robbins Leonard Elliott was born in 1920 at Wolfville, N.S. He graduated from Acadia University with the degree of bachelor of arts in 1941 and prior to his enlistment with the Canadian Army in September, 1941, was employed on the staff of the Halifax Chronicle. During the war he served overseas for four years with the North Nova Scotia Highlanders, and in the Canadian Intelligence Corps on the Continent with SHEAF and as field censor with the 21st army group.

Following his discharge from the Armed Services, he was on the reporting staff of the Windsor Daily Star before resuming his education at the University of Toronto where he secured his master of arts degree in economics and political science in 1947.

He joined the Citizenship Branch staff of the Secretary of State's Department at Ottawa in July, 1947, acting as editor. In this capacity he was in close association with foreign language newspapers across Canada. He resigned from the civil service in October, 1948 to undertake post-graduate studies at the University of Chicago, before returning to Ottawa to assume the post of private secretary to the Minister of Reconstruction and Supply.

●

New Permutit Executive. — Sheller L. Steinwender has been appointed vice-president of The Permutit Company, New York, N.Y., according to an announcement by Mr. Henry W. Foulds, president of the water conditioning firm.

Before joining The Permutit Company, Mr. Steinwender, a chemical engineer, was vice-president of the Scaife Company in Pittsburgh, Pa. Prior to that, he was with the A. O. Smith Corporation and the American Cyanamid Company.

●

Staff Changes, Canada Iron Foundries.—Canada Iron Foundries, Limited has announced the appointment of G. D. Turnbull as Manager of Production —Foundries, and of T. J. Hamilton as Manager of Production—Machine Shops (Trois Rivieres and Toronto). Mr. Turnbull has been actively engaged in the supervision and management of foundries since 1928, and was works manager of the Company's Fort William plant at the time of his new appointment. His responsibilities will extend to all the Company's eleven foundries. Mr. Hamilton has been chief engineer and assistant works manager, Trois Rivieres plant, and is currently director of product development. He will now be in charge of engineering and production of the Trois Rivieres and Toronto machine shops.

G. D. Turnbull

T. J. Hamilton

●

Atlas Steels Appointment.—H. George De Young was appointed executive vice-president of Atlas Steels Limited at a recent meeting of the board of directors. After joining the Atlas company in 1951 as works manager, Mr. De Young was successively named vice-president operations in May, 1952, and appointed to the board of directors in March, 1954. Immediately prior to his first Atlas appointment, he was works manager of Treadwell Engineering Company, Easton, Pennsylvania.

Born in Grand Haven, Michigan, Mr. De Young attended the Michigan State University for one year, then received an appointment to the United States Naval Academy at Annapolis, where he graduated in 1931. Thereafter, he resigned his commission in the Navy and went to work for Midvale Company, Philadelphia, Pa., an old and well-known firm of tool steel and special alloy steel manufacturers.

He became, successively, supervisor of hammers, assistant superintendent of the shell department making armor for naval vessels, and superintendent of the shell department making armor-piercing projectiles. In the latter job, he received an award from the U.S. government for research and development. In 1935, he became superintendent of rolling mills and was made works engineer for Midvale in 1947, resigning in 1949 to go with Treadwell Engineering.

New Equipment and Developments

New Gutta Percha Warehouse.—Gutta Percha and Rubber, Limited's new warehouse and office building was opened at Edmonton in January.

Located at 10930—119th Street, a few blocks south of Edmonton's Municipal Airport, the handsome one-storey brick and stone-faced building on 1½ acres of land will provide room for the company's present operations and possible future expansion.

Latest developments were incorporated into the building's design. Architects were Rensaa and Minsos, and general contractors were Poole Construction, both Edmonton firms.

●

New Contactors and Relays. — New mechanically-held contactors and relays, especially designed for maintaining continuity of sequencing in the event of power interruptions, are available from Canadian General Electric Company's Motor and Control Department.

Used also where exceptionally quiet operation is required, mechanically-latched relays and contactors eliminate continued energization of the coil, thus eliminating coil hum, according to company engineers. After the main device coil is momentarily energized to seal the contacts, the mechanical latch locks the contacts in position until the latch coil is energized. For this reason, when the power is restored after a failure, sequenced operations will resume at the exact point in cycling where they were cut off.

With contacts easily interchangeable from normally open to normally closed position without additional parts, the mechanically-held devices are entirely front-connected for convenient wiring. Contact springs are permanently attached to the movable contacts to facilitate removal and installation.

●

Tube Development.—Coincidental with the formation of a separate Tube Division, Canadian Westinghouse Company, Hamilton, announced early in the year a new tube development by company engineers.

The new electronic tube is the 5AS4, a full-wave vaccum rectifier of the filamentary cathode type, intended for use in power supplies of television and radio

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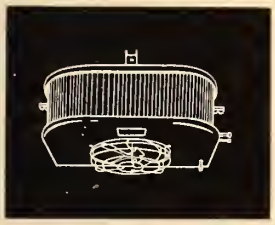

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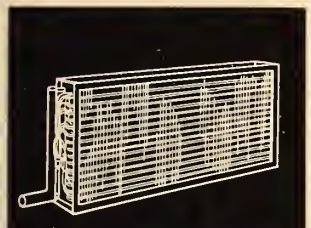

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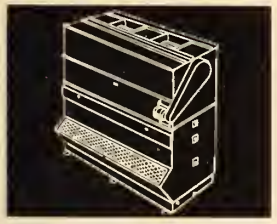

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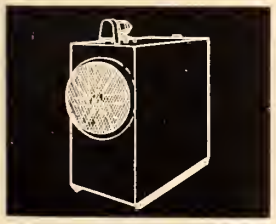

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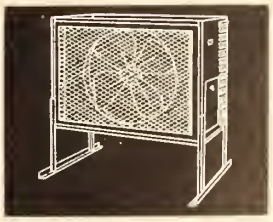

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equipment having high d-c requirements. The unit has been specially designed for operation at higher peak and average current rating.

The 5AS4 has a maximum peak inverse plate voltage of 1,550 volts and a maximum peak plate current per plate of one ampere. When operated as a full-wave rectifier with an a-c plate-to-plate supply voltage of 600 volts rms in a circuit with capacitor input to filter, the new tube can deliver a d-c output voltage of approximately 290 volts to the filter at a d-c current of 300 milliamperes. Similarly, when operated as a full wave rectifier with an a-c plate-to-plate supply voltage of 900 volts rms in a circuit with capacitor input to filter, the 5AS4 can deliver a d-c output voltage of approximately 460 volts to the filter at a d-c current of 275 milliamperes.

●

Limit Load Fan.—The Canadian Blower and Forge Company Limited, Kitchener, Ontario, recently announced the addition of a new type of limit-load fan to its present series.

Known as type "BL" the new fan was designed for air-conditioning, ventilations and general industrial applications.

This fan includes many of the exclusive design features promoted by Buffalo engineers, with improvements in wheel and housing to produce extremely high efficiency over a wide range of operation. Limit-Load horsepower, minimum noise level and stable air delivery from shut-off to free delivery, are other engineering features.

Housing is streamlined with outlet designed for most efficient air delivery and the Inlet Collar is ample for easy connection to any type of ductwork.

The newly designed, heavy gauge, die-formed shroud has full curvature for proper air flow in wheel and its die-formed blades, curved and backwardly inclined for stable air flow, are welded and riveted for maximum strength. Die-formed inlet bell with an exclusive die-formed stationary inlet vanes matches wheel shroud.

Either anti-friction or sleeve bearings are available according to job requirements.

The development of this new design was completed only after exhaustive tests on other wheel and blade shapes, including the flat blade backward inclined design. The backward curved blades of the type "BL" wheel, together with Canadian "Buffalo's" exclusive fixed inlet vanes, assures required rating on the job at maximum efficiency and minimum noise.

●

Shell Oil Construction.—Plans for the construction of a "platformer" at Shell Oil Company of Canada's Vancouver refinery are announced by G. L. Gardiner, refinery manager. A contract for the work has been awarded to Procon (Canada) Ltd.

Scheduled for completion towards the end of this year, the unit will enable Shell to utilize the most modern improvement in refining processes. Designed by Universal Oil Products Company of Chicago, the platformer will use straight run hydrocarbons from the topping plant as a feed stock, reforming them in the presence of a platinum catalyst into high octane components which, in turn, will be blended into highest quality gasoline.

Mr. Gardiner estimated the cost of the unit at $1½ million and stated that it will be capable of processing some 3300 barrels of feedstock daily.

Keeping abreast of the fast-growing B.C. economy, Shell's platformer marks the second major expenditure at the Vancouver refinery in as many years. Last summer a $10 million expansion doubled the plant's capacity from 9,000 barrels to 18,000 barrels per day.

Included in the additions at that time were a fluid catalytic cracking unit, a vacuum flasher, a gas recovery plant, blending facilities, storage tanks, a new office building, employees change rooms and other buildings.

●

Lansing Bagnall Lift Trucks.—Lansing Bagnall Industrial Trucks are now being distributed in Ontario and Western Canada by United Steel Corporation Limited of Toronto. This well-known line includes both battery electric and diesel operated trucks for a wide variety of industrial and commercial materials handling applications.

Parts are highly standardized allowing for increased interchangeability, the distributor reports, and parts and service are readily available.

Lansing Bagnall Trucks are another addition to the United Steel line of materials handling equipment, already one of the most complete in Canada.

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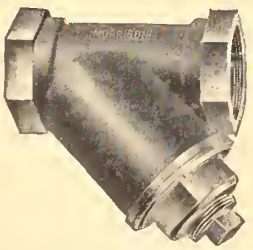

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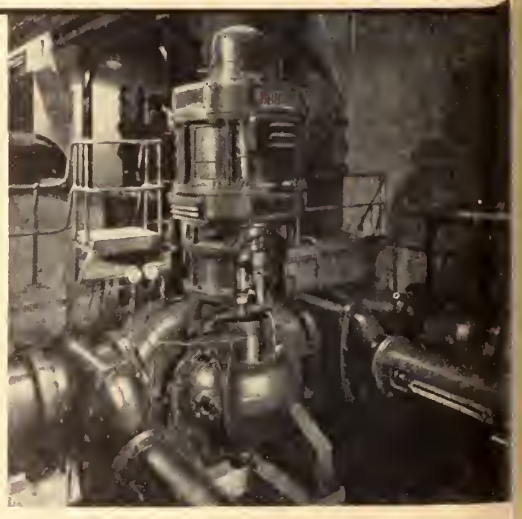

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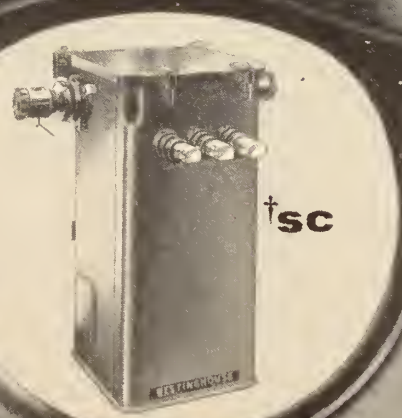

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A New Idea in

CIRCUIT BREAKERS

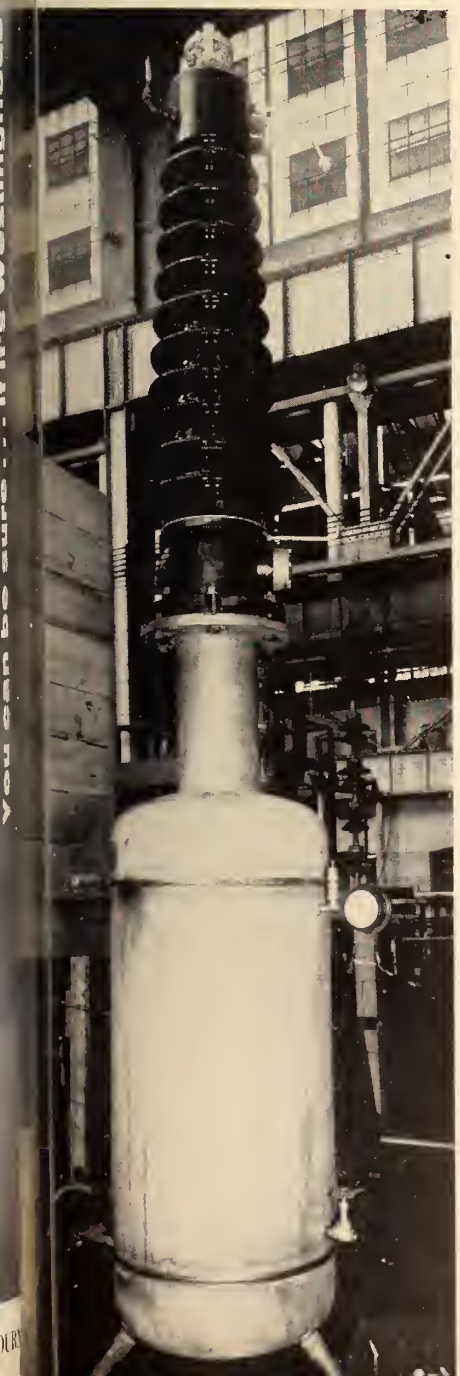
by

J. P. Skillen and D. H. McKeough,

Canadian Westinghouse Co. Ltd.,
Hamilton, Ont.

A paper presented before the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, at Toronto, May, 1955.

Fig. 1. Testing equipment.



Since the turn of the century, ways and means of interrupting the flow of electric current have been sought. Air break switches had their innings, only to be overwhelmed by the new and revolutionary idea of putting out fire with oil. The new-fangled oil breakers led a checkered career until, in the 1920's, radical improvements made them a really effective device.

The advent of the late war in Europe caused some new thinking in those countries affected. Steel for tanks was a critical material. Oil was a critical material and, moreover, a hazard under bombing. The effect was logical, other means using less critical materials must be sought and perfected. In Canada, we were not so much affected, and continued to bask in the sun of the tried and proven oil.

With the rehabilitation of Europe, a drive in those countries for foreign trade began to infiltrate into Canada the doctrine of air blast and oil-poor breakers. Our first reaction was that oil was tried and proven — so why change? However, since we were engineers, we had to "nose" into these new gadgets which were being offered. We found they seemed to have some merit, but the large porcelains were costly to make.

Again, being engineers, we asked ourselves why? In Europe these breakers are selling at highly competitive prices. The answer was simple. In Canada material is cheap but labour is high. In Europe material is critical but labour cheap. Bearing this in mind, it can be seen that a design composed of "labour and mud" may be good and economical in Europe, but not necessarily as economic as one involving less labour and more material in Canada.

Several Choices Open

Since the European breakers began to find some favour in Canada, we as engineers had to investigate more thoroughly their merits. Several years ago, our engineers began to accumulate data.

Through dissatisfaction with the cost of existing designs, a Canadian manufacturer decided that improvements in the circuit breaker must be made. Several steps were considered and rejected in turn until only one prospect remained — to undertake the development of an entirely new type, as described in this paper. The outcome is a breaker which is economical to build — a steel tank filled with compressed air in place of oil as a dielectric — fully acceptable to the switching engineer and the station operator.

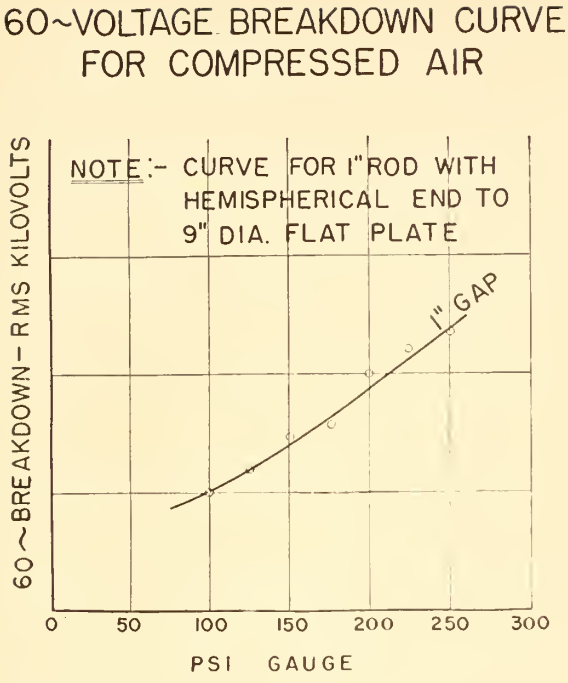


Fig. 2.

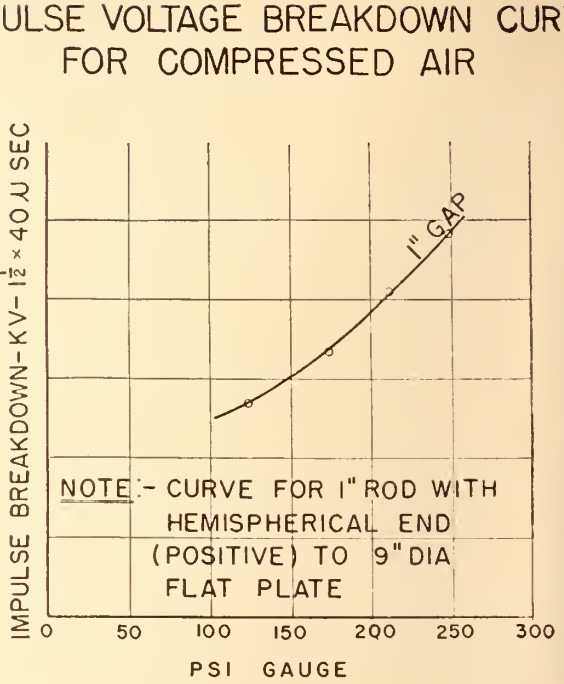


Fig. 3.

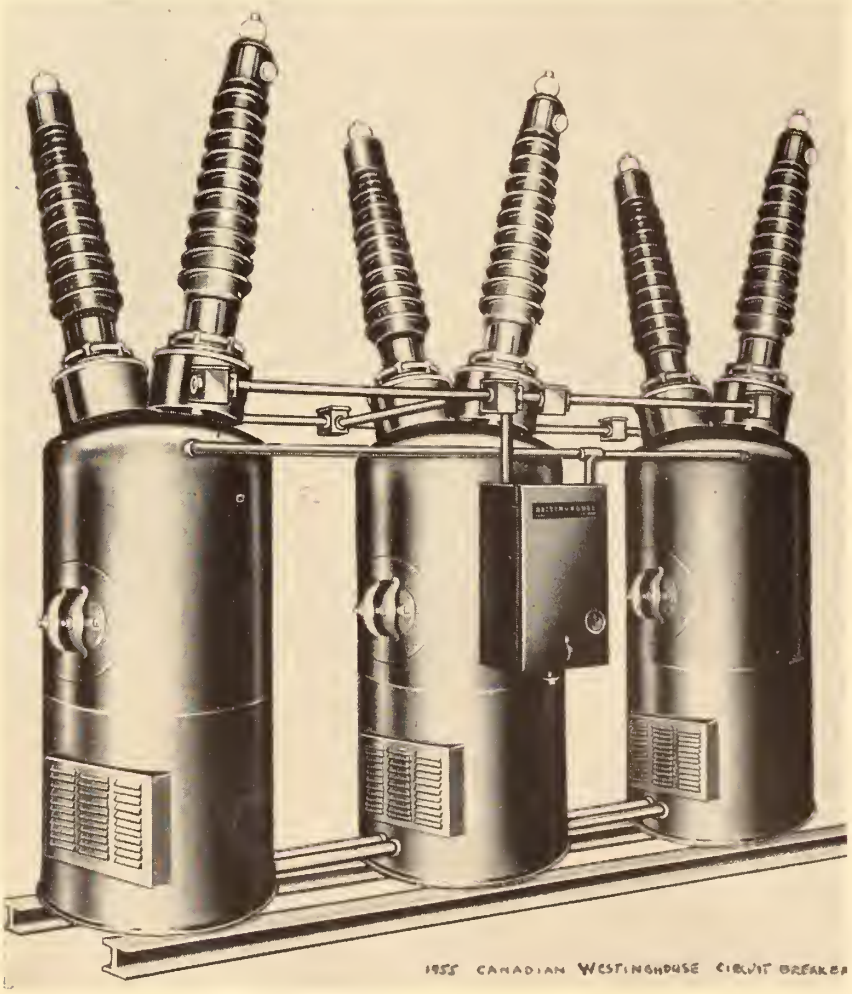


Fig. 4. The Jetaire breaker.

All of the conventional designs were thoroughly explored for merit and criticism, and we found plenty of both, which was carefully tabulated for future reference.

In the early 1950's we began to feel the pressure of foreign competition in air blast breakers, and it became necessary to decide what action we should take. A study of these tabulations did not leave us very enthusiastic about existing designs. A study of manufacturing costs of European designs did not show us much relief.

Several answers to the problem were possible:

1. We could stick to oil — but cost-wise competition was becoming very tough, also the gospel of "no oil" was being preached and received.

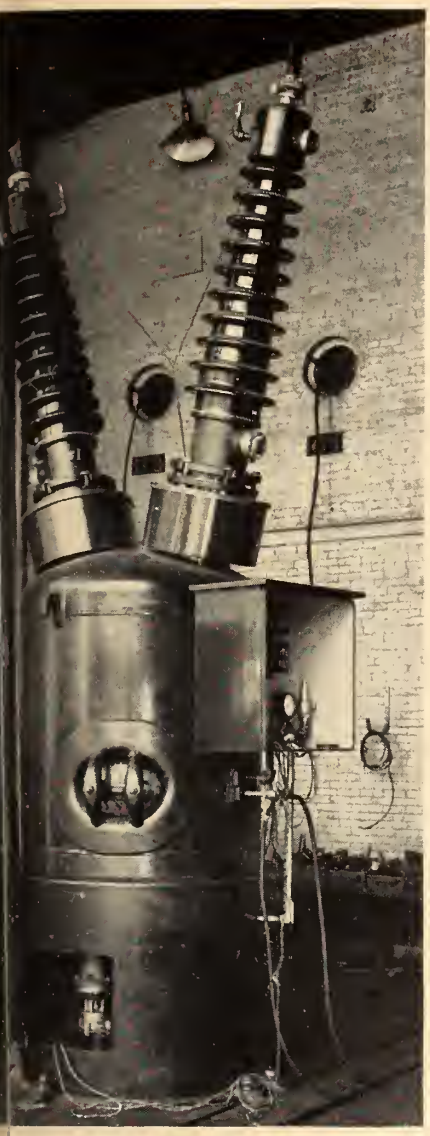
2. We could manufacture an oil-poor breaker, but we felt that this was only an interim step.

3. We could take out a license and make a European breaker. Cost-wise this was not attractive, however, and we still were lukewarm on the features available.

4. We could start from scratch and pioneer a new design which would meet our ideas of what a breaker should be. This is the approach we chose.

Requirements

Our first step was to lay down



The test pole in the laboratory.

the requirements of an ideal breaker. These came out somewhat as follows:

1. We must preserve the integrity of a grounded steel tank.

2. We must not use a porcelain in a structural member where it could be subjected to tensile stresses.

3. We must have bushing type current transformers and potential taps.

4. The dielectric should be non-inflammable.

5. It should be mechanically simple, compact, easy to install and maintain.

6. It must be a design balanced to Canadian economics, so that it would be economical to build, and could be priced competitively. This boiled down to "a steel tank filled with a non-combustible dielectric."

The first point to solve was, what dielectric? Compressed air seemed a natural choice; it appeared to have good dielectric properties and was certainly a good medium for arc extinction. Little information could be found on the behaviour of this material as a dielectric, so it was necessary to find out. A steel tank 26 in. in diameter was fitted with a standard 138-kv. Type O condenser bushing and many hundreds of tests, both impulse and 60 cycle, were made on various shapes and materials to plot new creepage and striking value curves on which to base our designs.

Figure 1 shows this tank set up in the shop during the testing period. Briefly, we concluded that high pressure air has dielectric properties which are at least as good as those of insulating oil. With the empirical data obtained by testing with electrodes of different shapes at different spacings, it is possible to reduce the overall dimensions for apparatus of a given voltage class. Figure 2 shows the effect of increasing pressure on the 60 cycle test. Figure 3 shows the effect of increasing pressure on the impulse strength.

Protecting Against Condensation

With this fund of data, design of a practical breaker was now started. Many dreams had been explored and their merits assessed. At this stage a conventional feature of many outdoor air blast breakers was strongly and unfavourably in our mind, namely the protection of the interior of the blast tube against condensation. It was felt that usual methods could be improved.

With the idea of housing the interrupters in an atmosphere of high pressure air, it seemed obvious that the blast valve should be at the outlet to the blast tube, not at the inlet. This would keep the entire system isolated from atmosphere with its insidious infiltration of condensed moisture. It would protect all parts by surrounding and filling them with clean high dielectric air and obviate the tricky and costly bleeding of dry air. It further made the blast valve easily accessible as a control point. This feature was therefore decided upon.

With the exhaust valve mounted in this way, high pressure air is available at the contacts before arcing begins, so that the dielectric strength of the gap builds up rapidly. This makes for a very efficient design of interrupter. This arrangement also permits isolating the circuit with the relatively short gap available at the main contacts, so the necessity for a sequential isolating switch, normally incorporated as part of the breaker structure, is eliminated.

The problem of deionizing and cooling the arc gases and metallic vapours was solved by mounting a cooler directly under the interrupter. This cooler houses a cartridge-type unit having a high rate of thermal transfer, yet offering negligible resistance to the air flow. Since the interrupter is the

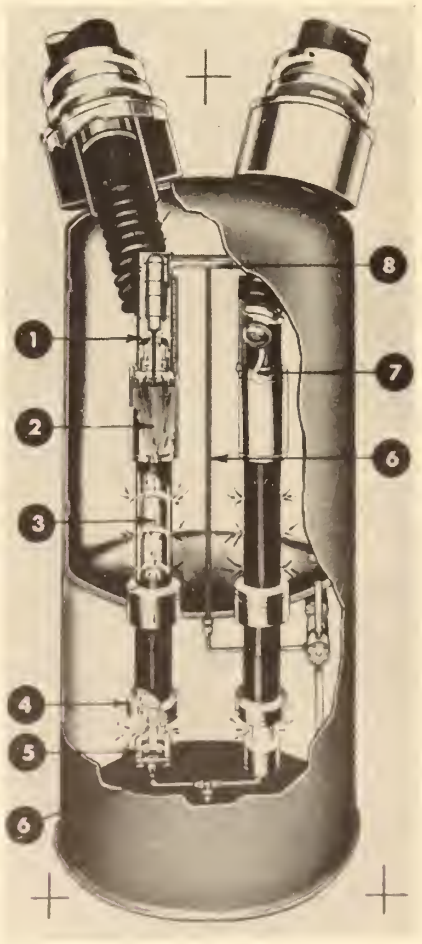


Fig. 6. Single pole unit.

Legend: 1. interrupters; 2. coolers; 3. blast tubes; 4. blast valves; 5. electro-pneumatic; 6. control tubes; 7. connector; 8. cross connector.

heart of any circuit breaker, our design thinking must start at this point. Fundamentally, breakers in this class will be based on an interrupter for use at a nominal voltage of 69 kv., having an interrupting rating of 2½ million kva.

For any multiple of this voltage and kva rating, the interrupters are arranged in series electrically and in parallel pneumatically. The use of shunt capacitors to grade the voltage equally across each break assures that each unit takes its share of the load electrically. At the same time the symmetrical arrangement of interrupters prevents the arc energy at one break from influencing the air flow at another. Moreover the use of identical interrupters, blast valves, etc., for different ratings permits greater manufacturing activity with reduced costs, and simplifies the problem of spare parts for the customer.

Result—The Jetaire Breaker

This new idea in breakers is shown in Fig. 4. Figure 5 shows the test pole in the H.P. Lab waiting its baptism of fire (and flood).

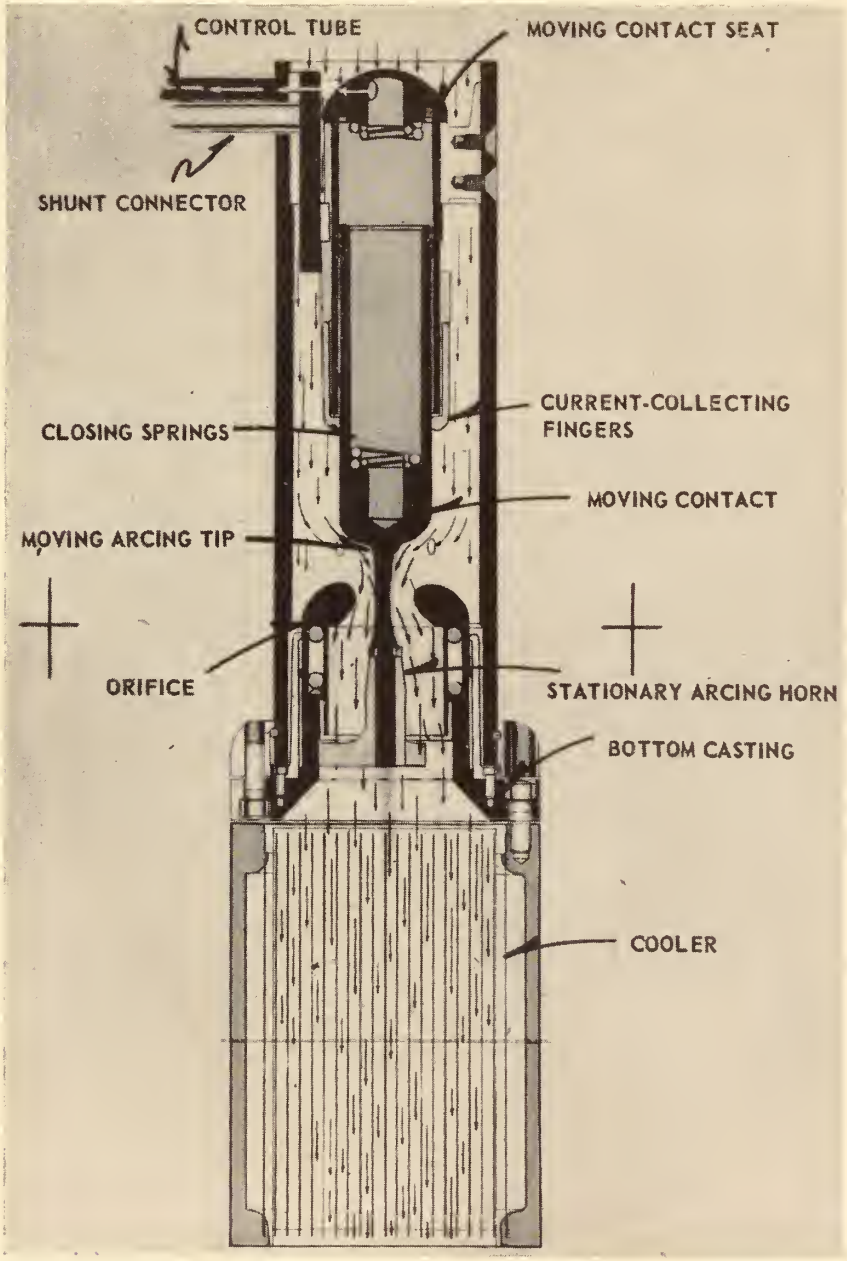


Fig. 7. "Jetaire" interrupter and cooler. Cutaway view to show interrupting operation.

Figure 6 shows a cutaway of the "internal organs" of breaker, while Figure 7 shows a cutaway of interrupter. To understand the principle of operation of the "Jetaire" breaker, consider the breaker standing closed on the line and each tank filled with high pressure air. Referring to Fig. 6 this means high pressure air in the tank, in the interrupters behind the moving contact head down through the coolers and blast tubes to the top of the blast valves.

The current flow through the breaker is in through one bushing to the bottom of the first interrupter. On the 115-138-kv. class of breaker there are two interrupters in series per phase and voltage division is ensured by capacitor shunts. The current then flows in through the lower nozzle into the moving contact, and is picked up on fingers and through the adjustable connector to the second interrupter, where the current flow is reversed and the connection to the other bushing is made.

Protective Devices

When protective relays operate on system faults, a pneumatic control valve simultaneously opens all blast valves. This immediately allows high pressure air to rush from the tank through the interrupters and coolers, blast tubes and out the blast valves to atmosphere. The pressure differential across the nozzle permits the nozzle to snap down approximately ¾ ins., and this action in conjunction with the air blast draws the arc on the elkonite arcing horn and the arc is interrupted by the air blast flow.

Deionization takes place in the cooler below the interrupter itself. During this time, another pneumatic control valve has been energized and, after the blast valves have been open a predetermined time, it operates to dump high pressure air from behind the moving contact. This contact opens by the force of high pressure air on its lower side to provide separation of the contacts.

The blast valve closes, halting the flow of air. The time of closing is a predetermined setting and this actually takes place approximately 8 cycles after initiation. This permits the nozzle to move up against its stop, while the moving contact remains in its upper

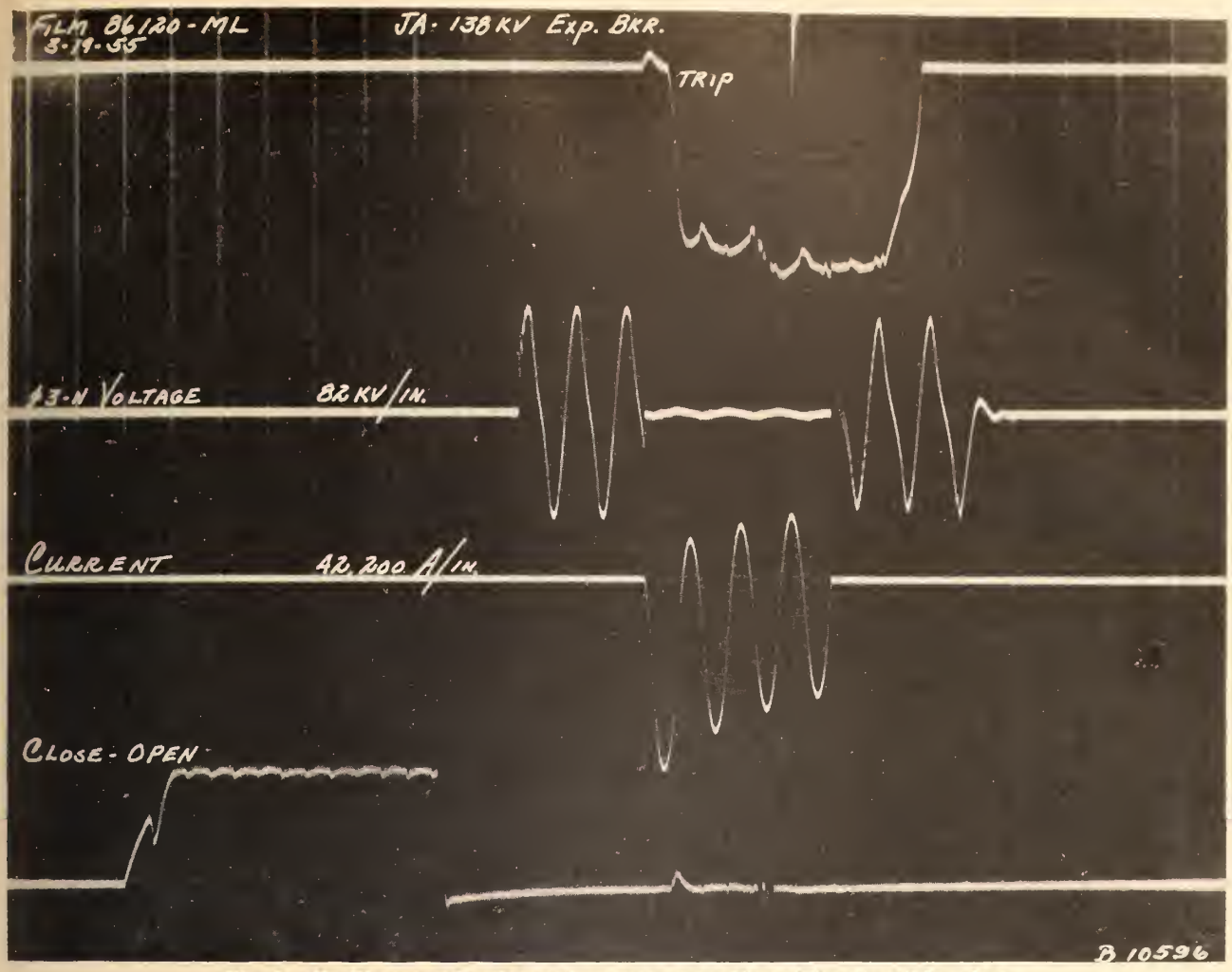


Fig. 8. Oscillogram showing a close-open operation of the circuit breaker.

position, thus isolating the circuit. To close the breaker, the action of the control valve is reversed and high pressure air is brought in behind the moving contact and this pressure allows the biasing springs to close the contacts.

This new breaker has been succesfully tested in four ratings 115 and 138 kv. 3.5 million kva. and 115 and 138 kv. 5.0 million kva. Fig. 8 is an oscillogram showing a close-open operation of the cir- of current equal to 5 million kva. cuit breaker with an interruption

Rugged, Economic, Simple and Accurate

This new breaker has many novel and interesting features. Due to its grounded steel tank construction it is remarkably rugged and stable, contrasting strongly with conventional porcelain. The tank itself is a registered pressure vessel, and contains the air for insulation and extinguishing the arc. It also provides a source of stored energy for operating the breaker contacts. The size of the tank is somewhat smaller than that of a conventional oil breaker.

Due to the absence of a conventional closing mechanism and linkage, no particular lineup of the tanks is necessary, only sufficient for piping connections. This feature can show economies in foundation designs. Again, test has indicated an absence of ground shock when interrupting, which has been a major installation factor in many designs of breakers.

The mechanical engineer will recognize the mechanical simplicity of the parts, and the consequent ease with which the rigid maintenance of accuracy can be held. It is no secret that the parts and assemblies of any air-blast breaker must be rigidly controlled so that an accurate balance of times and motions can be obtained. To a great extent the critical parts of this breaker are designed in such a way that automatic tools can produce duplicate parts.

Appeals to Switching Engineer and Station Operator

To the relay and switching engineer need we say more than that a full complement of 12 bushing type current transformers are available together with up to 6 potential devices. To the station man this breaker actually occupies less space than oil, or about one fourth of the space of at least one competitive air blast breaker. The arrangement of top

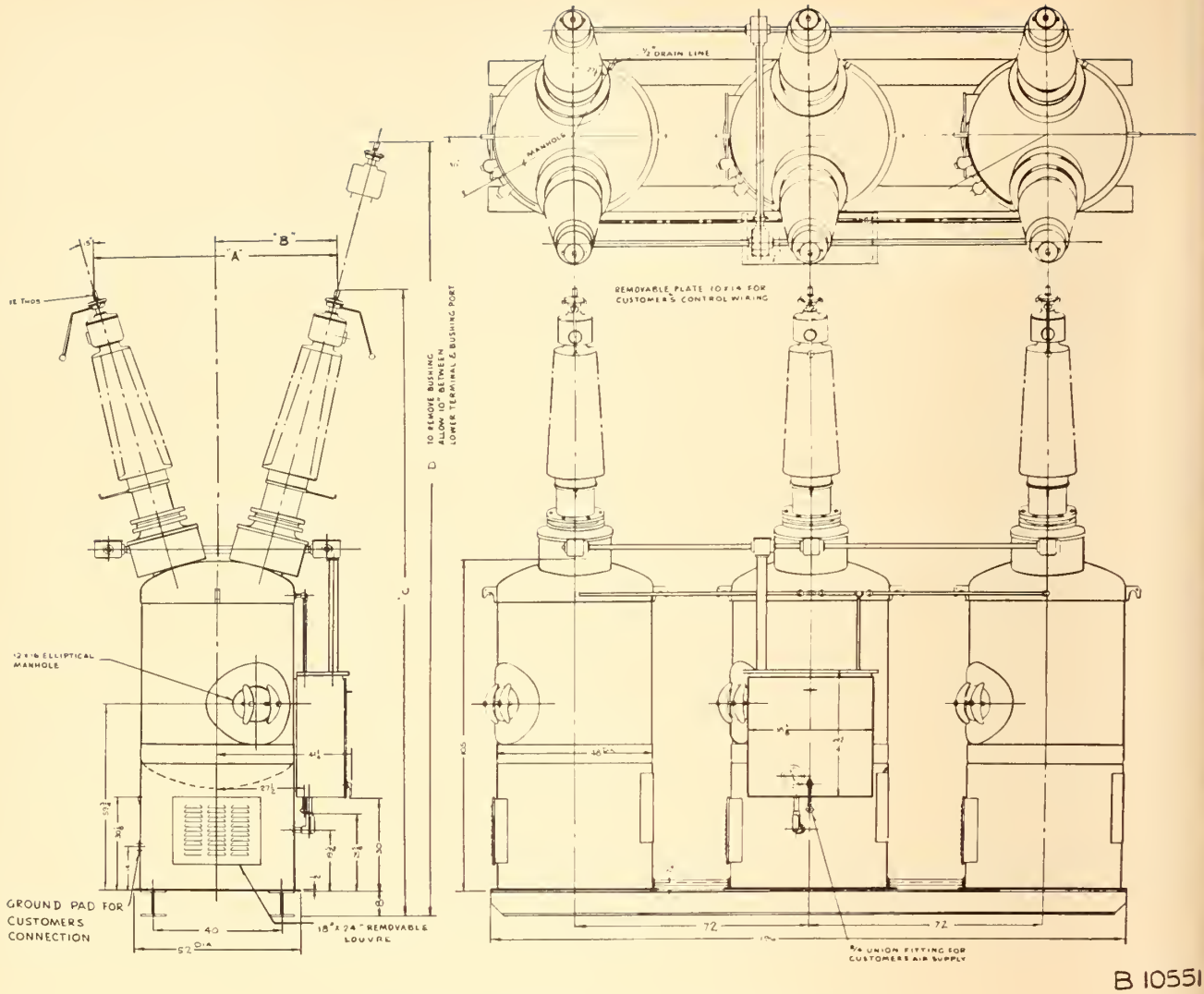


Fig. 9. Line drawing of the circuit breaker.

bushings makes a simple structure —just the same as has been used for oil. Installation and maintenance are simple, with room inside the tank in dirty weather, and with no oil to drain and clean up.

The interrupter contacts, blast valves and control valves represent the only moving parts in the breaker, since there is no linkage between the controlling elements and the contacts. These parts are readily accessible for inspection and maintenance. Another point worth noting is that the power arc is drawn on silver tungsten buttons, separated from the main contacting surfaces. This fact, along with the extremely short arcing times of ½ to ¾ cycles, mean long contact life and low maintenance.

Air Supply

The normal operating pressure for the breaker is 250 p.s.i. At points where the terminal bushings and blast tubes pass through the tank an effective air seal is obtained by the use of standard "O" rings. The elliptical manhole in each tank is of the type used in steam boilers. Since no bleeding of air is required in either the open or the closed position of the breaker, air consumption is kept to a minimum.

At the same time the tank provides for a large volume of stored air at the interrupters, thus several close-open operations are possible without drawing on air stored in the compressor station. A non-return check valve at the breaker prevents air flowing back into the supply line in case of a temporary drop in pressure in the line.

The air supply for up to five of these breakers is provided by a compressor unit, with an air storage tank located in the switchyard close to the breakers. This unit will pump and store air at 600 p.s.i. Chemical driers are used to maintain the dew point of the air in the tanks at less than minus 50°F. This type of air supply system is now being used in Canada to provide air for porcelain clad air blast breakers and fits in well with our requirements. √

GAS TURBINES

by

E. Bernhardt,
President,
Brown Boveri (Canada) Ltd.,
Montreal, Quebec

A paper presented before the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, at Toronto, May 1955.

The gas turbine as a prime mover is, of course not unknown to our power engineers, but until recently it has not attracted much attention in Canada because the most successful commercial machines require gas or oil as fuels, fuels of which we had only limited and costly supplies. The situation is now changed; gas and oil are abundant in the West and gas may soon be available at economic prices as far east as Quebec.

The author discusses the types of gas turbines on the market, their characteristics and economics and some details of design and of operations and ventures a few careful predictions as to their future. His conclusions are that there is a fallow field in Canada for the gas turbine, especially in the West, and that the success of the recent installation in Vermilion, Alberta, is part of it.

The general principles of the gas turbine being well known, there is no need to repeat them here, except perhaps to mention that as a general rule, the commercial gas turbine of today is usually of the so-called "open" type; "semi-closed" or "closed" circuit types have not yet found a wide acceptance. This fact may be emphasized by noting that a well-known European manufacturer has of late switched from his semi-closed circuit type to an open-type machine.

It should also be made clear that what follows is based mainly on Brown Boveri practice, and no mention, except in a general way, is made of machines of other types and makes. Furthermore, this paper is based on the writer's personal experience, acquired by 20 years' association with Brown Boveri; it takes largely into account information gathered directly from Brown Boveri's engineers and designers concerned with gas turbines, and from articles, publications, and information prepared by them.

There is considerable interest in gas turbines on the part of Canadian industry because of the Vermilion installation which was commissioned at the end of last year. It is necessary to emphasize here the progressiveness of Canadian Utilities Limited, in introducing this new method of power generation to Canada.

Economics of Gas Turbines

To begin, let us touch upon a subject which might at first sight seem controversial, but which can be discussed and appraised with

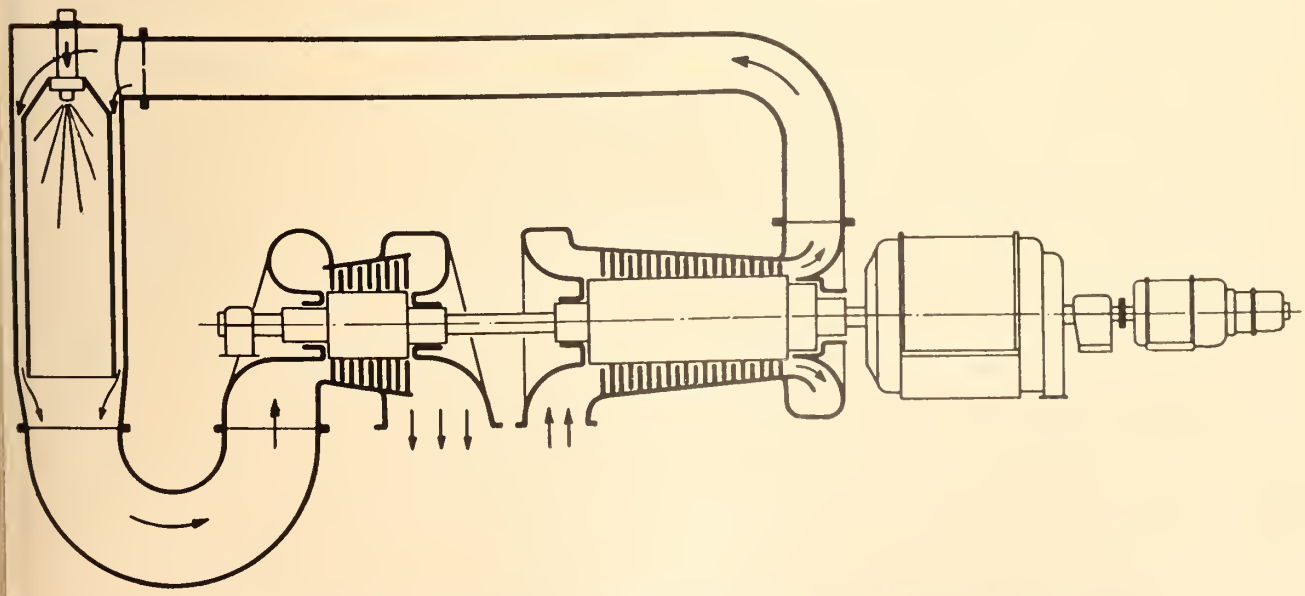


Fig. 1. Schematic arrangement of a single-shaft gas turbine without heat exchanger.

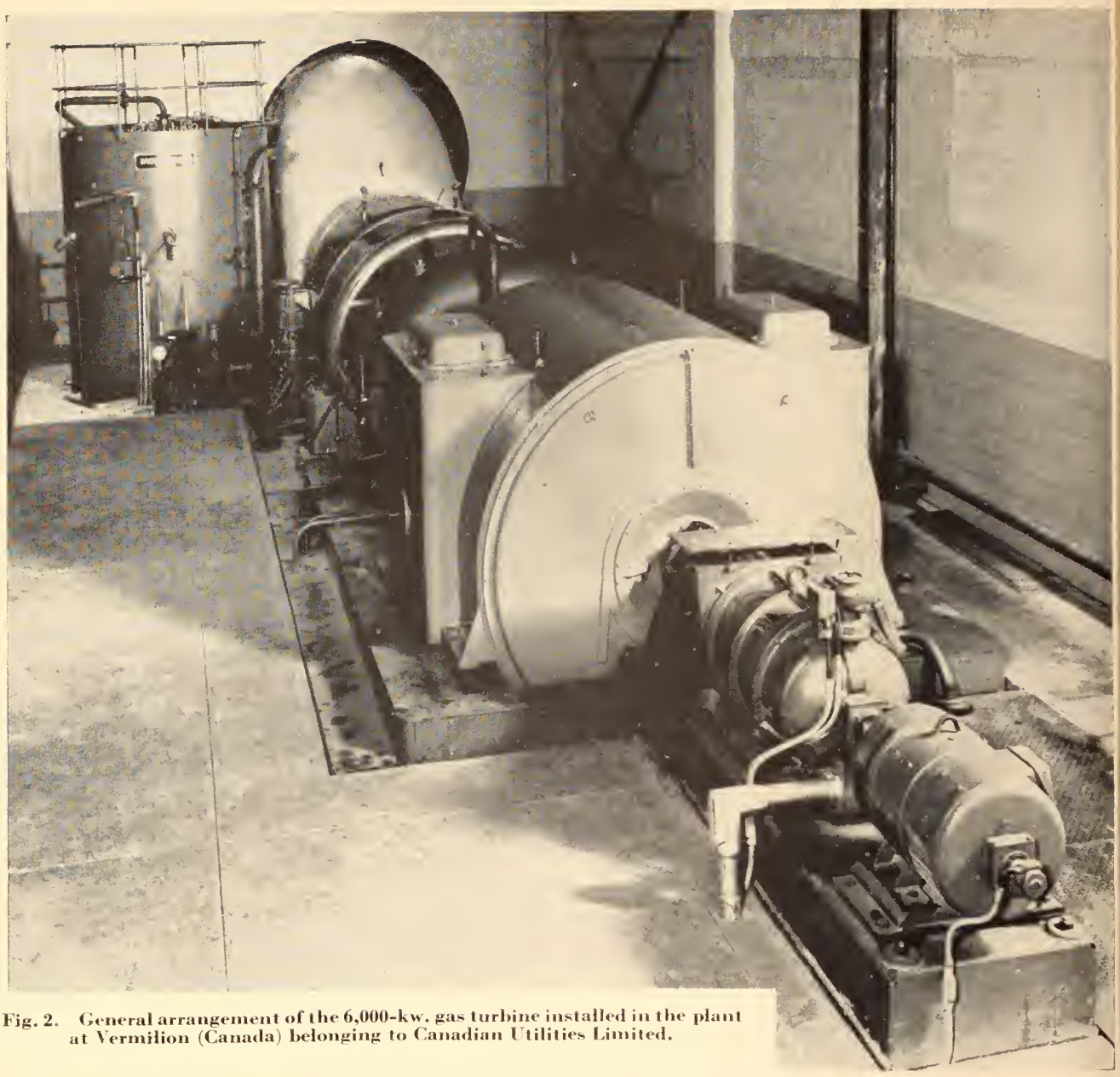


Fig. 2. General arrangement of the 6,000-kw. gas turbine installed in the plant at Vermilion (Canada) belonging to Canadian Utilities Limited.

relative ease, i.e., the economics of gas turbine power generation.

This subject has been dealt with extensively by Pfenninger, who is in charge of gas turbine development at Brown Boveri's works. Unfortunately, he takes European conditions as a basis and his conclusions are not entirely valid for countries like Canada where costs of fuel and of labour are different from those in Europe.

Estimates have therefore been prepared based on a 25,000 kw. plant, built for peak load operation, and with a total operating time of 2,000 hours per year. In order to provide a fair comparison with diesel engines, the calculations have been made on the basis of liquid fuel fired plants (gas turbines and steam turbines) in which Bunker C oil would be used at a cost of 8.2 cents per Imperial gallon and with a calorific value of 18,410 B.t.u. per pound. For the diesels, the calculation has been based on diesel oil at a price of 16.4 cents per Imperial gallon and with a calorific value of 19,720 B.t.u. per pound. Total generating costs with 1,000 B.t.u. natural gas at 11.0 cents per million B.t.u. are also given, but the details are omitted in this case. Conservative figures for the costs of land, buildings, etc., have been adopted to warrant safe conclusions For the gas turbine plants, a distinction has been made between a plant with and one without an air preheater. Operational labour charges have been included under fixed costs, but they could well be included under operating costs if found more convenient. Table I shows the results of this investigation.

It is apparent, so far as total fixed charges are concerned, that the gas turbine plant without air preheater is the most favourable. There is not as much difference between the gas turbine plant with air preheater and the steam plant, the latter being based on a steam pressure of 900 p.s.i.g. and a steam temperature of 900°F. The diesel plants show up unfavourably.

Total generating costs, which are of primary importance, show definite advantages in favour of gas turbines without air preheat-

ers, as compared to all other modes of generation. The gas turbine plant with air preheater also has an edge on the steam plant, as is to be expected on a basis of 2,000 hours per year operation; diesel plants are considerably higher in cost of kwh. generated.

It should be repeated that this calculation is made on the basis of liquid fuel and 2,000 operating hours per year. The picture changes if more extended operation is required; a point will be reached where the gas turbine plant with air preheater will become more economical than the one without, and eventually the steam plant will catch up to both.

On the other hand, if gas fuel is used as the basis for calculation, the picture will change considerably in favour of the gas turbine as compared to the steam plant fired with gas, and continuous gas turbine operation will be more economical than continuous operation by steam. From case to case it will have to be ascertained whether a preheater is, or is not, economical. A marked improvement in overall efficiency can be obtained with gaseous fuel by taking into further account that the gas inlet temperature can now be safely set at approximately 1,380°F. In the majority of cases where a gas turbine can be installed in the neighbourhood of ample supplies of gaseous fuel, its installation and energy costs will be lower than those of a steam plant of equal output.

There is a further point which heavily favours the gas turbine in climates such as those of Canada. Its efficiency increases with lower ambient air temperatures and with a constant intake volume of air, the output of the machine is increased. In view of the additional load demands in this country during the winter, the gas turbine with its increased winter output is ideally suited for power generation here. As a general figure, it can be taken that a 10°F. decrease in air temperature corresponds to an increase of 7 per cent in output and that the total thermal efficiency also increases in the ratio of about 103 to 100. These increases are indicated for the simple, single shaft gas turbine without preheater and thus will vary slightly for other types of machines, e.g., the two-shaft type and plants with air preheaters.

The main reasons why the gas turbine shows such interesting and economical results are:

It is low in first cost.

It requires little space, even the more elaborate plants with two shafts and preheaters.

No attendance is required after the plant is stopped.

It is ready for practically instant service — no long warm-up period required.

Service personnel requirements are modest.

Operation is simple and practically fool-proof.

It is adaptable to varied conditions. The lowest cost per kwh. can be obtained by the inclusion of a correctly chosen air preheater, should local conditions demand it.

Fuel consumption for starting is very low.

In many cases cooling water is not required, in others only in modest amounts.

Table I. Generating Cost of Gas Turbine, Steam Turbine and Diesel Motor Plants for Peak Load Operation for a Total Operating Time of 2,000 hours per Year

Plant		Gas turbine plant without air preheater 1	Gas turbine plant with air preheater 2	Steam turbine plant 3	Diesel plants 4	Diesel plants 5
Terminal output	kw	25000	25000	25000	2 x 12500	8 x 3100
Plant unit cost	$/kw	117	160	170	216	200
Heat rate at terminals	Btu/kwh	13100	10940	11400	9500	9570
Fuel cost (oil)	$/Mill.Btu	0.494	0.494	0.494	1.202	1.202
Lower heat value	Btu/lb.	18410	18410	18410	19720	19720
a. Operating Cost						
Fuel	ct/kwh	0.6450	0.542	0.5640	1.1400	1.151
Lubricating oil	ct/kwh	0.00115	0.00115	0.0016	0.032	0.039
Water	ct/kwh	0.0007	0.0007	0.0020	0.0007	0.0007
Maintenance	ct/kwh	0.0005	0.0006	0.0120	0.036	0.045
Total	ct/kwh	0.6473	0.5444	0.5796	1.2089	1.2357
b. Fixed Charges						
Operating labor	ct/kwh	0.0065	0.008	0.025	0.008	0.016
Interest and Amortization 8%	ct/kwh	0.466	0.640	0.68	0.865	0.80
Total fixed charges	ct/kwh	0.4725	0.648	0.705	0.873	0.816
Total generating cost	ct/kwh	1.1198	1.1924	1.2846	2.0819	2.0517

For natural gas fuel the total generating cost works out as follows:

a) Total operating cost:	0.1463	0.1214	0.1406
b) Total generating cost:	0.6188	0.7694	0.8456

Fuel prices:

Bunker C oil	8.2 ct/Imp. gal.	18410 Btu/lb.
Diesel oil	16.4 ct/Imp. gal.	19720 Btu/lb.
Natural gas	11 ct/mill.Btu	1000 Btu/cu.ft.

The plant unit cost comprises the total plant inclusive of land; buildings, railroad siding; oil tanks for a storage of 2,000 hours at full load; transformers and switchgear. The steam plant is designed for fuel oil firing and for a steam pressure of 900 psig., 900°F. It can also be used for natural gas firing.

Types and Applications of Gas Turbines

The simplest type of gas turbine is shown in Figure 1. It consists of a combustion chamber, the gas turbine itself, the air compressor, the generator and its auxiliaries and the starting motor. Outside air enters the compressor, is compressed to approximately 60 to 80 p.s.i.g., is mixed with fuel and ignited in the combustion chamber; from there the combustion gases reach the turbine, go through it and are discharged to atmosphere. The output of the turbine is greater than the power required by the compressor; the balance is applied to the generator. Starting is carried out by a starting motor for which auxiliary power is required. The starting motor does not have to be large enough to bring the gas turbine to full speed; one-third speed is sufficient to obtain an air volume and pressure to allow ignition in the combustion chamber and from that speed onward the gas turbine will accelerate itself until it reaches normal speed.

A neat arrangement is possible where natural gas at high pressure is available. This is to use a small expansion gas turbine as a starting motor, and also to reduce the high gas pressure to the operating pressure required for combustion.

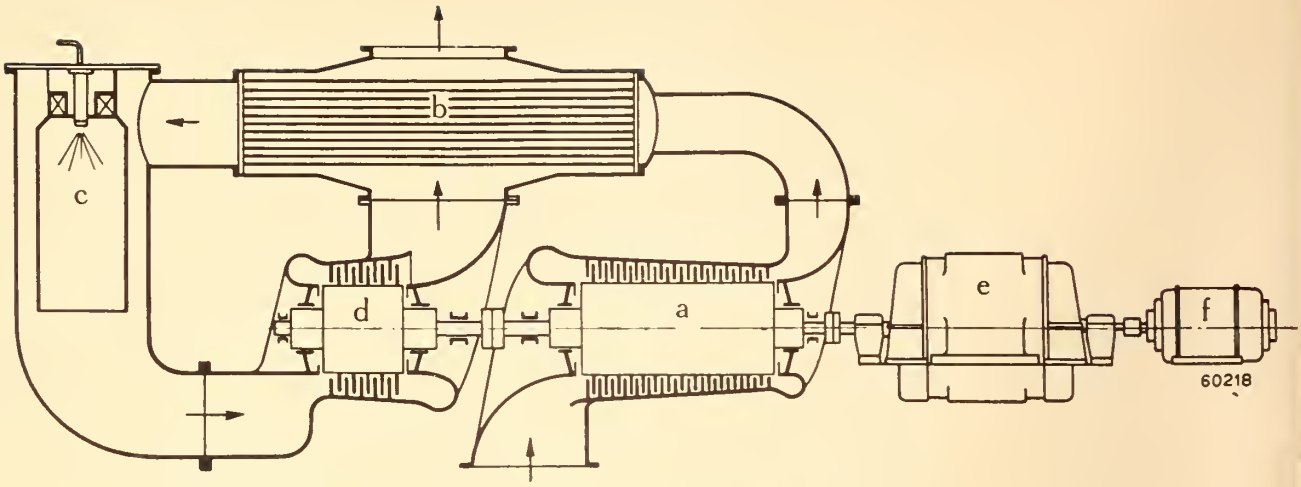


Fig. 3. Schematic arrangement of a single-shaft gas turbine with heat exchanger.

During normal operation this expansion turbine continues to furnish a small percentage of useful work. Such expansion turbines are in use with gas turbine plants in Iran. Where the gas pressure is too low for the necessities of combustion, a gas booster is added to the plant.

The Vermilion machine (Figure 2) is an example of the single shaft type without preheater.

Figure 3 shows a similar arrangement, but with the addition of an air preheater. The working principle is the same, with the exception that the air before entering the combustion chamber is heated in an exchanger, the latter being fed by the exhaust gases from the turbine.

The two-shaft turbine arrangement is diagrammatically shown in Figure 4. The paths of air and of gas are easily followed. Air enters the low-pressure compressor; after partial compression, it is cooled in a water-fed cooler and then passes into the high-pressure compressor. From here it enters the high-pressure combustion chamber. Then the mixture of gases and air is expanded in the high-pressure turbine. After giving up only the energy necessary to drive the high-pressure compressor, the gases then enter the low-pressure combustion chamber where a further quantity of fuel is added. This mixture enters the low-pressure turbine giving up its remaining useful energy and is discharged to atmosphere. It is obvious that many combinations of the two shaft arrangement can be made, for instance, with and without the addition of air preheaters. The generator can be placed on the low-pressure or the high-pressure shaft; the tendency today is to locate the generator on the low-pressure shaft.

Figure 5 shows the arrangement of a 13,000 kw. and a 27,000 kw

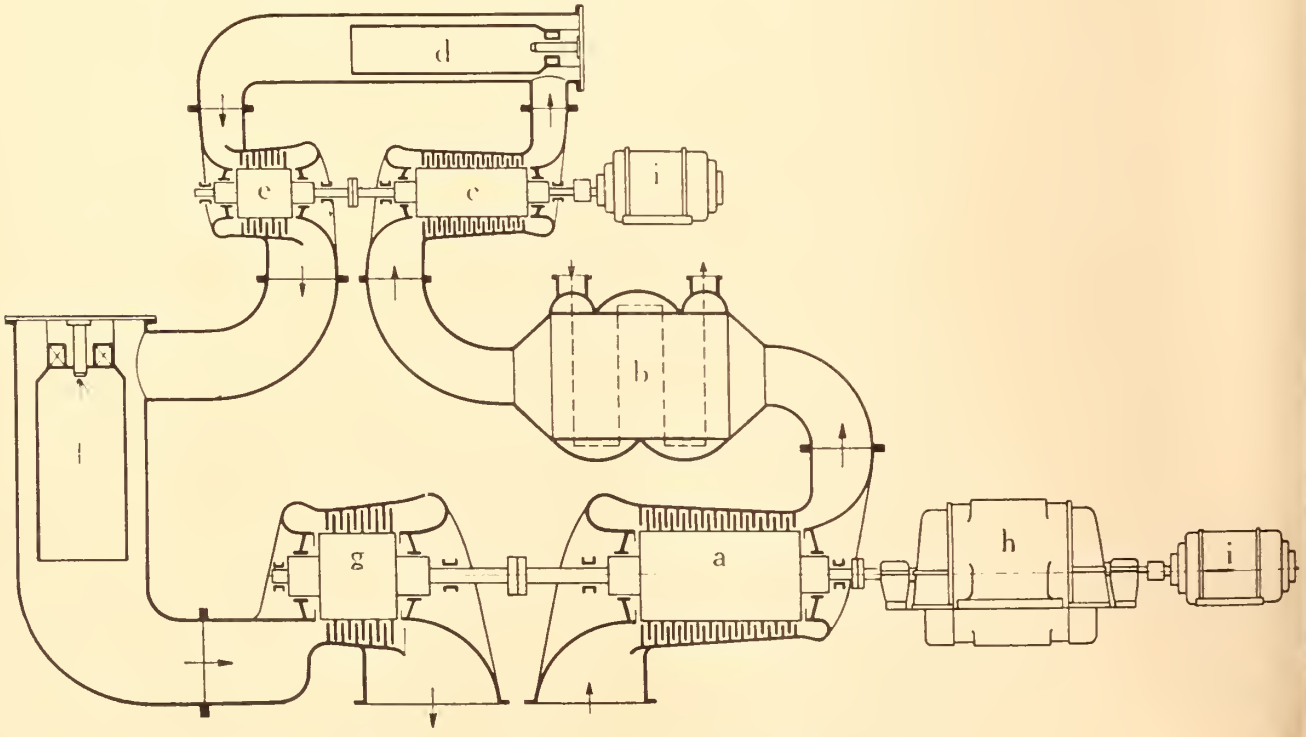


Fig. 4. Two-shaft gas turbine without heat exchanger.

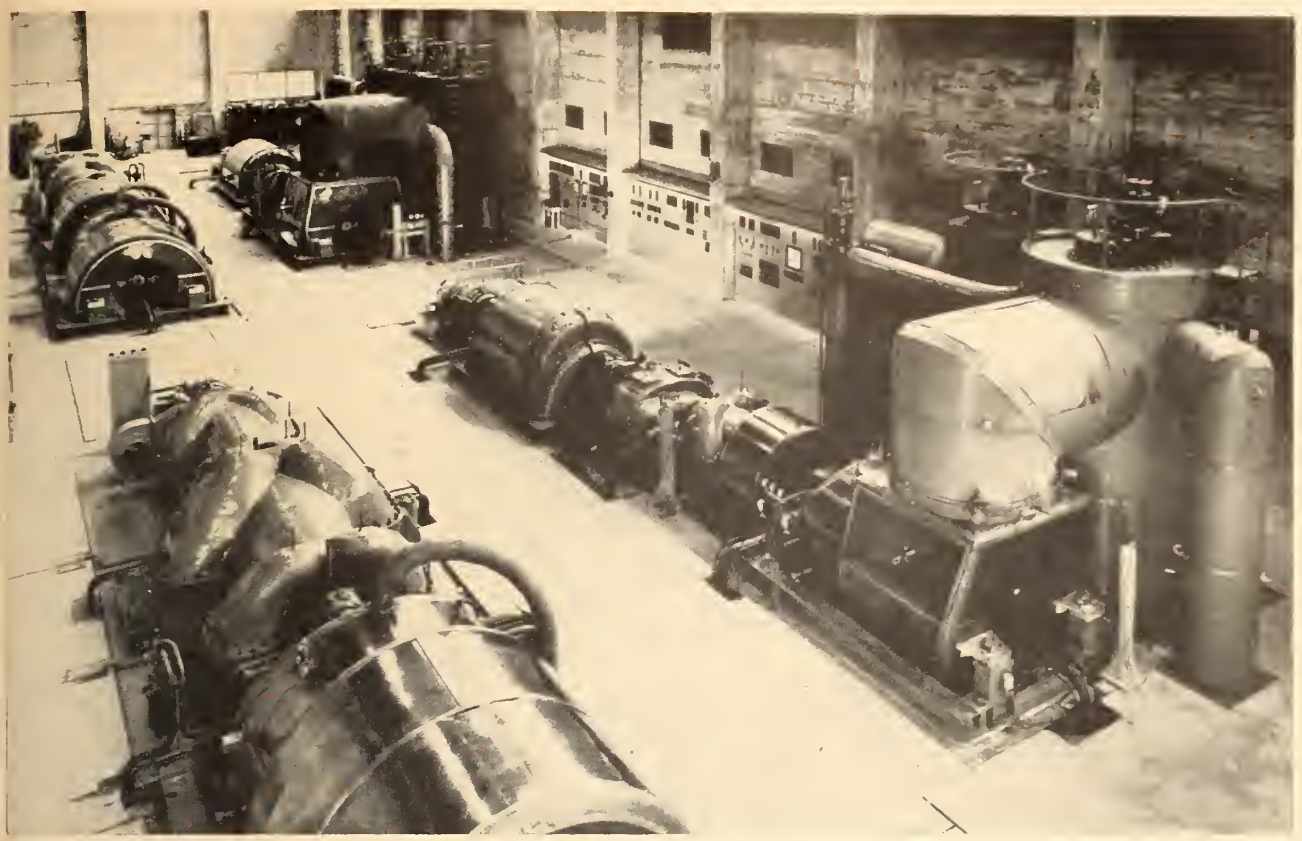


Fig. 5. General view of the gas turbine plant of Beznau, Switzerland, with the 13,000-kw. and 27,000-kw. gas turbine sets.

set in the world's biggest gas turbine station at Beznau, Switzerland. The set in the foreground, is the 13,000 kw. unit; at the back the 27,000 kw. set is visible. On the left the low-pressure part is shown, whereas on the right, the high-pressure turbine and its compressor as well as the 13,000 kw. generator are visible. In this arrangement the generator is driven from the high pressure shaft.

It is interesting to compare the Beznau machines and later designs, as far as general appearance and space requirements are concerned. This comparison leaves little doubt that, notwithstanding some difference in the general arrangement, progress has been made towards compactness and simplification.

Applications of Gas Turbines

The application of gas turbines to industrial requirements has been relatively slow, but it is certainly gratifying to note that in the last few months the number of gas turbine orders received has greatly increased. It certainly looks as if universal acceptance of the gas turbine has now been gained.

It has already been mentioned that the gas turbine is used mainly for electric power generation. Oversimplifying somewhat, it may be said that its primary field of application will lie, at least in Europe, in peak load service. In Canada, there is no doubt that it will also find its application for peaking purposes, although it should find considerable application as a base load machine in regions where natural gas is available.

Where gas is plentiful and cheap, or where flaring is now resorted to, the gas turbine is an ideal prime mover. Perhaps it will be applied mostly to supply base load, or perhaps at loads that correspond to the momentary output of gas,

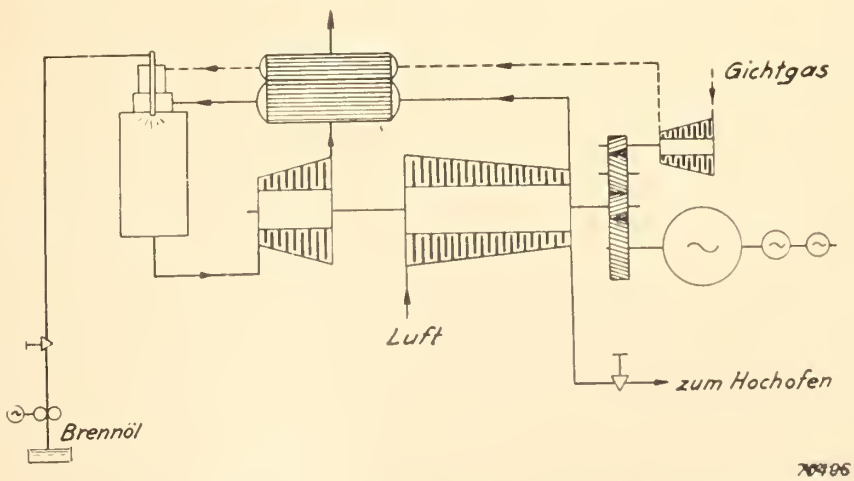


Fig. 6. Schematic diagram of the 5,400-kw. dual-purpose gas turbine plant installed at Dudelange, Luxembourg. Brennöl means fuel oil; gichtgas means blast furnace gas; luft means air; zum hochofen means to blast furnace.

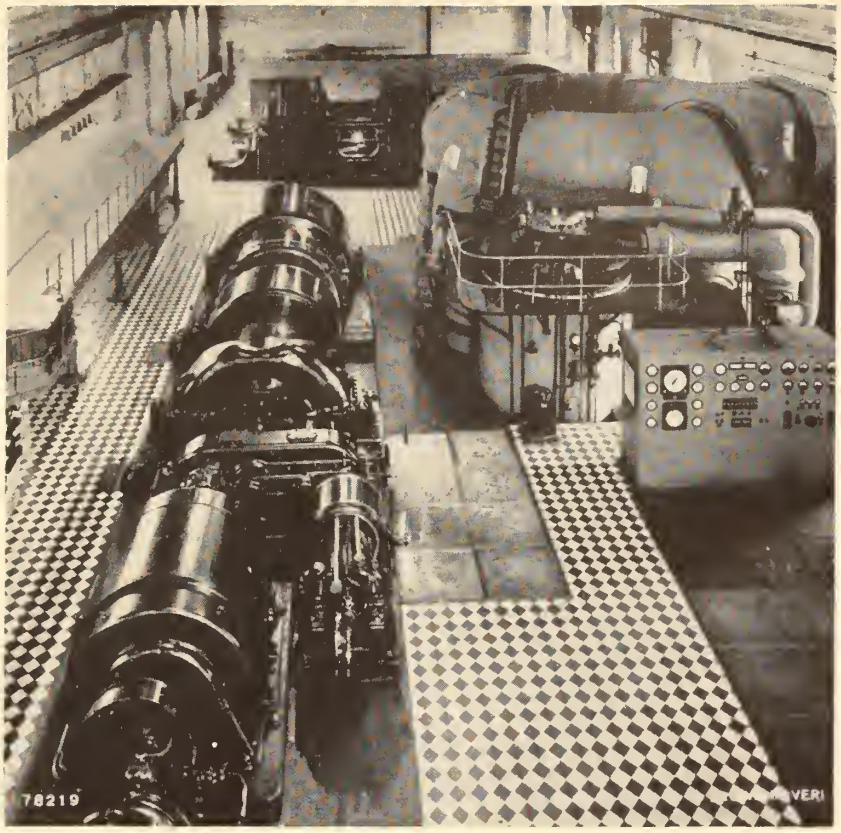


Fig. 7. General view of the 5,400-kw. gas turbine plant, dual-purpose type, at Dudelange, Luxembourg.

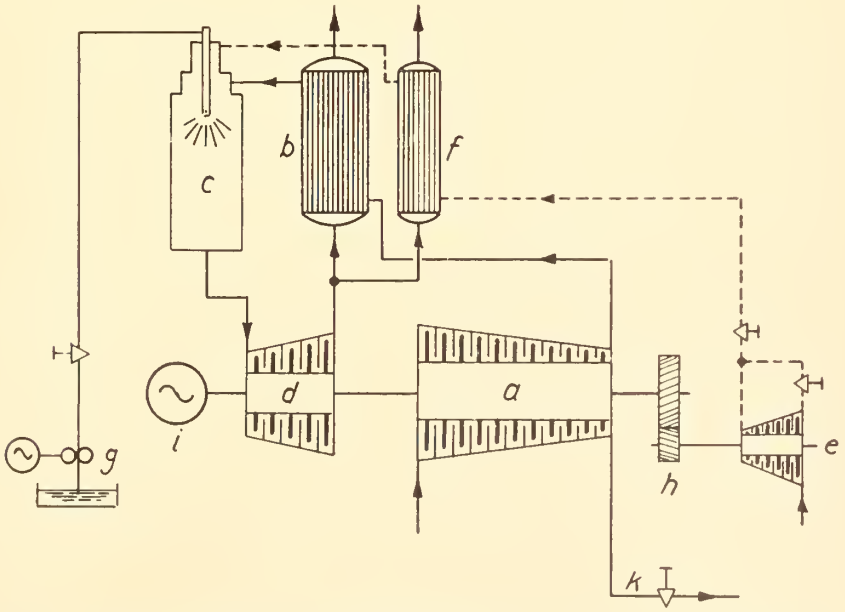


Fig. 8. Schematic diagram of the Baracaldo Steel Works gas turbine compressor in Spain.

Legend: a-air compressor; b-regenerator; c-combustion chamber; d-gas turbine; e-blast furnace gas compressor; f-blast furnace gas preheater; g-fuel oil pump; h-gearing; i-starting motor; k-air duct to steel works.

in a fashion similar to hydro-electric plants which make use of the run of the river.

Several gas turbine installations are in operation in the iron and steel industry, one example being a 5,400 kw. gas turbine installed at Dudelange, Luxembourg. The diagrammatic arrangement of this plant is shown in Figure 6 and a general view in Figure 7. The turbine uses blast furnace gas with low B.t.u. content. The plant consists of a single-shaft gas turbine of conventional type. Gas from the blast furnace is compressed by a small booster, driven by a gear from the main turbine shaft. The gas is then preheated in a heat exchanger and enters the combustion chamber. Meanwhile, the air has been compressed by the axial compressor, following which it is preheated before encountering the blast furnace gas in the combustion chamber. The combustion gases discharge through the gas turbine and the air preheater to atmosphere.

An interesting feature of this plant is the fact that it not only produces 5,400 kw. of electrical energy, but also fulfils the following additional requirements:

Delivery of 34,000 cu. ft. per min. of air at 28.5 p.s.i.g. for the steel works.

Delivery of 47,000 cu. ft. per min. of air at 7.1 p.s.i.g. for the blast furnaces.

Of course, the electrical output is automatically reduced, according to the demand for air.

This installation replaces spare compressors for the steel works and the blast furnace, thus reducing the initial cost of the plant very considerably. It might be said that the plant cost nothing at all.

A further interesting feature of this installation is the fact that it is a dual fuel plant. In the event of failure of the gas supply, which is always a possibility in a steel works, fuel can be changed immediately to oil.

Another machine, very similar to the Dudelange one, is installed in the steel plant of Altos Hornos de Viscaya in Spain. In this case the generator has been dispensed with completely, and the compressor is used exclusively for providing air for the Bessemer converters. The arrangement is shown in Figure 8. The set is a variable speed machine with pressure or governing and is fitted with

temperature limiting device, regulating the maximum air quantity delivered to the converter in relation to the maximum admissible gas turbine inlet temperature.

In this plant also dual fuel firing is available. A shortage of blast furnace gas will cause a speed drop; this in turn causes an alarm to be sounded and the operator will then actuate the liquid fuel valves. The machine regains speed, working either on a mixture of gas and liquid fuel, or liquid fuel alone if the blast furnace gas supply fails entirely.

The small dimension of the gas turbine makes it ideally suited to semi-mobile and mobile installations. As semi-mobile installations, the six 5,000 kw. gas turbine sets supplied to Aramco for Saudi Arabia may be mentioned. Although they are installed in permanent buildings, they are nevertheless intended for possible removal to other sites, the gas turbine, compressor and generator being installed on an easily dismountable base plate.

Complete mobility is reached in the two units under construction for the Federal Electricity Commission of Mexico (Figures 9 and 10). The plants are built for an output of 6,200 kw. and are mounted on two railway cars. The first car, the heavier, carries the gas turbine set with compressor, combustion chamber, generator and starting motor, as well as the turbine control board. The second car contains the high-tension switchgear, including air-blast circuit breakers on the 13.8 kv. side, and the step-up transformer with voltage taps for connection to the various prevailing voltages. A diesel generating set for starting purposes is also installed in the second car. The plants are completely independent of outside supply, except for fuel, furthermore all cooling is done by air thus making the plant also completely independent of water supply. It is perhaps interesting to note the relatively low cost of energy production expected with these plants. With bunker oil and with an annual running time of 50 per cent at 100 per cent load, the cost will be in the neighborhood of 8.5 mils per kwh. With diesel oil, the cost rises to 1.1 ct/kwh. with all fixed and operating charges taken into account.

These plants have been ordered to take care of seasonal load variations in various parts of the country. During the cotton ginning season, for instance, there is a heavy increase of power demand that is limited to a few months of the year. Now these demands cannot be adequately met. The plants will also be used in emergencies and for supplying the power necessary during the construction of dams and power stations in outlying parts of the country. Both plants are now under construction.

To complete the picture, mention should also be made of the two gas turbine locomotives of 2,200 hp. and 2,500 hp. respectively, in operation on the Swiss and the British State Railways (Figure 11).

Table II. Running Record of Some Gas Turbine Sets

	Kw output	Operating Hours	Total kwh. generated	Data available up to
Filaret, Romania	10,000	5,124	41,580,000	29- 3-54
Chimbote, Peru	4,000	7,505	3,522,000	30- 9-54
Santa Rosa, Peru	10,000	11,058	83,903,000	31-12-54
Pertigalete I, Venezuela	1,650	21,068	25,422,300	15- 1-55
II, "	1,650	20,311	23,569,900	15- 1-55
III, "	5,000	15,290	55,098,000	15- 1-55
Areache, Egypt (emergency plant)	1,200	6,932	4,717,000	1- 1-55
Beznau I, Switzerland	13,000	11,500	294,000,000	1- 1-55
II, "	27,000	8,600		
Dudelange, Luxembourg	5,400	22,720	108,000,000	1- 1-55
Dharan I, Saudi Arabia	5,000	5,256	25,308,000	2- 3-55
II, " "	5,000	6,144	24,047,000	2- 3-55
III, " "	5,000	1,842	?	2- 3-55
*Vermilion, Canada	6,000	2,756	14,733,100	28- 4-55

*Since commissioning, this machine has carried out 213 starts and a peak output of 8,800 kw. has been obtained at −2°F.

Operating Results

Although operating results have been discussed by various authors, it may be of general interest to indicate the latest figures from some representative plants, as set forth in Table II.

Relatively few difficulties have been encountered with the operation of Brown Boveri gas turbines and those that have come up have always been satisfactorily solved. Brown Boveri have never considered the manufacture of gas turbine engines for aircraft and have therefore never been influenced by this type of machine.

The development of their gas turbine designs has been slow and well measured. The very beginning is found in the development of the diesel supercharger, where interesting and valuable experience was gained. Parallel with the development of supercharging came the gas turbine used in conjunction with the so-called Velox boiler. The latter, which should not be called a "boiler", but more properly a "steam generator", is a supercharged boiler where extremely high gas velocities are attained, thus ensuring a very favourable coefficient of heat transmission. To obtain the high gas velocities required, the feed air to the boiler has to be supercharged and this is done by means of a gas turbine and an axial blower, similar to those described here. Temperatures at the gas turbine inlet are, however, very moderate—of the order of 800 to 850°F.—and a great deal of experience both in design and with materials has been obtained over a considerable period of years from such plants. Mention should also be made of the considerable number of gas turbines installed before the last war in connection with the Houdry gas cracking process in the gas and oil industry.

It is clear that any development of the industrial gas turbine, in contradistinction to the highly stressed aeroplane engine, has had to follow conservative and cautious lines. Therefore the inlet gas temperatures of gas turbines have been kept down to conservative figures. Only after it had been ascertained by artificial ageing and other methods that the materials being used would stand the stresses imposed upon them by higher tem-

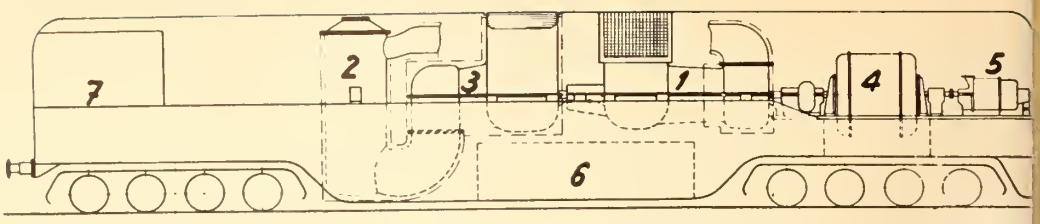


Fig. 9. General arrangement of the 6,200-kw. portable gas

Legend: 1-air blower; 2-combustion chamber; 3-gas turbine; 4-alternator; 5-exciter (also starting motor); 6-fuel oil starting tank; 7-switch and con-

perature, have the latter been allowed to rise.

The making public of technical difficulties and problems in connection with gas turbines has not always been appreciated at its full technical value. It seems that the frank admission of such difficulties has provoked some experts into criticizing gas turbine manufacturers one-sidedly. They have often done so by, generally or conveniently, omitting to mention the remedies and solutions with which manufacturers have successfully overcome these difficulties.

Maintenance Costs

In table I a figure for maintenance has already been indicated, a figure of primary importance to the user. There is certainly some variation in the maintenance cost of one plant compared to another.

One of the cheapest plants in maintenance cost per kwh. is the Dudelange gas turbine plant which, as will be remembered, is a dual-purpose machine fired with blast furnace gas. After completing its third year of service, there have been no spare parts used and the cost of maintenance has been estimated at about 0.002 cents per kwh. The highest costs have been experienced in the Beznau plant, where they are in the order of 0.008 cents per kwh. It should be remembered however that the plant is using Bunker C fuel and the maintenance cost includes periodical washing of the gas turbines.

In order to be on the safe side a figure of .025 cents per kwh. is perhaps reasonable. This figure would include the cost of periodical cleaning of both gas turbine and compressor and for inspection and overhauling after a period of, say, one year, including the cost of spare parts which might be required then. Also included is the cost of replacement of such parts as may be required after 100,000 running hours.

It should be stressed that the maintenance cost of gas turbines fired with gas should ordinarily be lower than that of other types. Since gas is the normal fuel expected in Canada, the lower maintenance figure, as indicated for the Dudelange plant, should really be taken into account for Canadian operation.

It may be of interest to indicate in a general way the maintenance which is involved; take the most unfavourable case, i.e., that of the Beznau plant with two machines, two-shaft arrangement, with preheater, intermediate coolers, and Bunker C fuel. The running maintenanee work is roughly the following:

Periodical check of the combustion chambers.

Periodical check of the fuel injection devices.

Cleaning of fuel tanks.

Periodical washing of the gas turbine in order to remove slag from the gas blades.

Periodical putting into service of the soot blowing equipment of the heat exchangers.

On an annual basis, the following additional work is involved:

Checking the air coolers.

Checking the heat exchanger.

Checking the control and safety devices.

Cleaning the fuel system.

Checking the compressors where necessary.

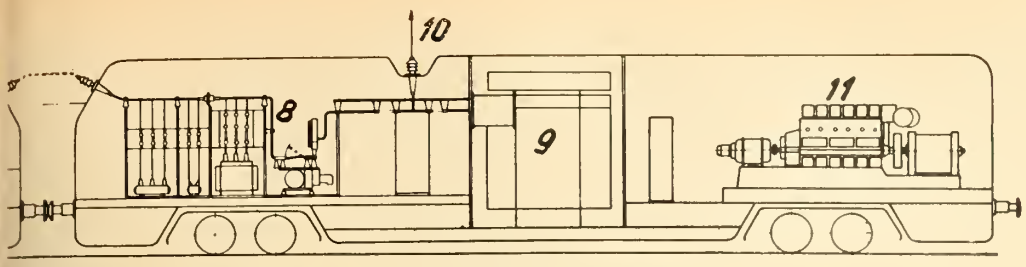
General check of the gas turbine

Operation of Gas Turbines

The gas turbine for power generation being a recent addition to the power field, it is natural that the operating people are anxious to know whether the operation and behaviour of the sets present any difficulties and special problems.

For starting a gas turbine, even a two-shaft set, one operator is sufficient. During normal runs, the attendance required is also limited to one man who may look after the machine and also attend the electrical switchboard. Obviously the personnel required will vary with the size of the plant, but there is no reason why a single shaft turbine may not be arranged for completely automatic and remote operation, thus reducing attendance cost considerably. Periodical inspection of such an automatic plant could be carried out by a flying squad whose job need not be limited to one plant only. It is simply a question of economics as to whether the extra cost involved for automatic operation is ultimately balanced by the saving made on labour and supervision. In Canada and for the smaller plants, there would seem to be a good case for completely automatic and remote control.

For attended plants, it is interesting to compare the number of attendants required as contrasted to those necessary with a steam plant, for example. Taking the case of Beznau, where there are the 13,000 and 27,000 kw. sets, the following personnel are available:



turbine plant for the Comision Federal de Electricidad, Mexico.

trol board; 8-HT switchgear; 9-step-up transformer; 10-connection with local network; 11-auxiliary diesel generating set.

One technician in charge of the power station.

Two mechanics per shift.

Two auxiliary workers per shift.

There is also a small reserve shift, which is used for incidental repair and general maintenance work in and around the station.

It is estimated that for a steam plant of the same capacity, say with two 20,000 kw. generating units, the cost for operation and supervision would be roughly, three times as high. The actual operation of the turbine is simple. The whole set is started by means of the starting motor, or starting motors, in case of two shaft arrangements. In three to five minutes, a starting motor reaches about one-third of the normal shaft speed. At that moment, it is disconnected from its supply and goes on turning with the rest of the set, but without applied power. Before reaching the above speed, the gases or oil in the combustion chamber are ignited, and the turbine starts to help accelerate the set, thus allowing the starting motor to be cut out, as mentioned above. As soon as the proper speed is reached, the set can be synchronized and the generator can be loaded. The entire starting operation requires 10 to 20 minutes. The stopping operation presents no problems.

Figure 12 shows the loading chart of the 13,000 kw. gas turbine at Beznau on a day when the set was on peak load from about 10 a.m. to noon, during the so-called "Swiss cooking peak." Loading started at 9.50 a.m. and the full 13,000 kw. was reached at 10.20 a.m., the rate of loading being therefore something of the order of 430 kw. per minute. The loading conditions of the bigger set are at least as impressive, showing a loading time of 40 minutes to about 26,000 kw., or in other words a loading of 650 kw. per minute.

A 12,000 kw. unit has been brought up to full speed in about six minutes and two minutes later it was carrying full load, all this from the cold.

Should a gas turbine be required to make frequent starts and stops, such as are required for peaking, barring gear similar to that applied to steam turbines is provided.

It is often desirable that the generator be capable of working also as a synchronous condenser and that provision be made to have the coupling between generator and turbines easily accessible and removable. During a recent visit to Beznau, both generators were running as synchronous condensers, owing to the abundance of hydro power which prevailed at that time in Switzerland.

A special type of coupling allows the uncoupling of the generator from its gas turbine at full speed, thus permitting a change from power generation service to

Fig. 10. General view of the 6,200-kw. gas turbine plant for the Comision Federal de Electricidad, Mexico. (contractor's sketch.)

Fig. 11. 2,200-hp. and 2,500-hp. gas turbine locomotives of the Swiss Federal Railway and British Railways respectively; the British locomotive is "No. 18,000".

synehronous condenser service at any time. Reeoupling, however. ean only take place when the maehine is at a standstill.

Conclusion

It may well be said that the gas turbine has eome to stay. In a country like Canada, where abundant oil and gas are available, th gas turbine should provide a wel eome new device for producin power. The gas turbine is, how ever, not here to replace othe modes of generation. Economically it has a justified plaee in takin eare of certain kinds of load an its installation in preference t other modes of generation wil depend on the problems to b solved and on the local condition The western provinces, with thei chcap gas supply, are ideally suite to the installation of gas turbine and it is to be expected that the will to a eertain extent replac steam generating plants there.

In the east, where hydro powe is abundant, and where therefor the eost of power generation b gas turbines is quite dependent o the cost of fuel, the future of th gas turbine will be found especial ly in the field of peak load plant and in industrial applications. O the other hand, if relativcly chea gas supplies are available in th east, there may be factors in fav our of the gas turbine for base loa operation; this would probably in volve plants with heat exchange to inerease efficiency. For the high er outputs, two-shaft maehin would likely come into considera tion.

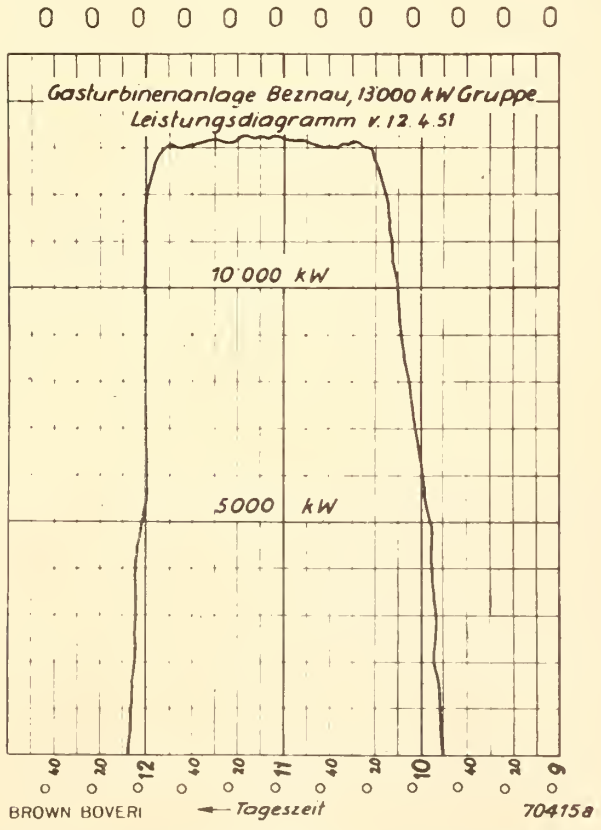


Fig. 12. Loading and unloading diagram of 13,000-kw. gas turbine unit. (Gasturbinenanlage Beznau, 13,000-kw., Gruppe, Leistungsdiagramm v.12.4.51, means Beznau gas turbine plant, 13,000-kw. unit, performance diagram for 12.4.51; Tageszeit means time of day).

Fig. 1. Individual digester control panels on operating floor of kraft pulp mill.

Modern Trends in Layout and Design of Pulp and Paper Mills

by

A. M. Hurter, M.E.I.C.

Project and Process Engineer,
Stadler, Hurter and Company, Consulting Engineers,
Montreal

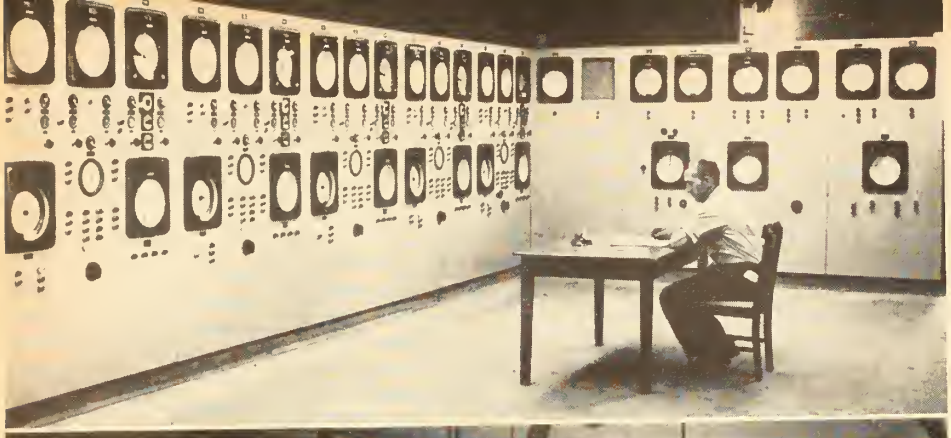
The past decade has witnessed the introduction and rapid growth of the semi-chemical pulping processes, high yield pulping, and the consolidation and standardization of the multi-stage bleaching processes. It has also witnessed the use of chlorine dioxide for pulp bleaching, the introduction of chemi-groundwood and improved methods of pulping agricultural residues. However, apart from these developments there has been little change in the basic technology and processes of pulp and paper manufacture and there is no indication that this situation will change in the near future.

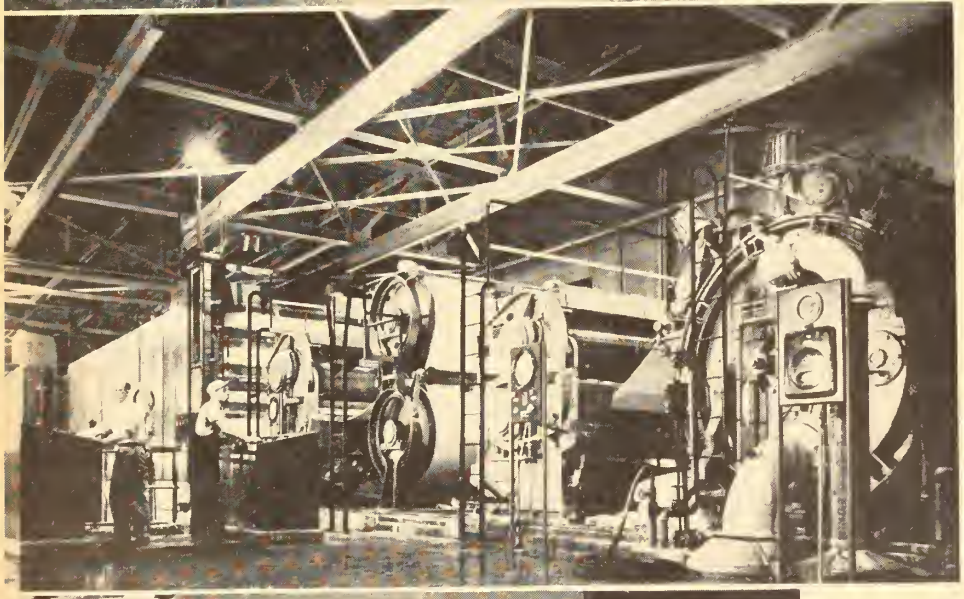
The big change in the industry has been rather in the more careful application of the standard and established processes and equipment, to effect improved control and manpower and waste reduction. In other words, the biggest changes in the industry and present trends have been, and are, more a matter of careful engineering than of the introduction of any revolutionary development of the research laboratories.

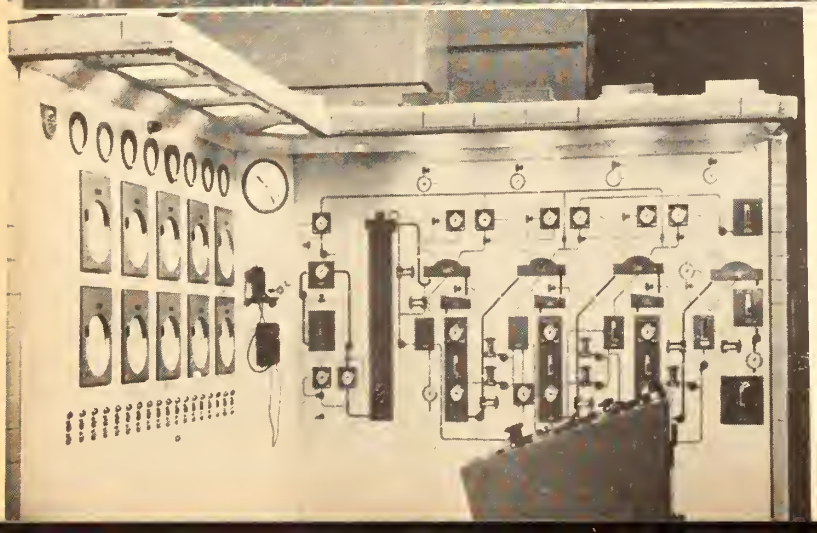
This paper was prepared for presentation at the Latin American Meeting of Experts on the Pulp and Paper Industry, under the joint auspices of the United Nations Economic Commission for Latin America and the Food and Agriculture Organization at Buenos Aires, October 19th to November 2nd, 1954. While the paper was specifically prepared for presentation in Latin America, most of the material is applicable to the pulp and paper industry in general.

This change, automation, manpower and waste reduction, has come about so gradually that it has, to a large extent, passed unnoticed. The reason for this is simple. With few exceptions, no basically new process or art is involved, nor has there been any radical change in processing equipment. Modern pulp and paper equipment, while in many cases greatly improved, remains essentially the same as equipment available a decade ago.

Indeed, in many cases the modernization of equipment has consisted merely of quite unnecessary "streamlining" to improve the appearance. It is quite possible, therefore, with minor modifications, to design an essentially modern pulp and paper mill using equipment available a decade ago. The opposite is equally true—it is







also quite possible to design an obsolete mill today using modern equipment and technology.

How, then, has this change to better control and manpower and waste reduction come about? It has come about gradually by product specialization, the introduction of product control systems, the application of automatic control systems and effective materials handling, and through well engineered mill layouts and mill integration.

The first of these factors, product specialization, is simple. It is not difficult to see that a mill producing only one, or a very small number of products, will be more efficient and have a lower unit production cost than a mill producing a wide variety of products, all other factors being equal. For this reason there has been a pronounced trend towards product specialization.

However, product specialization is not always possible in a limited market, and for reasons discussed more fully later, specialization in only one product is not desirable if a high grade product is to be produced at reasonable cost. A careful analysis of production costs of various grades, together with a more careful analysis of customer requirements can, however, greatly improve the efficiency of a mill producing a wide variety of products.

One fine paper mill we know of, operating in a limited market, greatly reduced the variety of papers produced without loss of sales volume by such an analysis. They found production costs of some grades were higher than economical, due to the additional cost of lost time on grade changes, and that in many cases the customer had no real reason for requesting a particular grade other than precedent. It was found that in many cases the customer was

Fig. 2. Consolidated digester control panel in control room of a sulphite pulp mill.

Fig. 3. Individual console type washer control panels in kraft bleaching plant.

Fig. 4. Individual console type control panels controlling a pulp drier.

Fig. 5. Graphic control panel in a bleaching plant.

quite willing to accept an alternative grade if it met his actual needs, particularly if he could obtain the new grade at a lower priee.

The second factor, product control systems, is somewhat less obvious. Quality control, testing proeedures and statistical control methods form a subject in themselves, and are beyond the scope of this paper.

The primary reason for product control systems is quality uniformity, but there is also the secondary purpose that the customer shall not necessarily receive the highest quality that is technically feasible, but only the quality commensurate with his needs, production costs, the price received and market conditions. Worded in this manner, this may sound somewhat strange. It is a fact, however, that many mills do produce a much higher quality product than is required by the end use, the competitive position and even the customer's desires.

We know of a pulp mill whose management pride themselves on the excellence of their product. It is excellent pulp,—far better than competitive brands at the samo price—but the excellence is due to a drastic wood cleaning operation, which results in a direct loss of 15 per eent of their raw material. The ehief reason they continue to maintain such an operation is that they lack, among other things, a product control system, and eannot control uniformity of product except by such severe wood cleaning methods.

Produet speeialization and produet eontrol systems are mentioned briefly beeause they are faetors affeeting manpower and waste, and these are important factors. However, in our opinion the chief factors that have influenced the modern trends in layout and design of pulp and paper

Fig. 6. Wood handling system with racked wood piles.

Fig. 7. Long belt conveyor for handling wood from slasher to mill.

Fig. 8. Single fixed arm movable stacker for random piling of wood.

mills are: automation, materials handling, mill layout and mill integration.

Automatic Control

The trend towards automatic control and instrumentation is not peculiar to the pulp and paper industry, but is a growing feature of almost all industries. The general trend to automation has been termed "The Second Industrial Revolution", and many articles and papers have been written on the subject of automatic factories, automatic control and servomechanisms. Even novels have appeared outlining the social impact of automation.

In the pulp and paper industry, the more obvious factors that lead to the introduction of automatic control systems are better control of quality and material, and reduction of waste. The shortage of labour during the war and its high post-war cost focused attention on the manpower reduction possible by automatic control. Also the sheer growth in physical size of many mills and the need for co-ordinating a large series of unit operations has, in many cases, made manual operation impractical.

The growing trend toward automation is also closely tied in with process equipment development and design. Batch process operations have large equipment and space requirements, which greatly increase the capital cost of a mill, hence continuous processing with much smaller equipment and space requirements, is favoured. At the same time, automatic control systems which improve quality control and reduce labour requirements are more easily applied to continuous processing systems. Conversely, the design of most continuous process equipment is based on the maintenance of constant material and energy balances, which requires automatic control.

Automatic control and continuous processing are thus closely linked, and have arisen from both operating and capital cost considerations. Which has led to which is difficult to say, but the author believes no one will deny that automatic control has shaped and affected the design and process of modern pulp and paper mills to a very great extent.

In addition to controlling operations at, or near, optimum efficiency, automatic control systems generally provide a record of their operations. This has provided a source of data and information on plant operation and troubles, such as was never previously available. This source has proved invaluable to research staffs and plant management, who are constantly seeking to improve the plant efficiency and to detect the source of trouble, though some regard the records furnished by automatic control instruments as a mixed blessing.

The sheer volume of record charts that must be collected and changed, analyzed and filed each day in a modern mill is rather overwhelming. It would appear that pulp and paper mill personnel having been without very complete records of operation for so many years are now determined to record everything possible. In time, as equipment and technology improve, the number of recording control instruments will probably decrease, and only the more important process variables will be recorded.

There is also a trend toward multipen instruments which will record several process variables on one chart. This should help in reducing the volume of charts, and facilitate the analysis and comparison of inter-dependent variables.

Automatic control in pulp and paper mills is still far from complete automation. Indeed, automatic control is at present, in most cases, confined to individual process stages, and there is little interlinking of successive operations. However, much has been accomplished as can be seen from Figs. 1 to 7. Fig. 1 shows the operating floor of a kraft pulp mill digester house with an automatic control panel for each digester, and with recording and control instruments to control the digester cooking cycle.

Fig. 2 shows a more recent trend in digester control systems. In this case—a sulphite pulp mill—all the control panels are located in a control room beside the operating floor, instead of mounting individual control panels opposite each digester as in Figure 1. This arrangement has the advantage that the cook can observe the operation of all digesters and can be aware of trouble or emergencies more rapidly. Also, the instruments are protected from corrosive fumes and vapours.

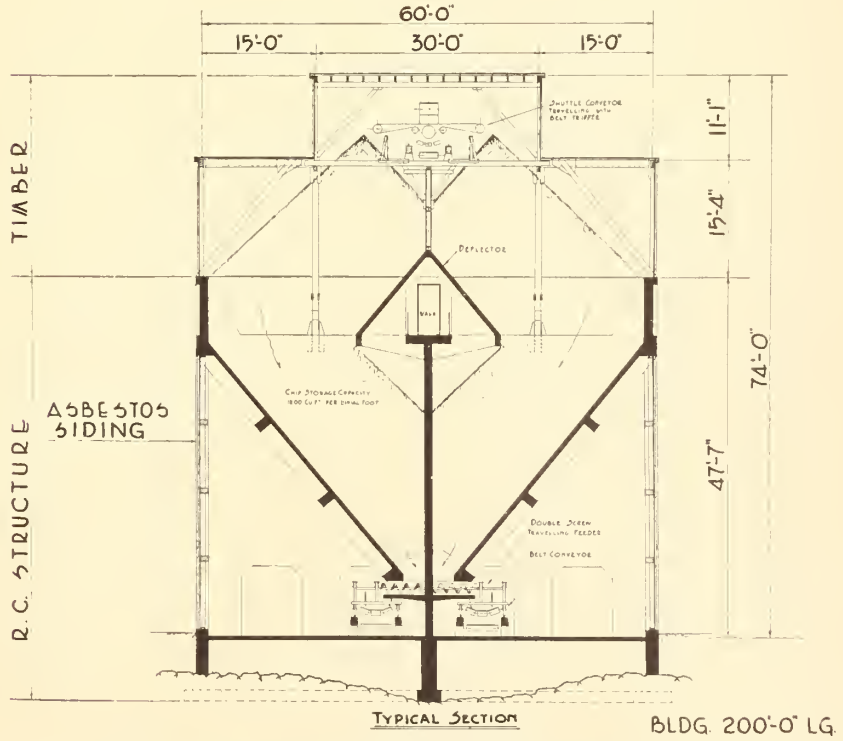


Fig. 8a. Cross section of a modern fully automatic ground level chip storage bin. The screws travel the full length of either side of the bin undercutting the entire mass. One side of the bin is always kept straight to prevent arching and the deflectors reduce the weight on the discharge to prevent packing.

Fig. 3 shows individual console type control panels for the control of vaeuum washers in a bleachery. These panels are for washer control only. The main bleachery control panel is located on the end wall, not shown in the picture. Fig. 4 shows similar console panels for the control of pulp dryers.

The latest development in automatic and remote control panels is the graphic panel. On such panels a flowsheet of the process stage is painted on the panel, or formed from strips and plastic silhouettes. The remote control valve switches and the control instruments are mounted on the panel at the correct positions relative to the flowsheet, (Fig. 5). Usually the instruments are of a miniature type for space reasons.

Such graphic panels have the advantage that it is instantly apparent what points in the system are being controlled by the various control instruments and switches, and the chances of error are therefore reduced. They are also of great assistance in training new personnel, and in starting up a new process or mill.

It is expected the trend will continue and that as the equipment and technology for continuous processing improves, the degree of interlocking of control systems for various process stages will steadily increase with a still further reduction of manpower. At the same time, stock chests which are at present required to equalize flow and quality between stages will gradually disappear.

At present most of the instruments used for automatic control are of the pneumatic type. They have the merit of being relatively simple—their handicap is a limited transmission distance. Electronic instruments, which do not have this limitation, are gradually making their appearance, though there is some hesitation to their adoption among mill personnel. These instruments are definitely not so easy to repair.

At this point you may well say, "Ah, repairs! Automation may be very well in Canada and the U.S.A. where proximity to suppliers makes repairs a simple matter. What about countries remote from instrument suppliers such as South Ameriea, Africa, or the Far East? In any case, labour-saving is not so important here, for labour is cheaper."

In answer it should be pointed out that automation not only decreases the manpower required but also decreases the operating skill required. To learn to cook pulp by manual control to a consistently reasonably uniform quality requires years of experience. With automatic control almost anyone can obtain good results in less than two weeks.

Thus, if a mill is to be built in a remote area where little, if any, skilled labour is available, in the first place automatic control reduces the number of men that have to be trained; and secondly, the training period can be greatly reduced. The mill can thus begin to produce at a much earlier date and the gain in production will more than offset the cost of the instruments.

It is perfectly true that automatic control instruments require maintenance, and any control system is only effective as long as it is properly serviced. It is at this stage that most difficulties occur. If the mill is remote from instrument suppliers and does not have a man trained in instrument work, they may as well forget about automation completely. Any money spent on instrumentation would be wasted.

However, most of the instrument companies have excellent training programs to train mill personnel in the application, care and repair of control instruments. It is thus possible to have personnel trained to properly service any instruments purchased. A large mill using instrumentation extensively, or even a small mill producing only one or a small number of products which permit extensive automatic control, can afford to maintain a trained instrument mechanic or engineer.

On the other hand, mills producing a wide range of products largely on a batch basis and which can therefore utilize only a limited amount of automatic control, generally cannot afford the instrument maintenance required. The big mistake many mills make is that they purchase a few instruments, so few that having a man trained and assigned to maintaining them is not warranted. As a result these instruments soon become useless from lack of maintenance. The author suggests that in areas remote from instrument suppliers automation is a question of all or nothing.

Fig. 9. Cable conveyor system with movable twin hinged arm stacker for random piling of wood. The elevation of stacker arms can be adjusted to height of piles and the stacker arm can also be lowered to the ground for reclaiming of wood.

Materials Handling

Materials handling, that is, the effective economic handling of raw materials, materials in process and finished product, has received a great amount of attention in the past few years. It is a major consideration in modern mill design, and is one of the pronounced differenees between older and modern mills. As generally used, the term "materials handling" in the industry applies primarily to the handling of raw materials, or finished products. However, although the bulk of the "handling" of materials in the processing stages is by pump and piping, some interesting "materials handling" problems do arise in the processing stages.

The handling of raw materials and finished product is a simple matter of how to handle the material at the lowest possible unit cost. The high cost of labour in North America was the prime incentive for the study and application of materials handling methods and techniques. The high cost of labour is also, incidentally, the reason that materials handling techniques are most advanced in North America.

The handling of materials in process is another matter, and is due largely to the trend to continuous processing. While manpower saving is a factor, it is more a problem of providing uniform feed to processing stages, which is difficult to accomplish manually. The important consideration is that the system shall permit the desired degree of control, and that it is capable of continuous trouble-free operation with very little maintenance. Cost is of secondary importance, and in general the technically best solution is used.

The subject of materials handling is complex and the applications vary greatly among mills and areas. Almost each material in each area and type of mill is a subject in itself. We will, however, attempt to cover briefly some of the principal trends.

The one basic trend is towards handling of all raw materials in one shift, and in some specialized cases, such as large newsprint mills, this trend is being expanded to include handling of finished product. The labour saving is obvious. On a 3-shift operation manpower is reduced to a third, on a 4-shift operation to a quarter. Handling of all raw materials in one shift requires that the handling equipment be of sufficient capacity to deliver the total daily requirements in one shift. It also requires sufficient storage with automatic discharge to carry mill operations over the remaining shifts.

The handling and storage of chemicals and fuel for one-shift materials handling operation usually presents no difficulties and no great expense. The storage of wood chips is also no great problem or expense but the cost of the wood handling, barking and chipping equipment increases considerably with one-shift operation. In the case of straw pulp mills, particularly those using a cut straw operation, one-shift operation with

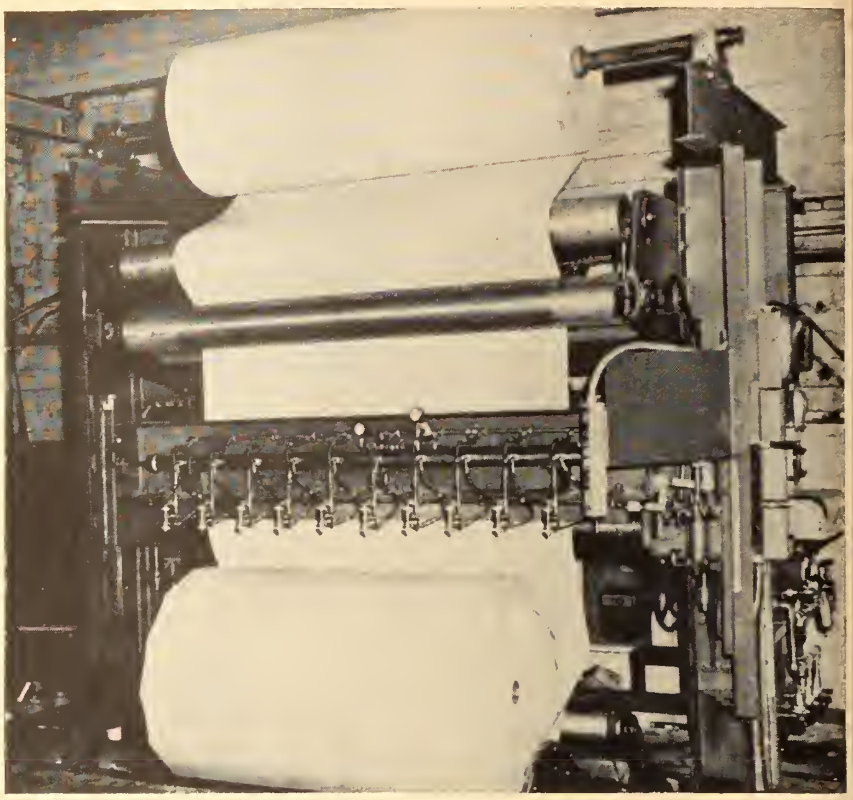


Fig. 10. Fully automatic roll wrapping machine.

appreciable labour saving is difficult.

The handling of wood, the most common raw material, and in the production of wood pulp, the largest by volume and the most cumbersome of the raw materials used, has naturally received the most attention. Wood handling systems vary considerably, depending on the mill location, type, size and means and frequency of wood delivery.

Mills where delivery is seasonal must have sufficient wood storage to carry the mill over periods when no wood is delivered. Generally, such long term log storage is by large random block piles. While racking of wood is preferable, particularly in the case of chemical pulp mills, only mills requiring a comparatively small amount of wood storage, or mills in areas of high wood costs, can afford this method.

Racking of wood and reclaiming, whether by travelling crane, a conveyor system (Fig. 6), or manually, is costly. Random piling by means of a stacker and reclaiming by grapple and crane is very much cheaper. Mills in areas where wood supply is more or less continuous all year round have no great storage problems. Storage by random piling by crane, racked storage, or water storage is feasible and inexpensive.

In modern mills of northeastern North America, wood handling by belt conveyors is the trend in larger mills. The conveyor shown in Fig. 7, we believe, is the longest in the world handling wood. The length is 1,610 ft. between pulley centres. Fig. 8 shows a single fixed arm travelling stacker. The reinforced concrete tower in the foreground is one of the fire protection towers, almost completely buried in the pile when the pile is full.

The belt conveyor is technically the best solution for handling wood in northern climates. Power and maintenance costs are low but capital costs are high. However if capital is expensive and the first cost of a wood handling system is of paramount importance, or if the quantities of wood handled are small, a cable conveyor system is generally used, even though it is technically inferior and the power and maintenance costs are high. Fig. 9 shows a cable conveyor system designed for a Finnish mill. Here the travelling stacker has movable arms which can be lowered and also used for wood reclaiming.

Short or steep log conveyors are usually of the chain type. It is, however, possible to carry wood on belt conveyors up inclines of up to 8 degrees, if a herringbone profile type rubber belt conveyor is used. Cable conveyors can handle wood up inclines of up to about 20 degrees. In warmer climates and where an ample supply of water is available, water flumes are used extensively in place of the belt and cable conveyors used in northern mills. For obvious reasons flumes are used in Northern mills only for the summer delivery of wood.

In all cases the critical points of any wood handling system are the transfer points between conveyors. Ideally, logs should transfer with a minimum of drop, at a speed matching the conveyor and turned in the right direction. Logs falling from a considerable height, or hitting the conveyor at too high a speed, can cause serious damage or reduce life, while logs transferring at random angles can cause log jams. The correct design of transfer points is not simple, and considerable experience is required.

The conventional position of the chip bins used to be above the digesters. Today, in all modern mills the chip storage is on ground level. There are several reasons for this. The digester house dimensions restricted the practical capacity, so that one-shift wood handling operation was virtually impossible. Structurally, it resulted in a tall slender expensive building, with all the load concentrated at the top and lastly, the chips tended to arch in such bins, while discharge was far from uniform and required considerable attention.

With ground level storage there is no capacity limitation, and simpler structures are possible. Two types of ground level bins are in use today, the circular silo type and the rectangular type. The silo type has the advantage of lower first cost. Rectangular bins have the advantage that chips cannot arch but flow freely, which permits fully automatic operation and remote control by push button (Fig. 8a).

The handling of finished pulp, either dried or wet, by slitter-cutter, automatic layboy, automatic baling and weighing and the versatile fork lift truck, is standard practice in almost all modern mills. In the case of paper mills, however, there is wide variation in the handling of the finished product, and while lift trucks are used extensively, there is still considerable manual labour required.

Larger mills are beginning to install rather elaborate conveyor systems for their finishing departments, and our firm recently designed a fully automatic roll wrapping machine. This machine (Fig. 10), wraps, crimps, applies glue, puts on end bands, cuts the sheet and ejects a packaged roll in 45 seconds, or less. In one mill one of these machines, combined with a new conveyor and storage system is wrapping 700 tons of newsprint per day. This system requires only 2 men per shift and has resulted in a manpower saving of 15 men.

Beyond mention that materials handling is a very large factor in modern mill design, that there is a trend to one-shift operation and to ground level chip storage, there is little of a general nature that can be said regarding the trends and influence of materials handling methods and techniques in the design of modern pulp and paper mills. The applications are specific to each problem, material and mill, and the methods used vary greatly. The important point to be kept in mind is that, with the exception of the handling of material in process, materials handling is a matter of economies. The technically neatest solution is not necessarily the best, and a good solution in one mill is not necessarily applicable to another.

Cable conveyors, despite their shortcomings, are often a better solution than the use of the technically superior belt conveyors. A good example is the wood handling system shown in part in Fig. 9. In this case the mill was located at a considerable distance from the wood receiving and storage area. The existing system consisted of a small railway system and manual wood piling and reclaiming.

Several solutions were possible. A cable or belt conveyor log storage and reclaiming system with rail or truck shipment to the mill; a cable or belt conveyor system for log storage and reclaiming with a log conveyor to the mill; or location of the chipper at the log storage area and a chip belt conveyor to the mill. Due to distance and terrain, log conveyors

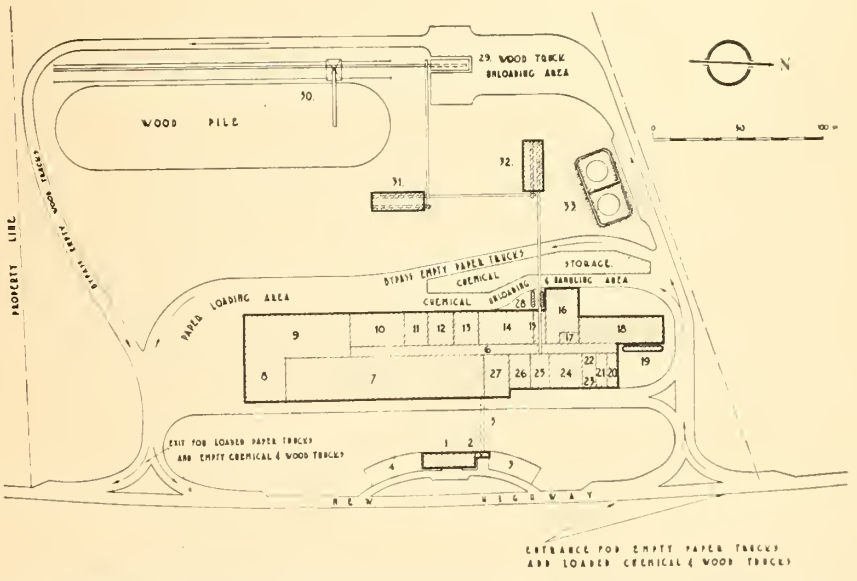


Fig. 11. Modern central corridor type mill — a bleached kraft paper mill with all shipping by truck. (Backhammers Bruk A/B, Bjorneborg, Sweden.)

1. Office Building; 2. Time Office; 3. Parking Place Bicycles; 4. Parking Place Cars; 5. Tunnel; 6. Corridor and Pipe Gallery; 7. Paper Machine; 8. Finishing; 9. Shipping and Storage; 10. Mill Stores; 11. Carpentry Shop; 12. Machine Shop; 13. Restroom, Cafe and Laboratory; 14. Bleachery; 15. Bleach Making; 16. Causticizing; 17. Water Treatment; 18. Recovery Boiler; 19. Steam Accumulator; 20. Turbines and Transformers; 21. Evaporators; 22. Resin Rec.; 23. Black Liquor; 24. Diffusers; 25. Digesters; 26. Screening; 27. Stock Preparation; 28. Chlorine Storage Tanks; 29. Truck Unloading Conveyor; 30. Travelling Stacker; 31. Washing and Chipperhouse; 32. Chip Storage; 33. Oil Storage Tanks.

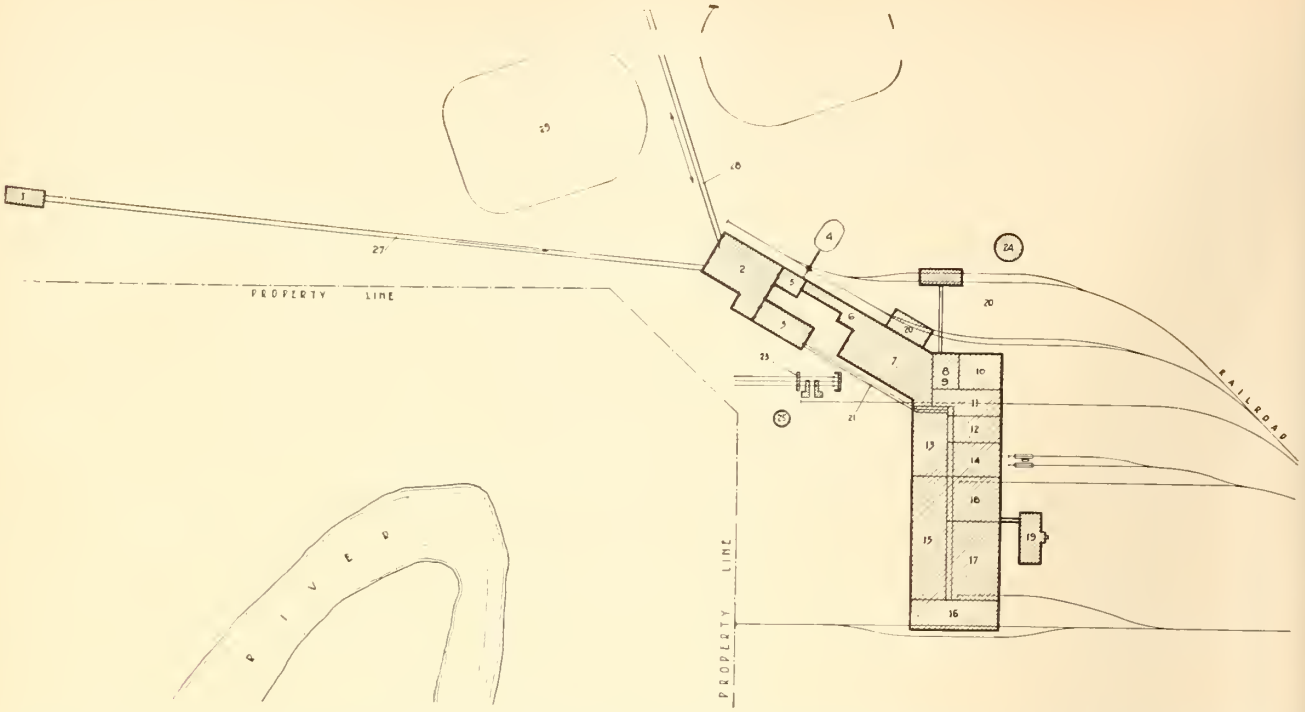


Fig. 12. Layout of a modern compact central corridor type mill—a bleached kraft pulp mill (Long Lac Pulp & Paper Co.

1. Pulpwood Slasher; 2. Wood Preparing; 3. Chip Storage; 4. Lime Storage; 5. Lime Sludge; 6. Rotary Lime Kiln; 7. Causticizing; 8. Recovery Boiler; 9. Precipitator (located above 8); 10. Coal and Refuse Boilers; 11. Digestors and Evaporators; 12. Pulp Washing; 13. Screening; 14. Bleachery; 15. Pulp Drying; 16. Pulp Storage; 17. Repair Shops; 18. Mill Stores; 19. Mill Office; 20. Chemical Storage; 21. Substation; 24. Oil Storage; 25. Water Tower and Valve House 27. Pulpwood Conveyor from Slasher 28. Pulpwood Conveyor from Storag Piles.

to the mill proved prohibitive in cost and the question remained as to whether to send chips to the mill by belt conveyor, or logs by rail.

For the cable conveyor log storage system shown in Fig. 9, with rail shipment to the mill the capital cost was $80,000., and the manpower saving amounted to 100,000 man-hours annually. The belt chip conveyor would have cost an additional $230,000. for an additional manpower saving of 30,000 manhours. This would probably have been attractive to a North American mill, where labour cost is high, but due to the high cost of capital and comparatively low labour cost the conveying of chips was ruled out.

The system thus finally selected was not by any means the best, the neatest, or the most modern from a purely technical viewpoint. It was, however, a modern materials handling system, as the wood was handled in the most economical manner at the lowest possible cost under prevailing conditions. The installation paid for itself in three years.

Mere mechanization is also not necessarily the mark of good materials handling. One mill we know of in Europe would have been well advised to continue their manual racking of wood. The travelling overhead crane system installed, while reducing manpower, yielded a very low return on the investment. In the design of a materials handling system, there are many alternatives, and the optimum development of each is not a simple matter. Considerable experience with all the various alternative methods is required in order to make the correct selection.

Plant Layout

One of the most important factors in the design of modern pulp and paper mills is the layout of both equipment and buildings. The effect of equipment layout on mill efficiency is not difficult to understand and is generally appreciated. The effect of the building structure and disposition of buildings on mill efficiency is less obvious and is often not fully appreciated.

Equipment layout is importan and is generally given very carefu consideration in the design of an modern mill. Some of the mor important "rules" governing goo equipment layout are:

1. Provide easy access to a equipment, and make sur that the equipment can b properly installed in the firs place. Make sure that an component which may hav to be removed for mainten ance, repair or replacemen can be removed or replace without difficulty. Otherwis the equipment will not b serviced properly and main tenance costs will be high If adequate access is not pr vided, demolition of walls o floors may be necessary lat and major plant shutdown may be required.

This point would seem obviou but unfortunately it is often ove looked. We have seen some mil where access was so successfull blocked off that major structura changes and removal of walls an floors were required for equipmen replacement. We have seen othe

mills where equipment was hidden away and not serviced for years, indeed almost forgotten, until it broke down.

Any additional space to provide easy access to equipment is a good investment. No matter how ample the space appears in the original layout, we have yet to see a mill with too much space to spare. In the space of a very few years an ample layout has the habit of becoming crowded, as auxiliary equipment and refinements are added to the original layout.

2. Provide easy access to all equipment control and adjustment points, and keep distances between major control points short. If access to equipment controls is difficult or if the operator has to walk a considerable distance to control points, the controls will not be adjusted by the operators as frequently as required for optimum production and quality. Where necessary, adequate platforms and stairways over and around equipment should be provided, and in such cases as digester houses and bleach plants which cover several stories, elevators should be available.
3. Keep piping or conveyors connecting equipment as short as possible. This not only reduces capital costs but maintenance and power costs as well. However, all valves should be conveniently located, for inaccessible valves will not receive much attention.

   Also, pipelines and conveyors should not be too inaccessible for maintenance, while at the same time proper clearances must be observed. Thus it may at times be necessary to make the interconnecting piping or conveyors somewhat longer to permit convenient location of valves, to simplify maintenance, or to maintain clearances.
4. Group similar equipment whenever possible. For example, if possible group all the pumps for one mill department on the same floor or in the same bay. Avoid duplication of operations. This not only reduces operating but also maintenance labour.

These are the principal "rules" for layout of equipment. Basically the development of a good layout involves the elimination of as many men as possible, and arranging that operation and

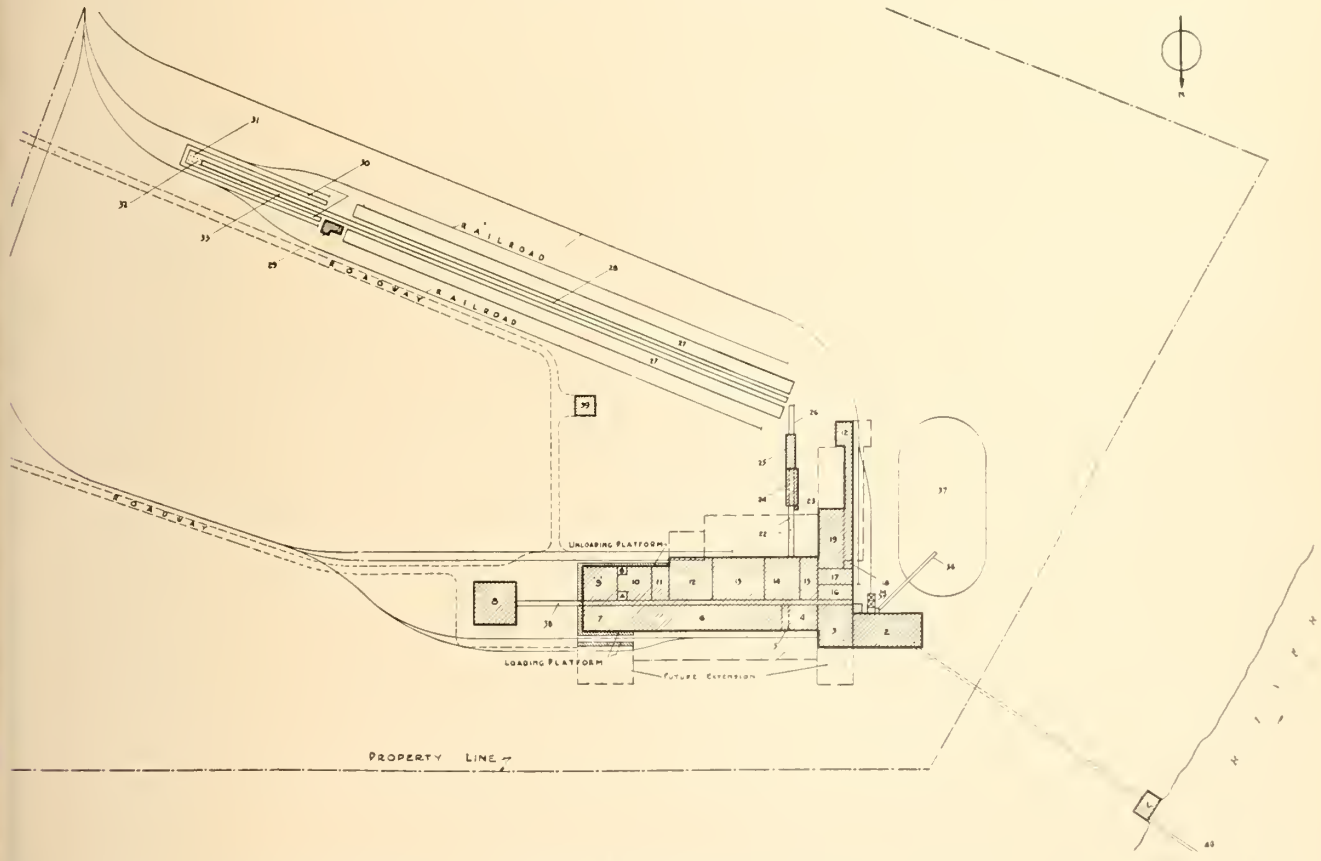


Fig. 13. Layout of a modern compact central corridor type mill — a high alpha bleached kraft pulp mill. (Nihon Pulp Kogyo KK, Japan.)

1. Water Intake and Pumps; 2. Water Purification; 3. Coal Boilers; 4. Turbo Generators; 5. Electrical Switchgear; 6. Pulp Drying Machine; 7. Pulp Storage; 8. Offices and Labs; 9. Mill Storage; 10. Machine Shop, 10A. Welding Shop, 10B. Blacksmith Shop; 11. Carpenter Shop; 12. Bleachery and Bleach Making; 13. Unbleached and Bleached Screening; 14. Digesters, Blow Tank, Heat Recovery, and Brown Stock Washing; 15. Evaporators; 16. Recovery Unit; 17. Chemical Storage; 18. Lime Storage; 19. Causticizing; 20. Lime Kiln; 21. Lime Sludge; 22. Belt Conveyor; 23. Bucket Elevator; 24. Chip Storage Building, including Chipper and Screens; 25. Log Washer Building; 26. Inclined Chain Conveyor; 27. Pulpwood Storage; 28. Belt Conveyor; 29. Slasher Building; 30. Unloading Ramp; 31. Concrete Pits (for Unloading Truck); 32. Inclined Chain Conveyor; 33. Chain Conveyor; 34. Elevator; 35. Coal Pit; 36. Coal Conveyor; 37. Coal Storage; 38. Mill Corridor; 39. Garage; 40. Dam.

maintenance are as convenient as possible for such men as are required. The advantages of a good equipment layout are generally appreciated. The actual mill layout, however, and the disposition of the various buildings is less well appreciated and is the subject of some controversy. In order to illustrate the trends in modern layout, and our conclusions, a brief historical review may help to clarify the issue.

Originally, most paper mills were located close to streams or rivers which, in addition to supplying the process water requirements, also furnished the power through water wheels. Power transmission within the mill was mechanical by gearing, shafting, belts, and pulleys. As a result, mills were crowded close to river banks, and were kept as compact as possible because of the limitations of mechanical power transmission. The entire mill layout was governed to a large extent by the location of the water wheels and the mechanical power transmission system.

The introduction of the steam engine permitted somewhat greater flexibility in mill layout. However, the layout of such mills was still subject to the limitations of mechanical power transmissions, for it was quite impractical to have each piece of machinery driven by an individual steam engine.

The introduction of electric motors increased the possibilities of mill layout still further, though in the initial stages it was generally merely a matter of substitution of electric power for steam or water wheels. Mechanical power transmission to the various machines was still used. However, even after the introduction of the steam engine and later the electric motor, many mills continued to be crowded against river banks in order to exploit water wheels and mechanical transmission to the fullest extent, and this trend continued into the second decade of this century.

Such older mills, many of which are still in existence today, are characterized by their almost complete lack of flexibility in layout. The buildings are crowded together due to the limitations imposed by mechanical power transmission and some departments and processing stages are completely surrounded by other departments. Due to the crowding of equipment and departments, access to equipment is difficult and there is generally little or no provision for inter-department traffic or communication.

Expansion or addition to such mills is virtually impossible without almost complete duplication of operations. Normally, on one side of the mill is the river and on the other side the department to be expanded is usually blocked off by other buildings or the yards and storage piles. Thus any expansion or addition must be carried out as a separate or duplicate operation away from the main mill complex, which increases capital costs and results in a disproportionate increase in manpower. Furthermore, as such mills grow by additions or duplication of operations they become progressively less efficient. Maintenance, processing sequence, supervision and internal traffic become complex and manufacturing costs increase.

When individual electric motor drives became available for pulp and paper mills, mill layouts changed rapidly. Since the main drawback of the older layouts was lack of space and provision for expansion a trend in some areas was to go to the other extreme, namely, a scattered layout in which the various mill departments such as wood room, bleach plant, digester house, recovery system, boiler house, screen room, machine room and finishing, etc. are housed in individual buildings.

These are set far enough apart to permit practically unlimited expansion of any department. The various buildings were then linked by conveyors and piping and a system of roadways within the mill property provided access to the various buildings. Many new

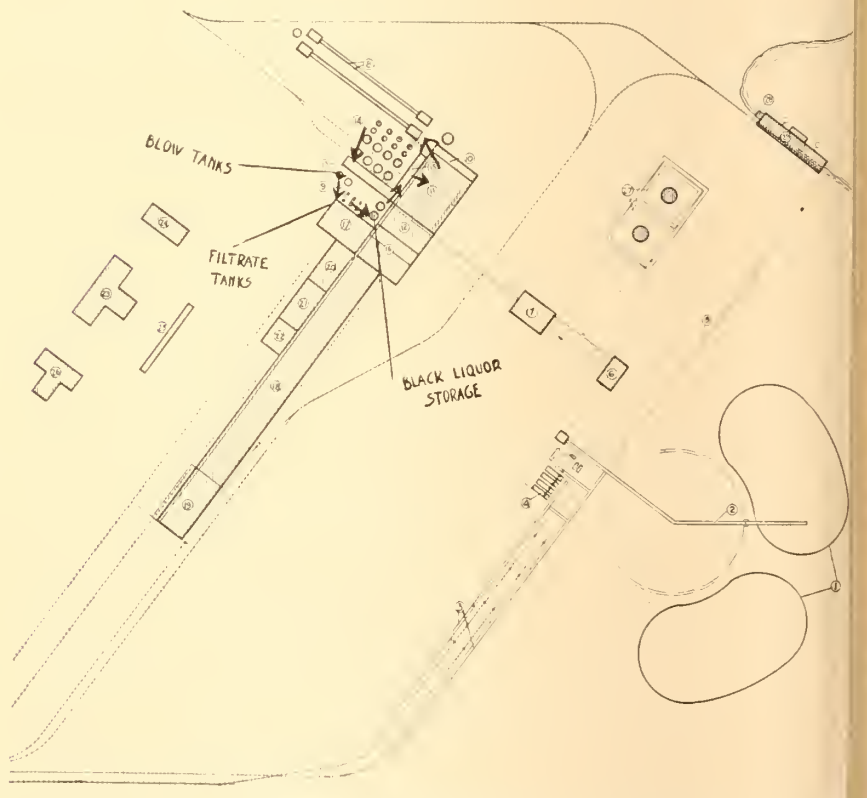


Fig. 14. Layout of a compact central corridor type mill projected for southern kraft linerboard.

1. Pulpwood Storage; 2. Pulpwood Stacker; 3. Pulpwood Unloading Ramps; 4. Barking Drum Plant; 5. Future Pulpwood Conveyor; 6. Chipper Building; 7. Chip Storage; 8. Lime Kilns; 9. Blow Tanks, Black Liquor Storage Tanks, Washer Filtrate Tanks; 10. Feed Water Treatment; 11. Boiler House and Recovery System; 12. Turbo Generators; 13. Digesters; 14. Causticizing and Liquor Storage; 15. Evaporators; 16. Screening and Stock Preparation; 17. Pulp Washing and Hot Stock Refining; 18. Board Machine; 19. Shipping and Storage; 20. Repair Shops; 21. Mills Stores; 22. Laboratories; 23. Administration Building; 24. Research Dept.; 25. Garage; 26. Services; 27. Oil Storage; 28. Oil Pump House; 29. Wharf.

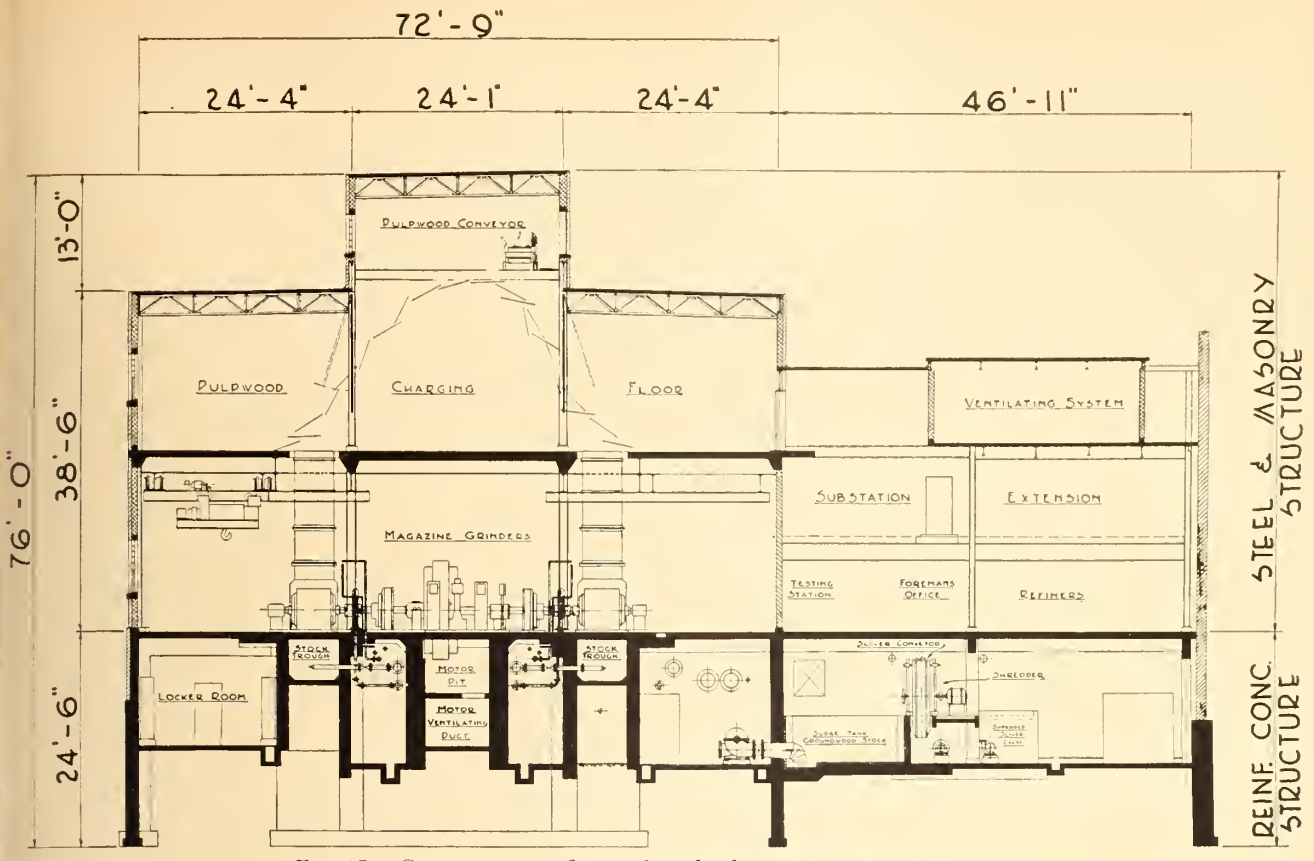


Fig. 15. Cross section of a modern high magazine grinder room.

mills are still being built according to this "scattered" or "spread" layout system.

In our design work we, among others, did not follow this trend. Perhaps the prime and original reason for this was our climatic conditions. Most Canadian mills are located in areas where there is a long hard winter. A scattered layout results in a greatly increased exposed wall area. When building for our climate this increases building costs considerably, and a larger exposed wall area also means higher heating charges. Furthermore, a system of communication between scattered processing stages by means of exposed roadways is far from pleasant when the snowfall is heavy and the temperature drops to 20° F. below zero or lower.

For a northern climate a compact mill layout with a minimum exposed wall area appears the only practical solution. The only problem is to avoid or eliminate the disadvantages of the older crowded layouts, and that is to provide for effective internal traffic and to provide for future expansion without duplication of operations. Over a period of years we developed what we term the "central corridor" layout, and most of the mills designed by our firm follow this pattern. Figs. 11, 12 and 13 show typical layouts of mills of this type for northern climates while Fig. 14 shows the layout of a southern mill of the central corridor type.

The various mill departments are grouped according to process sequence on either side of a main traffic corridor running down the centre of the mill, on the two main floors. Unrestricted expansion is provided for at both sides of the mill. It should be noted that such a layout allows for symmetrical expansion without duplication of operations, and that the extension of any department becomes a part of the department and not a separate unit.

The main mill corridor provides access to every department and permits rapid movement of interdepartment traffic with a minimum number of elevators. Equipment can be replaced or moved to the machine shop for maintenance or repairs with little difficulty and regardless of weather. Distances are short. Besides providing effective internal traffic, the main mill corridor provides space for a neat direct and accessible mill services system for steam, water, compressed air and power distribution. These lines, and often ventilating ducts, run down the main corridors and branch out into each department.

The "central corridor" layout proved very successful and, although originally developed to meet climatic conditions, other advantages became apparent. In the first place, building construction costs are lower than for a scattered layout, and though this advantage is less pronounced in warmer climates where much of the equipment can be located outdoors, it still represents a considerable saving.

In addition to reducing the exposed wall area, a considerable number of internal partitions can also be eliminated, which further reduces building costs. Piping and conveyor costs are also lower, for distances between successive processing stages are much shorter. At the same time power and maintenance costs are proportionally lower.

Although in warmer climates an external system of roadways for communication between isolated mill departments is feasible, few mills are located in areas where there is no rainfall and no bad weather. An internal communication system unaffected by weather

is eertainly to be preferred, not only for the benefit of the operators but also for the maintenanee and repair crews.

The time required for an operator to reach his working position is much less in the ease of a compact layout than in the ease of a scattered layout. A eompact layout also requires less operating manpower, smaller maintenance crews, and less supervisory personnel, all factors sueh as automatie eontrol and materials handling being equal.

However, perhaps the most important advantage of a eompact eentral corridor layout is the very close and rapid eommunication possible between the operators of various departments. The cook in the digester house need take only a few steps to see how the pulp looks on the vaeuum washers. The bleaeh plant operator ean discuss problems with the sereen room operators personally and see for himself any difficulties that may have arisen. In other words, the operators are not a group of isolated individuals linked by telephone but a elosely knit team aware of each other's problems. Supervision and co-ordination are greatly simplified and effieieney is improved.

Comparing the two types of modern layouts, the advantages of the scattered layout are:

1. Engineering of the mill layout is much simpler. A scattered layout is not very difficult to develop.
2. Engineering of the mill departments is much simpler. The equipment layouts can be made without regard or consideration of the layout of other departments, and an optimum equipment layout for each department ean be achieved.
3. As a result of greater simplicity of design the engineering time required is less, and construction ean start at an earlier date after commeneement of engineering.
4. Since the mill is eomposed of individual buildings, eonstruetion is simpler and may be somewhat faster than in the case of a large building eomplex. Much, however, depends on the eontraetor; the differenee is not so great in the case of an experienced contraetor.

The disadvantages are:

(a) The scattered layout is limited to milder elimates.
(b) Traffie between departments is subject to weather eonditions and greater distanees must be traversed.
(c) Mill processing stages beeome isolated units and interdepartment communieations, eoordination and supervision are not as good and labour eosts are higher.
(d) Building eosts are higher.
(e) Piping and eonveyor costs and maintenanee are higher.
(f) Expansion is generally nonsymmetrie and duplication of operations may be neeessary in some eases.

The advantages of the eompact "eentral eorridor" layout are:

1. Greatly improved internal eommunieations, eo-ordination and supervision between departments.
2. Lower building costs, though this advantage is less in warmer elimates.
3. Lower piping and materials handling eosts.
4. Lower labour requirements.
5. Lower maintenanee costs.
6. Better overall efficieney.

The disadvantages are:

(a) The engineering time required is somewhat longer.
(b) The eonstruetion time required may be somewhat longer, though it might be mentioned that in the ease of a "eentral corridor" type mill layout we developed for a Japanese elient recently, the mill reaehed full produetion exaetly one year after construetion was started.

Basieally, in the seattered layout the mill is eonsidered as a group of independent departments or eomponents loosely linked by piping, conveyors and roadways, and eaeh eomponent is designed individually. In the compact layout the design conecpt is the mill as a whole and the mill is designed as an integrated unit of which the varions departments are components which interact upon each other.

It will be appreeiated that designing with the eoncept of the mill as a nnit presents more problems than designing a series of components. Also, at times some saerifices in the layout of a department must be made in order to aehieve optimum layout of the mill as a whole.

In our opinion, sinee a mill is operated as a unit it should b designed as sueh, and although compact unit design is more diffi cult to develop than a scattere individual component design, th author believes the advantages ir herent in the compaet design wi make this the principal trend i mill layout.

Mill Property

Another faetor whieh ean affe mill efficieney to a great extent the mill site and external traffi arrangements. That any propose mill should be loeated in an are having ready access to raw mate ials, water, labour, and means c transportation of raw materials an finished product is a matter c eeonomics and is well understoo However, assuming that the ge eral area is the optimum possibl from eeonomic consideration quite serious errors are ofte made in the selection of th aetual mill site or property itsel It is this latter point which merit brief discussion.

The most eommon error is th provision of insufficient area fc the mill property. Often the mi property is of sufficient size onl for immediate requirements, an there is no provision for future ac ditions to, or expansion of th mill. We know of quite a numbe of mills in this predicament toda and some are in the unhappy pos tion of having residential areas towns or villages located betwee mill departments or storage pile Needless to say, under such cond tions, materials handling cost both for raw materials and finishe product are considerably highe The correct procedure is to est mate the maximum possible futu expansion of the mill in view the economieally aecessible volum of raw materials, and to size th mill property aeeordingly.

The second most common err is the choice of a mill site whe the terrain or natural features wi restrict expansion or make expa sion costly. A particularly goo example of sueh a case is a mi the author knows of in Europ This mill owns property on tw sides of a small river. On one si is a relatively large flat area. O the other side is a narrow strip land between a large steep hill an the river.

For reasons that will probabl always remain unknown, the mi was built on the narrow strip b tween the hill and the river. Th mill has been expanded sever

times, and each time huge volumes of the hill had to be removed and high retaining walls built. The cost was very high and the resultant layout not particularly efficient.

The third common error is the location of the mill and property in such a manner that access to transportation is only possible from one side or end of the mill. As a result there is interference between incoming shipments of raw materials and outgoing shipments of finished product, which can greatly increase materials handling costs.

The mill located between the hill and the river, mentioned previously, besides being poorly located for expansion is also poorly located for access to transportation. Transportation connection is by means of a single spur railway line crossing the river. Furthermore, the strip of land on which the mill is located is so narrow that every railway car must be turned on a turntable before it can be moved to the proper mill department. Since all raw material received and finished product produced must pass over this turntable and single railway spur it is not difficult to imagine the handling problems.

Ideally, the mill property should be a relatively flat piece of land free of natural obstacles, of sufficient area to permit expansion within the limitations of the raw materials economically available, and the property should be so located with respect to transportation facilities, either road, ship, or rail, that there will be no interference between incoming and outgoing shipments. It should be possible for raw materials to enter one end or side of the mill and for finished products to leave the other side or end of the mill.

The external traffic arrangements are an important factor in the design of a modern mill, and the mill property can greatly affect future expansion or additions. The best modern equipment and the best mill layout can be spoiled by poor mill property selection, even if all economic factors for the area in general are favourable. Considerable care should therefore be taken in the selection of the actual mill property.

Mill Structures

The shape, size, disposition and form of the structures for a pulp and paper mill are determined by the equipment arrangement and layout. In other words, the buildings and structures are primarily a housing and support for the equipment and the buildings are shaped mainly by equipment requirements and not by architectural considerations. The structures cannot be designed until the equipment layout has been determined, and any attempt to reverse this sequence, that is, to fit equipment for a mill into buildings designed in advance or into existing buildings will not result in an efficient mill.

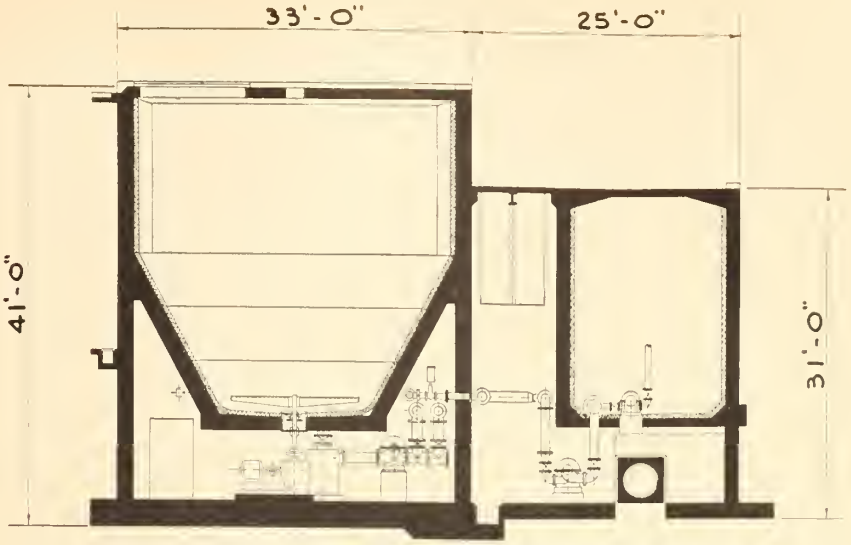


Fig. 16. Section of a modern high density self-sluicing sulphite blow pit with liquor storage tank at right. (C.I.P. Gatineau.)

In the design of the structures there are two viewpoints, one that while the shape is determined by the equipment layout, the structure is a housing and support, pure and simple, and divorced from equipment, and the other that the two are interrelated. As in the case of mill layout, our viewpoint is that the design should not be divorced, but that structure and equipment form a unit.

Such equipment items as boiler settings, flumes, tanks and towers are in effect structural members, that can and should be incorporated in the building structure. The resultant design is neater, cleaner in appearance, and requires fewer building columns than when the structures are designed as independent housing or supporting units.

Figs. 15 and 17 illustrate our views. Fig. 15 is a larger (400 T/D) groundwood pulp mill designed for a Canadian client. Note that the grinder foundations and stock flumes form an integral unit, which also forms the foundation for the main building columns. The motor foundations and ventilating duct forms another integral unit while the spaces between the flumes and motors form the piping galleries.

Fig. 17 illustrates a large sulphite pulp mill designed for a Finnish client. Here the digester house rested partly on rock and partly on caissons to rock. The stock chests, with their midfeathers, form the foundation for the mill. The digesters sit on a bridgework on the top of the chest. This fusion of equipment and structure yielded a singularly neat layout.

Framed structures are preferable for pulp and paper mill buildings. Monolithic concrete or bearing wall structures are too difficult and expensive to alter if a change or expansion of the mill is necessary at some future date. For walls, materials such as brick, precast concrete panels, metal panels or metal, wood or asbestos sheathing are suitable. The choice depends on mill location, climate, and costs. Solid concrete or cyclopean masonry should be avoided because of the cost of alterations. Floors should be concrete.

For the structural frame, steel or reinforced concrete may be used. The number of columns should be kept to an absolute minimum, even if this means that the cost of the structure is increased slightly. Columns are always a source of interference and hinder access to equipment. Even if favourably located in the initial equipment layout, the columns

almost invariably interfere with any proposed changes in equipment or layout.

Whether to use steel or reinforced concrete for the structural frame is largely a matter of economics. In the case of a few mill departments, however, it is decidedly preferable to use steel, since a reinforced concrete frame cannot be easily altered or expanded. Screen rooms and stock preparation departments seem to be subject to rather frequent changes, which may involve structural changes.

These buildings are best designed in steel frame, or at least with steel trusses. The building for a single paper machine, where there is the possibility of an additional machine in future, is also best executed in steel construction. Otherwise the addition of the second machine will involve either a disproportionately large building, with a duplication of the tending aisle or a row of columns, which will interfere with the access to the second machine.

In the case of these same mill areas, screen room and stock preparation, where structural steel is recommended for buildings, the floors should not be designed purely to carry the loads of the equipment as located initially. These departments are subject to frequent equipment relocations, and the floors should be uniformly strong enough to carry the weight of the equipment, no matter how or where located.

A good structural design for a pulp and paper mill should be as unobtrusive as possible. The number of columns should be at a minimum, and placed in keeping with equipment layouts. Wherever possible, equipment should be incorporated in the structure. It is well worth while spending a little more to achieve clear, neat structures relatively free of columns. The cost of the mill structures is approximately a fourth of the cost of the mill, and it is false economy to permit interference with the efficient operation of the equipment to effect a small saving on the cost of the buildings.

Waste Reduction and Mill Integration

Another significant trend in modern mill design is the reduction of waste. This has been accomplished in a number of ways; by process refinement to produce less waste, re-use of waste in the process, by the production of secondary grades from waste, the production of by-products, and by integration of a number of mills. Less drastic barking and wood cleaning systems, modern chippers, rechippers and chip screening, and better knowledge of chip size ranges have greatly reduced wood losses in wood preparation.

Refining of screenings rejects with disk refiners and extensive re-use of white water and savealls have reduced wood losses still further, while at the same time the re-use of white water also reduces water requirements and increases the system temperatures. In chemical pulp mills, improvement of chemical and heat recovery systems and modified cooking practices have greatly reduced chemical and steam requirements.

Such waste reduction and re-use of waste in the main process is largely due to equipment refinement and the careful application of existing equipment. In the design of a modern mill all these refinements are almost automatically included in the original design. However, the production of secondary grades from waste, which is a modification of the principle of the re-use of waste in the mill, is an important consideration in the design of any modern mill, and is sometimes overlooked or ignored.

In the manufacture of higher grades of paper and bleached pulps, extensive re-use of rejects and white water is more difficult to justify economically if quality

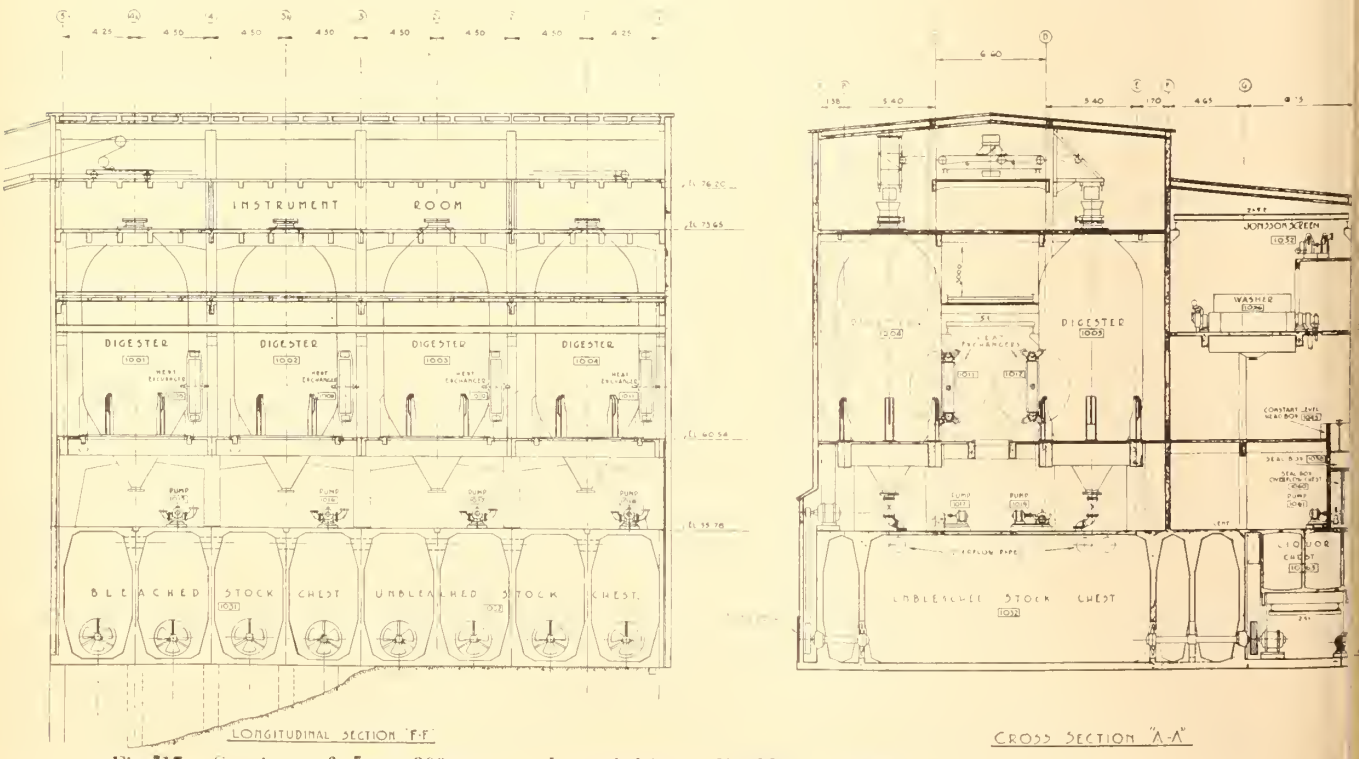


Fig. 17. Sections of a new 300 ton per day sulphite mill. (Mymmene Aktiebolag, Finland.)

is to be maintained at a high level, since dirt tends to build up in the system. In addition, extensive re-use of white water can increase bleaching costs, since the fines in the white water consume a disproportionately large amount of chemicals, and are largely disintegrated and lost. Such over-bleaching to remove dirt also leads to strength deterioration. It is thus desirable for a mill producing high grade papers and pulps to also plan to produce some lower grades such as paperboard, where the rejects and white water from the production of the high grade products can be utilized.

It is in the field of by-products production such as vanillin, lignin plastics, alcohol, yeast, etc., that research has been most active. The developments appear most promising. To date, however, they have not caused any significant change in mill design. There are several reasons for this. Among the most important is that the market for some of the by-products is quite limited, while others cannot be produced economically in some areas at the present time. Research is, however, proceeding vigorously and it can be expected that the manufacture of by-products will become an important phase of the pulp and paper industry in the not too distant future.

Next to the introduction of methods of waste reduction and re-use in an individual mill perhaps the most important trend in waste reduction is the integration of several mills. In its simplest form, mill integration involves the combination of a mechanical and or chemical pulp mill with a paper mill. The savings thus effected are obvious, and whenever possible a combined pulp and paper mill is built.

The next step, developed to the greatest extent in Scandinavia, is to construct usually on the same site an integrated complex of mills using wood as raw material. Such an integrated operation, which may involve a lumber mill, a mechanical and chemical pulp mill, a paper mill, a wallboard mill, a plywood mill and by-product plants, can process the raw material with maximum efficiency. All of the wood delivered to the integrated mills can be put to optimum use, and the waste of one operation can form in part, or in entirety, the raw material for another operation.

As wood costs continue to rise an increasing number of lumber mills are entering the pulp and paper field, while an increasing number of pulp and paper mills are entering the lumber and wallboard and sometimes the plywood field. It is expected that this trend towards an integrated pulp and paper, lumber and wallboard operation will become increasingly more popular. Thus the possibility of such a combination should be considered in the development of any new project, even if only to the extent of making provision in the mill layout and size of property for the possible future addition of such other mills.

Process and Equipment

Up to this point this paper has dealt primarily with the influence of automatic control, materials handling, mill layout and mill integration on the trends in modern mill design. It is mainly these factors that characterize a modern pulp or paper mill, and that have for the most part influenced modern design trends. The influence of any changes and development in process and equipment, while important, has been a secondary factor. However, any discussion of modern trends in pulp and paper mill design would be incomplete without brief mention of the major trends in process and processing equipment.

The main trend in process and processing equipment is toward continuous operation. This trend is closely associated with the trend to automation. In equipment the trend has been principally the modification of existing equipment to permit automatic control, though in some cases basically new equipment, specifically designed for continuous operation, has been developed.

Virtually, all liquor preparation systems for chemical pulp mills are now continuous. In kraft pulp mills the entire process after the digesters is continuous and most bleached plants, both kraft and sulphite, are continuous. Most of the sulphite mills, however, still use batch washing of pulp and manual sluicing, but this is changing. Figures 16 and 17 show two recent designs for continuous sluicing and washing of sulphite pulp. About the only stage in chemical pulp mill operation that is still predominantly a batch operation is the cooking stage, and one of the prime interests in the industry at present is the development of a continuous digester.

Quite a large variety of continuous digester designs have appeared on the market, but as yet most of them are restricted to the production of lower grade pulps. A Swedish design, however, has proved quite successful for both bleached and unbleached kraft pulp. It should not be long until all the types of chemical pulps can and will be produced in continuous units. Stock preparation systems are also continuous for the most part, the only exceptions being mills producing a wide range of products per machine which, by necessity, must use batch systems.

There is also a pronounced trend to larger capacity equipment, both for reasons of manpower savings and capital cost savings. In cases where the increased capacity is obtained chiefly by increasing equipment sizes, this trend is due more to the manpower savings possible, since production is greater with approximately the same manpower. In cases where the equipment capacity is larger due to improved machine efficiency, such as in the case of screens, for example, the trend is due more to capital cost savings.

In the case of a new mill such high capacity equipment occupying but little space means lower installation and building costs, while in the case of an existing mill high capacity equipment may permit increase of production, without high capital expenditure for alterations and increases in the size of the existing buildings.

Some attempts are being made by equipment manufacturers to standardize pulp and paper machinery, at least as regards common component parts such as bearings, gearing, framing, etc., but progress in this direction has been very slow. The bulk of the process equipment is still custom made at a correspondingly high cost.

As a result of the lack of standardization, the maintenance costs and the inventory of spare parts required are also high. It has been suggested that the solution would be to purchase all equipment from one manufacturer. Unfortunately, no manufacturer in-

dividually produces all of the equipment required for a mill, and in any case this practice would not seem to be desirable, as generally all of the equipment produced by one manufacturer is not necessarily the best.

Each manufacturer tends to excel in some types of equipment. There is, however, a definite trend in many mills to standardize on classes of equipment and to purchase for example all motors from one manufacturer, all valves from another, all pumps from another, etc. and insofar as possible with a repetition of a particular size or type. Such standardization can reduce both maintenance costs and spare parts inventory considerably.

Another trend is the purchase of oversized equipment. Generally the cost of a larger unit is not much greater than the cost of a unit that meets the present requirements. A larger unit has the advantage that the mill production can be increased with little additional expense. Another advantage is that on start-up the desired produetion ean generally be reached more easily with units larger than immediately necessary. Operation at lower than the designed capacity will in many cases result in better operating efficiencies and lower production costs. The degree to which equipment should be oversized depends on the expected increase in demand, technical considerations and economics, and must be carefully studied.

Another change in processing equipment and piping has been the extensive utilization of eorrosion resistant materials of construction, such as stainless steels, nickel cast irons, monel, copper, bronze, transite, rubber, plastics and ceramics. Homogenous materials such as copper and stainless steel are preferred, as opposed to coated or lined materials such as rubber or plastic coated steels which are more subject to failure.

Cast iron, steel, wood and concrete are disappearing rapidly as construction materials for process equipment. A large portion of the new processing equipment being installed in new mills, or as a part of modernization programs, is built of corrosion resistant alloys, or is rubber or plastie coated. Bare concrete chests have virtually disappeared in new or modernized mills, and even new groundwood pulp mills now often have all piping of stainless steel.

The trend to better materials of construction is due, in part, to the desire to reduce maintenance costs, and in part to produce quality considerations. The closing in of mill water systems and extensive re-use of white water has increased stock and white water temperatures and created conditions favourable to slime formation. Slime colonies develop to troublesome magnitudes in cast iron piping, and on wood and concrete surfaces where they have a chance to cling and grow. A system utilizing corrosion resistant equipment and piping, and tile lined chests, that is easy to keep clean and to which slime growths cannot readily cling, is one of the best means of controlling slime troubles.

Second Hand Equipment

There has been little change in the basic technology and processes of pulp and paper manufacture and in general there has also been little change in most of the equipment beyond increase in unit capacities and modification to permit continuous processing. High unit equipment capacities and continuous processing are very desirable in a large mill, as the space saving and manpower saving is considerable.

In small mills, however, the space and manpower saving possible through the use of modern equipment with high unit capacities is not great, and in the case of a mill producing a large variety of products continuous processing cannot be used effectively. There is thus no great advantage in purchasing the most modern equipment for small diversified mills. Moreover, since the mills that are most likely to be built in regions other than North America and Europe will, for some time, probably be of this type, the possibilities of using second hand equipment should be thoroughly investigated.

Pocket grinders, for example, have not changed in design in years, and might as well be purchased second hand. They seem to last almost indefinitely, and a fair number are available since most of the large producers of mechanical pulp have eonverted or are converting to high capacity magazine grinders. Second hand rewound electrie motors are perfectly acceptable. Some makes of screens, deckers and wet machines have very long life expectancies and can well be purchased second hand.

The most expensive single item in a pulp and paper mill is the paper machine itself, and in the case of a small mill the purchase of a second hand machine should be considered very earefully. The useful life of a paper machine is long. Indeed, most of the paper machines in operation today are over 30 years old. In most cases such older paper machines become available on the second hand market not because they are worn out, but because the capacity is too small for economical operation in North America.

If in reasonable condition (and perhaps partially rebuilt, modernized and modified to suit the particular application), a second hand paper machine can give results as satisfactory as a new machine, and usually at one quarter to one third the eapital cost.

It is thus quite possible to use a considerable portion of second hand equipment in the construetion of a smaller mill, without appreciable loss in efficieney and with a considerable decrease in capital cost. The mill must, however, be carefully designed in accordance with the best modern practices, and the equipment must be carefully selected and investigated for condition and suitability.

Concluding Remarks

It is difficult to treat so broad and general a subjeet with any degree of thoroughness within the limitations of a paper. A text book would be a medium more appropriate in size. This paper will however, have aeeomplished its purpose if it has brought attention to the pronounced influence of automation, materials handling mill layout and mill integration on the effieiency of a pulp or paper mill and that there is more to the design of a modern pulp and paper mill than the acquisition of modern pulp and paper machinery.

Indeed, to repeat, it is quite possible to design an essentially modern mill using equipment available a decade ago, and the opposite is equally true—it is also possible to build an obsolete mill using modern equipment.

Power

Past, Present and Future

by

J. Eccles, C.B.E., M.I.E.E., M.I.C.E., M.I.Mech.E.,

President

Institution of Electrical Engineers.

A sense of inadequacy serves to heighten my feeling of gratitude to my fellow-members for having accounted me first amongst equals in The Institution for the period of one year. My limitations are obvious and well known to many. As I stand here somewhat in awe of those giants, my predecessors, some of whom adorn these walls and benches, I can but promise to do my utmost to serve, whilst you may derive comfort from the thought that the wisdom of the Council, the knowledge of the Secretariat, and the restraining hand of tradition, will protect your interests. I thank you all.

The Institution has a membership of nearly 39,000 but mere numbers is not strength, and the strength of this Institution derives from the fact that it knits together in common fellowship those professionally engaged in the whole range of electrical engineering, from the practical application of well-established technology to the translation of the newest theory into the technical marvels of our age.

To do so, there must be wise and energetic leadership with the maximum practicable degree of devolution of responsibility to the Sections, Centres and Sub-Centres. That this is achieved is a tribute to the enlightened guidance of Mr. Brasher and his staff, and to the reservoir of managerial experience distilled through the deliberations of your Council. The manner in which the Sections and Centres discharge their duties, and seek to promote the highest interests of The Institution and the technical well-being of its members, is a source of constant admiration.

Through the papers that are published, with or without discussion The Institution seeks to include in its Proceedings a complete record of technical progress in all branches of electrical engineering. Many of these papers are necessarily of a highly specialized and mathematical nature. Whilst recognizing that a high degree of specialization is essential to economic success and that the tendency may increase, it is important to ensure that the general practitioner and other specialists are kept informed of the trend of events in fields other than their own. To this end, it is greatly to be hoped that more members will find time to present papers of a general character on the current techniques in their own spheres.

As I hope to show, we are faced with the prospect of an ever-expanding range of research and experiment in difficult fields, and if we are to succeed it is imperative that the volume and quality of technical education and training should be stepped up. It is the privilege and the duty of The Institution to offer informed advice on this matter to those whose responsibility it is to decide the form and extent of the educational facilities to be provided. This duty is being discharged.

More Students Needed

One of the things causing concern is the inadequacy of the intake of students and juniors to the electrical engineering profession. Insufficient schoolboys are imbued with scientific insight and knowledge of the part that science must inevitably play in securing an acceptable existence in an industrial country. Too many are unable to pass the university entrance examinations. If this defect should stem from lack of appreciation by headmasters, housemasters and careers masters of the indispensable necessity of scientific education, it calls for immediate remedial action at those levels. If the teaching of science in schools cannot be improved and extended, the universities may have to consider the selection of entrants more on potentialities than on detailed scientific knowledge, and themselves teach science from an earlier stage. Character and an inquiring mind may be a better foundation than very early knowledge of Ohm's law.

A further thought on this may be worthy of record. It is a fact that each generation of technologists has to learn its technology from the beginning. There is no way of starting where the other man left off. Each must plod through the ABC of the subjects he elects to study. To simplify this process should be a duty of educationalists, and how better might this be started than by simplifying the units in which basic quantities are measured? The ra-

One of the penalties of election to the presidency of a great engineering society is the task of composing and delivering a presidential address. All too often these addresses are parochial in that they deal almost entirely with the affairs of the society concerned, but occasionally one is delivered that should attract the attention of all engineers and still less often one which deserves to be read by the public at large.

We believe that the inaugural address of Mr. J. Eccles, the incoming president of the Institution of Electrical Engineers, delivered in London on October 7, 1954, falls into the last category. It is with particular pleasure that we publish a condensed version of it, not only because we think it a model of what a presidential address should be, but because of the very cordial relations that have long existed between the I.E.E. and the Institute.

tionalized M.K.S. system of units has been recommended as an international standard by leading authorities, and it would seem that the time has now come when this simplification could be used exclusively in textbooks and academic courses.

Although there is no restriction upon the subject-matter of an Inaugural Address, it will not have escaped notice that almost invariably each holder of this office has quite naturally chosen to discuss in his address some aspect of the work upon which he is engaged.

I am an electrical power engineer and, fortunately for you, though unhappily for me at this moment, Sir John Hacking in his memorable address three years ago, and more recently in his Presidential Addresses to the British Electrical Power Convention and to the Junior Institution of Engineers, has given very full accounts of the immediate past and middle-distance future of electrical power engineering in this country.

One could attempt to dot some of the i's and cross the t's of what has already been written. The story of the 275-kv Grid could be brought up to date. Then, too, there is the proposed cross-Channel connection linking Britain with the European mainland across a 26-mile stretch of turbulent sea with rocky foreshores and an uneven bottom reaching a depth of 216 ft. at its lowest point. Again, there is the continued story of endeavour and achievement in the field of power generation in which the equivalent of six modern power stations are fully equipped each year, thus bringing into use some one and a half million additional kilowatts of electrical generating capacity in Great Britain alone. On the utilization side there is a human story in the manner in which electricity is spearheading the drive for food production and arresting the depopulation of the countryside, and there is much of technical interest in the means whereby annually over 10,000 farms and three times as many rural dwellings are receiving supply in this country for the first time.

It would have been possible to develop and arrange thoughts on these and other aspects of electrical power engineering, but inevitably they would have had to be of a detailed character and so were better dealt with in discussable papers.

General Observations on Power Engineering

In this address, therefore, I wish to depart a little from tradition and offer some observations of a very general character on the long-term past and future of power engineering. Before delving into the past or peering into the future, it may be well to consider what it is the power engineer seeks to do and why it is necessary to have him around at all. The function of the power engineer, is to give man command over Nature by releasing her great storehouse of energy and presenting it in forms and quantities that, at one end of the scale, enable him to achieve the otherwise impossible, and at the other, enable him to gain a livelihood without undue physical exertion. Today we accept the benefits as a matter of course, and realize their significance only when they fail to appear, but let us pause for a moment to discuss their magnitude and their effect upon our mode of living.

Each year in this country we consume about 200 million tons of coal. It is probable that half of this is used to produce mechanical and electrical power. Taking a realizable efficiency of conversion from coal to usable power at the point of application, it is easy to show that 100 million tons of coal used in this way will do the work of at least 750 million unaided men working a 44-hour week for 50 weeks. The population of this island is rather less than 50 million, and hence by the conversion of this amount of coal into work we have endowed each man, woman and child with fifteen slaves to do their bidding.

Oil provides another set of slaves and a calculation of the same kind shows that the present consumption of liquid fuel in this country provides the equivalent of a further five slaves for each living soul in Great Britain. These latter have to be purchased in, and transported from, foreign lands, but, this done, the whole platoon requires neither food nor raiment, and all we have to do is to provide their working tools and ensure that they are usefully employed.

How has it come about that each of us has to depend upon 20 inanimate slaves to maintain his present standard of mobility, comfort and leisure? For how long has this been going on, and what are the chances of its continuance? These are some of the vital questions of our age, and in attempting to answer them let us go backwards in history a little way.

Some geologists compute the age of the earth to be about 3,000 million years. That period passed without any event of significance to power engineers until about 300 million years ago, where there seems to have occurred a condition, or series of conditions, conducive to luscious vegetable growth. Vegetation grew, decayed, was reborn, and decayed, repeating its life cycle until there was built up stratum upon stratum of hydro-carbonaceous matter.

Times changed, the climate altered, there were violent internal explosions with consequent disturbance of the earth's crust. Never again have there been repeated in nature conditions so conducive to an accumulation of her precious hydro-carbon store. To this event, or series of events, we owe the coal measures and the oil wells which today provide over 85 per cent of the world's fuel.

Evolution and Improved Technology

This garnering of nature's harvest being over, there is nothing of significance to relate until beings resembling man made their appearance about a million years ago. We know little that is not speculative about the evolution of man, before the period of recorded history. It is thought, however, that a million years ago he knew how to control fire, and it would seem that his progress since then has been conditioned as much by the state of his technology as by any other single cause. For a very long time men remained gatherers as distinct from producers. Later they assumed a more active role and endeavoured to improve upon nature by tilling and fertilizing the soil, using domesticated animals for work and food and fashioning tools of stone and metal to increase the range and usefulness of their endeavours. It was in this latter phase that the demand for fuel grew apace. Wood was required for warmth, for cooking and for smelting metal, and whole districts were deforested by burning for no other reason than to provide wood-ash as a fertilizer.

The record of these early civilizations seems to show that an improvement in technology encouraged an increase in population which overshot the capacity of the reigning technology to feed and to clothe with the result that, in the exercise of that strongest human instinct — self-preservation — man with his limited knowledge unwittingly cut off the branch on which he sat.

However, the pattern was not even and, in some areas, improving supply technology, aided by slave labour, was able to meet the increasing demand for long periods

By 10,000 B.C., men knew how to make bricks, by 6,000 B.C., they began to tap the fossil fuels, beginning probably with the most accessible deposit, asphalt.

About 1,000 B.C. the Chinese were using natural gas for fuel and lighting, which they procured from wells 3,000 feet deep and transmitted in bamboo pipes. According to Herodotus, an oil well was working on the island of Zante in 400 B.C., the lighter fractions being separated by stretching a hide over a cauldron of boiling oil and wringing out the condensed liquid.

The earliest recorded use of coal is 1,100 B.C. in China. The first use of coal outside China was probably in Greece, and there is evidence that coal was known and used in Britain before the Roman occupation.

Improved Supply Technology—Arrogance—Decay

These apparently isolated but perhaps not unconnected examples of technological progress coincided, in some cases, with quite advanced civilizations, but it may be significant that almost invariably an improvement in supply technology was accompanied by an increase in population and by an arrogance or indolence in the governing body, which formed the seed-bed of decay. In this respect, things came to a head round about 500 B.C. In 538 B.C., Belshazzar was slain on the night of the handwriting on the wall and the Babylonian empire came to an end. In China, industrial progress ceased with the full flowering of the Confucian philosophy, and in India the caste system withdrew all intellectuals from the industrial crafts. Greek industrial progress died with Alexander the Great.

These events and others ushered in a period of two thousand years of technological stagnation in which, whilst fuel was still used for heat, little further progress was made in establishing man's command over nature. What was needed was the discovery and application of means to augment man's energy and improve his transport. The Phoenicians had used the force of wind in sailing ships since 1,000 B.C.; Hero of Alexandria came near to converting heat into work; the Romans used water power and the Chinese had used the explosive force of gunpowder.

It would be wrong to suggest that nothing happened anywhere during the Dark Ages. At the end of the Roman occupation, Britain experienced a political setback, but with the gradual emergence of more settled times the demand for fuel outstripped the current rate of vegetable growth and the countryside was being steadily denuded of its forests. Long before this, coal had been discovered as an outcrop and its value as a fuel was known.

Science and Technology Awake

Thus we arrive at the 15th, 16th and 17th centuries A.D., with science and technology slowly awakening and facing the prejudices that had become entrenched in men's minds, without opposition during their long period of hibernation. It was in this setting at the very end of the 17th century that an Englishman, Thomas Savory, invented the first successful steam engine and showed how heat could be converted into work. By means of this engine, improved by Newcomen and Watt, there was tapped an enormous reservoir of energy stored in the coal measures for 300 million years. In 1827, the first steamship crossed the Atlantic to the New World, and in 1829 the first steam-driven railway locomotive was in operation. In 1884 Charles Parsons invented the first practical steam turbine, which so raised the sights in size and efficiency that today single machines are being designed for an output of 200,000 kw. using only three-quarters of a pound of coal per kilowatt-hour.

Contemporary with these events in the realm of steam, work was in progress on the design of machines in which controlled explosions of oil or gas could be translated into continuous mechanical power. The result was the internal-combustion engine, which, apart from many useful fixed applications, completely revolutionized the mode, range and speed of transport. The first motor-car using this engine took the road in 1885, and the first aeroplane left the ground in 1903.

Prior to the emergence of most of these applications, Michael Faraday had discovered and demonstrated how a new and more versatile form of power could be made available. It was at the Royal Institution, London, on the 29th August, 1831, that Faraday first demonstrated the basic principle of electromagnetic induction.

Earlier in this address, I suggested that the present use of energy was equivalent to the service of twenty slaves for each person on this island, and I posed questions on the chances of this state of affairs being maintained and what is likely to happen if the supply fails. I shall now attempt a qualitative answer to these questions in the light of current knowledge.

World Reserves of Fuel

It is not easy to estimate the total coal reserves of the world, and although attempts to do so have been made, the results are subject to many qualifications—the thickness of the seam, the quality of the coal, its depth below the surface and many other things have to be evaluated before its economic worth can be assessed. Economic worth is a relative term which depends on the availability and cost of alternative fuels. Liquid fuel enjoys a somewhat special relationship to all others.

A recent American assessment of the world reserves of all fuels is shown in Table 1. This estimate suggests that the world reserves of crude oil are only about 5 per cent of world coal reserves, whilst, with 1:1 breeder reactors, the potential energy of nuclear fuel is more than twenty times as great as that of the world reserves of coal, oil and natural gas put together.

Table 1. World Reserves of All Fuels

Fuel	World Reserve	Source of Data	Total Energy B.T.U.
Crude oil	610×10^9 barrels	Weeks and Moulten	$\times 10^{18}$ 3·5
Natural gasoline	11.5×10^9 barrels	American Petroleum Institute	0·07
Shale oil	620×10^9 barrels	Bureau of Mines	4
Natural gas	560×10^{12} ft^3	American Gas Association	0·6
Coal	3482×10^9 tons	Bureau of Mines	72·2
Total conventional fuel			80
Uranium	25×10^6 tons	Raw Materials Division of A.E.C.	1700 at 1:1 breeding
Thorium	1×10^6 tons	do	71
Total new fuel (say)			1800

The world annual consumption of coal is about 1,600 million tons and the consumption of crude oil is about 640 million tons. With regard to oil, it has been estimated that consumption in the United States will be doubled between 1950 and 1975, and if this rate of increase were general the life of world reserves would be very much reduced. The supply of this fuel may easily become critical within the lifetime of the present rising generation.

This all too brief survey lends colour to the thought that, of the fossil fuels, oil will be the first to go. The efforts to produce a substitute liquid fuel may include the synthesis of coal, which, in turn, would accelerate the rate of destruction of this fuel. Even so, the reserves of coal are sufficient to allow time for the orderly development of alternatives.

Obviously, the country with large reserves of all kinds of fuel is most favourably situated to maintain and expand its mechanized civilization, and provided it uses these resources economically and makes commensurate advances in its political and cultural life, it is probably destined to remain a world force for a longer period than other less well-endowed peoples. The importance, therefore, of the economical use of native fuel stretches far beyond the desirability of maintaining one's standard of living, although it includes it.

Alternatives to Fossil Fuels

What then are the alternatives to fossil fuels? The general answer is nuclear fuel. I think, however, it would be wrong to give the impression that, although nuclear energy is there for the taking, it is a simple matter to release it in quantities suited to our requirements. Hitherto heat has been obtained by amputating and re-grafting the limbs of matter; in nuclear fission, it is proposed to tear out and divide its heart.

Ever since man's emergence from the Dark Ages, world population has been increasing. Curiously enough, this has been noticeable even in countries where technology showed no advance. Perhaps the general trend has been made possible through better means of communication whereby the effects of industrial technology and medical science are felt beyond the confines of the countries that initiate them. Whatever the reason, most countries have participated in the production of a world population which has enjoyed a fourfold increase during the last 300 years and is now growing by 20 millions a year —that is by more than 2,000 an hour.

The fate of previous civilizations has been sealed when population outstripped the ability of their technology to provide sustenance and shelter, and the fate of our own cannot be dissociated from this self-same influence.

In this welter of possibilities, it may be of value to look at two possible alternative situations—one on the assumption that nuclear fission or nuclear fusion will not prove to be a practical means of providing power, and the other that it will.

Without atomic energy, the main alternatives to coal, oil and natural gas are water power, tidal power and wind power, with solar energy and geothermic heat available in certain zones, and wood, peat and animal wastes each making its own contribution.

Water Power

Hitherto the assessment of world inland water-power resources has included only those which show prospect of economic development and are not required for other purposes such as navigation, irrigation or domestic use. In future, much more may be pressed into service, perhaps for dual purposes of which power will be one. However, the most recent estimates show that the world total of inland water power, 40 per cent of which is in Africa, could supply at least three-quarters of man's present energy requirements.

One of the largest most spectacular sources of water power lies at the western end of the Mediterranean. This inland sea loses water through evaporation which is not wholly recovered from its river inflow, with the result that water is constantly flowing through the Straits of Gibraltar, and to a lesser extent through the Dardanelles. If, therefore, both straits were dammed, the level of the Mediterranean would gradually fall, and having established a suitable differential it could be maintained by admitting water from the Atlantic through suitable turbines. Rough calculation shows that, with a differential of 70 feet the inflow could develop 12 million kw, which is 75 per cent of the present demand for electricity in Great Britain. It would require a modern Hercules to undo the work of his illustrious namesake and no doubt the political repercussions would be considerable.

Tidal Power

Tides are produced by the combined gravitational effect on the earth of the moon and the sun. Since the liquid portion of the earth's surface is free to move large oceans respond to the differential attractive force at the nethe and the further shore. Winds an currents also play a significant par The result is that, at any give point on the coastline of a larg ocean, the tidal lift normally vari cyclically twice in the course of lunar day, twice in the lunar mont and twice a year. The amplitude tidal lift varies from place to plac Since tides follow the moon an man's efforts follow the sun, th tidal cycle is not co-ordinated human needs, and, in this sens tides are an unsatisfactory source energy.

The simplest device for usin tidal energy is to trap water in a estuary, or reservoir, at the time high tide, and after the tide h receded sufficiently allow the tra ped water to escape through tu bines in which most of the energ due to the differential head converted into useful work. Th daily work periods are cyclic, an their incidence in time of day als traverses twelve hours during eac lunar month. There are device such as pumped storage and double basin working, by means of whic the energy available for externa work can be controlled and bett fitted to human requirements. The is also a difference of up to tw hours in the time of high tide different places round our coast. a powerful electrical transmissio system were available to connec together all such points, it would b possible to take advantage of thes time differences to reduce the amour of pumped storage. So long as th harnessed tidal energy formed small proportion of the total energ in the electricity system to whic it was connected, it could b accepted as and when it was avai able without storage.

Energy of the Wind

Force is required to move air fro one place to another, the correspon ing energy being proportional to th cube of the velocity. It is practicabl to abstract some of this energy b slowing down the speed of a movement.

Because of the low density of th medium, the energy release per un volume for speed changes likely t be achieved in any practicable win mill is quite small. Stated con versely, a windmill must be a bulk structure with large-diameter van for even the relatively small outpu of 100 kw. contemplated in recen designs. Furthermore, the win

bloweth where (and when) it listeth. It would seem that practical considerations will limit the contribution to be made by this source to a small proportion of man's present-day energy requirements.

Solar Energy

The amount of solar energy reaching the land areas of the earth's surface is equivalent to 10,000 times man's present requirements. Unfortunately, owing to the moderate temperature, the low intensity and the daily and seasonal variations, there is little hope of producing mechanical power by present known methods in any but tropical and semi-tropical regions.

Neglecting therefore, for the moment the possibilities of nuclear fission, the most reliable and economical alternative to coal and oil is water power if one looks at the world as a whole. However, the locations of possible water-power projects are such that quite fantastic power transmission schemes would be required to transport the energy to present centres of population. Apart from the political implications of such energy transfers across national frontiers, they present technical problems of a scale and type quite beyond anything that has been solved hitherto.

An alternative to transmitting the energy to the people is to transport the people to the energy source, and a considerable shift in the weights of population may well take place in the future if nuclear fission proves to be intractable as a source of industrial power. Great efforts would, no doubt, be made to ease the situation by developing tidal, wind and solar power in localities where there was little water power.

The foregoing assessment of the situation which may arise in the absence of a successful outcome of the attempts to harness the fission or fusion process for industrial purposes suggests that, when coal and oil are exhausted, it should be possible to muster man's present-day energy requirements from all the known sources, but that energy transmission or population transportation would present enormous technical and social problems.

Nuclear Energy

Let us now look briefly at the nuclear-power possibilities.

Professor Einstein postulated that matter could be converted into energy. He calculated that the annihilation of one pound of matter would release energy equal to 11,340 million kwh. of electricity. Were such complete conversion possible, six pounds of matter would release energy equivalent to the whole of the electricity generated in Britain last year. No means has yet been found to achieve this result.

It has been possible, however, to release a tiny fraction of the mass energy of matter by persuading a heavy atom to divide into two lighter atoms whose combined mass is a little less than that of the heavy one. Similarly, it has been possible to release energy by persuading a number of light atoms to form a single atom whose weight is a little less than the sum of the weights of the lighter atoms which combine to make it.

Some of the possibilities may be illustrated by comparing the deviations from whole numbers of the atomic masses of a number of elements on a scale in which the mass of oxygen is taken as 16. Some of these deviations are positive and some negative. Theoretically there should be a release of energy when atoms with a more positive mass deviation divide or combine to produce atoms of a less positive or of a negative mass deviation. The division of uranium into two lighter elements or the fusion of hydrogen into helium offers the possibility of energy release.

Since hydrogen constitutes a substantial proportion of the earth's crust, the potential energy from the hydrogen-helium fusion process could be enormous. A practical difficulty is the sustained temperature at which this reaction takes place, and it would seem that, until something is discovered which will enable the reaction to proceed at a lower sustained temperature, the industrial application of this great energy source will remain unsolved.

From published data on the fission of uranium, it would seem that the process can be controlled in such a way as to liberate heat at a temperature suitable for industrial power purposes, but that before efficient large-scale nuclear power stations are practicable, work has to be done on heat-transfer methods and materials and on the treatment of the products other than heat which form part of the process.

Of the uranium existing in nature, only about 0.7 per cent is fissile. However, a process has been devised through which the remaining 99.3 per cent can, by a double reaction, be converted into plutonium, in a controlled manner the energy of fission of all the uranium and perhaps the thorium content of the earth's crust. The practical and economic problem is to find the uranium and to separate and purify it.

From this point of view, it is unfortunate that uranium is so widely dispersed amongst the other materials of the crust. For example it has been stated that the uranium content of a ton of granite, if it could be isolated, would produce as much heat as a ton of coal. However, there is no known economical method of isolating the uranium content of granite, and this is equally true for trace contents in many other common substances.

There remains, therefore, the problem of recovering pure uranium and thorium from their ores where they appear in forms and quantities that render the process economically practicable. It has been estimated that the availability and accessibility of uranium is such that (at present costs) an expenditure of £50 per pound of pure metal should be sufficient to mine and refine enough of this fuel to provide man's present energy requirements for 1,500 years. Similarly, on the same basis, an expenditure on less productive ores of up to £100 per pound of pure metal should procure sufficient uranium to last another 8,500 years. These very general figures should be taken only to indicate the satisfactory manner in which uranium can meet world energy requirements and, broadly, what effort would be required to render it available.

There are some who argue that, because it is now theoretically possible for nuclear fission to satisfy man's total demand for energy, the pursuit of all other sources should be abandoned. I do not share that view. There are problems to be solved before the energy of fission becomes a reality on a large scale. The chemical process of uranium separation and purification will itself consume a considerable amount of energy, and in any event the alternative sources will be fully competitive for many years to come.

As coal and oil approach exhaustion, a possible balance may be found by harnessing all the water power of the world and, as far as possible, meeting local power requirements from this source. Where there is a local surplus of water power, the energy could be used to purify fissile material so as to provide power in lands where the alternatives are insufficient. Since fissile material, even in its natural state, is easily transportable, such packaged fuel might solve the power transmission problem.

Water power, tidal and wind power will, no doubt, be developed

(*Continued on page 787*)

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Problems in Construction in the Far North

by

Squadron Leader H. D. Monteith, Jr.E.I.C.,

Royal Canadian Air Force, Ottawa, Ont.

There seems to be a popular feeling of mystery attached to the Far North, and the man who lives or builds there is credited with having almost magical powers. Nothing could be further from the truth. Certainly there are problems in effecting construction in the Far North. These problems can be divided into three main classes, each of which has a bearing to some extent on the other two. These are technical problems, logistical problems and economic problems. Problems in each of these classes are met everyday in construction, no matter what the location of the project. In the Far North only the details differ.

What do we mean by the "Far North?" For purposes of this paper we shall consider it as being roughly the area of Canada lying North of the 55th parallel of latitude, or, in more general terms, that part of Canada beyond the line of population. Notwithstanding the pictures which are provided for movie consumption, e.g., the howling blizzards with the struggling explorer, the Far North differs from our more southern climes to the greatest degree as far as construction problems are concerned, in the matter of distances, and to a somewhat lesser extent in the matter of climate

Logistics, or the problem of bringing men and materials to the construction site at the proper time, is most affected by distance. Climate also affects logistics as it dictates the period during which construction can be undertaken and also the period, in many instances, when transport can be undertaken. Likewise the distance and the climate contribute to the technical problems by dictating, to a large degree, the type of construction which must be employed. In turn these factors also affect the economics of construction in the Far North.

It is the intention here to describe some of the problems, technical and logistic, encountered by the RCAF in some of their constructing projects in the Far North. At the same time it is hoped these examples will illustrate the fact that the technical problems, with minor differences in detail, are similar to those met anywhere. Once this becomes recognized, the outstanding problem in construction in the Far North is the logistics problem.

Foundations

Let us first consider the technical problems. In the experience of the RCAF the main factor contributing to problems of this nature must be the climate. The climate in the Far North is extreme. The mean annual temperature over the area we have defined as the Far North, varies from a high of 35° F in the westerly section to 0°F in the farthest north, with an average over the area of probably 20° F.

This low temperature is the basic cause of one of the first problems encountered in some northerly locations, namely permafrost or permanently frozen soil. This permanently frozen ground extends from a few inches below the surface, the depth varying with the location, to depths measured in hundreds of feet. This condition necessitates revised thinking in the design of foundations and services.

It has been the experience of the RCAF, and doubtless this has been born out by the experience of others, that permafrost if not disturbed provides an excellent bearing for a structure. To date in RCAF experience, buildings have been confined to those of one storey. The problem is somewhat compounded by the layer of soil between the permafrost and the surface, known as the 'active layer'.

This layer acts in a manner similar to normal soils found wherever freezing weather is prevalent, freezing and thawing and thus causing expansion and contraction. It is therefore necessary to get below this layer with foundations. One of the successful solutions has been the use of pile foundations. Two types of piles have been used by the RCAF steel pipe and timber, the choice being dependent upon local conditions.

The steel pipe type of pile has been used where the soil is a very fine silt with a large percentage of ice present. Its introduction into

Construction in Canada's Far North presents technical, economic and logistic problems, of which the latter is of greatest importance, explains the author. Great distances and lack of normal transport facilities call for careful planning and timing. Discussing methods peculiar to the north for building foundations and providing services, he gives examples of how available transportation can influence design and construction procedures, and how storms and equipment breakdowns can sometimes upset the most careful planning.

the permafrost is a simple procednre. A 1¼ in. steam jet is held against the ground. This moves downward leaving a hole approximately 5 in. to 6 in. in diameter. When the desired depth is reached, the steam jet is removed and a 4 in. steel pipe is placed in the hole. The desired depth is determined using a rnle-of-thumb of penetrating the permafrost 2½ times the depth of the active layer.

The pile is then allowed to freeze in, after which the pile is cut to the desired grade and capped with a steel plate. Wooden sills are placed on these piles and the structure completed. This type of foundation has been used under a variety of buildings including quarters, warehouses and even a garage with a reinforced concrete floor. In all cases a minimum of 2 feet clearance was kept between the bottom of the floor and the surface of the soil.

The wooden type of pile has been utilized in other locations where the soil was more gravelly by nature and with a smaller percentage of ice. Because of this, the steam jet method of opening the hole is not practical. Several methods of preparing the hole for the pile were investigated. Eventually, although it was time-consuming, the holes were excavated by hand using steam, bars and shovels. The 12 in. x 12 in. timber piles were then placed in the holes and the holes backfilled, the backfill material being well wetted during the operation. The piles were allowed to freeze in and the structure completed in the same way as with steel pipe piles. Here too, care was taken to ensure at least 2 feet of clearance between the surface of the soil and the bottom of the floor.

Another type of foundation used with good success has been a gravel fill with mud sills placed on top. In one particular case this method was utilized because approximately 4 feet of fill were required to bring the grade to the required level. This fill was well compacted and the sills laid directly on top of the compacted fill. The space between the bottom of the floor and the top of the fill was filled with vermiculite insulation. It is suggested that foundation problems are by no means peculiar to the North. Similarly the types of foundations described above are not peculiar to the Far North, although the reasons for utilizing them may differ from the reasons necessitating their use in the more southern areas.

Utilities and Services

Another well known engineering practice, which must be revised because of the presence of permafrost, is the design and installation of water and sewage disposal systems. Normally these services are installed below the frost line, primarily to prevent freezing. In permafrost areas we have still the same problem of preventing freezing of the lines, but we cannot accomplish this by burying the lines below the frost line.

The obvious solution, of course, is to run these services through heated corridors or boxes above ground. This has been done in a number of locations with excellent results. Usually the steam lines from the central heating plant are placed in the same corridor or box as the source of heat. The RCAF did have one case however, where this system could not be wholly utilized. At this location the source of water was a small lake approximately 1,700 feet from the camp area, and on the side of the runway remote from the camp area.

Obviously it was not practical to have a steam line as the source of heat. There was also the problem of crossing the runway. Electrical heating was decided upon as the source of heat. As the normal personnel complement of the site was not large (15 to 30), storage for a month's supply of water was provided in the camp area. The distribution around the camp was in a heated corridor. The large storage capacity made it necessary to pump water from the lake only about twice a month.

The line to the lake was constructed as follows: a 24 in. x 24 in. wooden box was built of 2 in. x 6 in. T and G. The box was lined with tar paper. In the centre of this box the 2 in. galvanized pipe water line was placed. Along the top of the water pipe was laid a 2 wire No. 11 Pyrotenax cable. The cable and the pipe were then wrapped in aluminum foil and finally the box was filled with vermiculite insulation. This box was supported above the ground on wooden stilts. Under the runway a 10 in. corrugated metal pipe was used to encase the water pipe, heating element and insulation. In this case the aluminum-foil-wrapped water pipe and heating element were wrapped in 3 in. of fibreglass insulation, the whole being wrapped in 15 pound felt tar paper.

The water pipe was supported in the centre of the conduit by plywood spacers every 4 feet. Expansion loops were placed at the quarters points of the line. In practice the line is preheated for a period of 12 to 15 hours prior to the commencement of pumping. Provision has been made for backpumping of the line in the event of a stoppage. In addition, compressed air can be introduced into the line on completion of pumping to ensure that no water remains in the pipe. This system has proven most efficient. The sewage effluent line is handled in the same manner, except that the heat is left on in the line at all times during the cold weather. Here again it is suggested that no other than standard engineering practices were utilized.

Drifting Snow

Another common problem in the Far North, also attributable to climate, is that of blowing snow. The snow, particularly in the extreme north, is powder-fine. This fineness coupled with relatively high winds produce a situation which can become quite serious. The writer has seen a building almost completely filled with snow which entered through a loose fitting door jamb. Where this problem becomes most annoying is in the matter of roof ventilators or endwall louvres for ventilating attics. It has been our experience that these must be completely shut during the cold months to prevent an attic full of snow. Extreme care must also be taken in fitting doors and windows or other openings, to ensure weatherproof joints. While the writer cannot speak from personal experience it is considered that a similar problem would exist in desert areas, although the immediate cause may be different.

The above then are a few of the technical problems which have confronted the RCAF on some of their far northern construction projects. While the specific causes themselves are not met in the more southern areas, the problems themselves are parallel to problems encountered every day in construction projects further south.

Normal Transport Facilities Lacking

Now consider the logistic problems. As mentioned above, the factor contributing most to logistic problems is the great distances encountered. Resolute Bay on Cornwallis Island is some 1,000 miles north of Fort Churchill, the nearest railhead, or 1,600 miles north of Winnipeg, the nearest large center of population and Industry.

On the Alaskan Highway, Snag is 1,200 miles from railhead at Dawson Creek, or 1,700 miles from the nearest large centre of population and industry at Edmonton. A railhead at Whitehorse is the terminus of a narrow gauge railway running from Skagway on the coast. From Skagway to Vancouver is 900 miles. Or consider the mouth of the MacKenzie River. This is 1,200 miles from the nearest railhead at Waterways or 800 miles from the end of road traffic at Hay River.

Now distance, in itself, is not too difficult a problem, and certainly we have long distances in southern areas as well. However, in the Far North, we must add one more factor, namely the lack of normal transport facilities. Resolute Bay can only be reached by boat or by air. Likewise the mouth of the MacKenzie can be reached by boat or air, while Snag or other points on the Alaskan Highway can be reached by truck or by air. Still other points can only be reached by tractor train or, of late, the helicopter.

The second factor, in degree of importance, influencing logistics, is the climate. Admittedly, however, this is open to dispute. Climate dictates the time of year when not only construction, but also the transport of men and materials, can be carried out. Boats can proceed to Resolute Bay, during only a 4 to 6 week period in July and August. Similarly, the ice must leave the MacKenzie before boat transport can be used. In the matter of tractor trains the opposite is true. They must operate only when there is sufficient ice on the lakes and rivers in their paths, to allow safe passages.

Air transport can, of course, be carried out at any period of the year. However, air transport is confined to articles which can be fitted into aircraft and also to points where airstrips are already in existence or where water areas are available for landing of the aircraft. Helicopters overcome this lack of landing facilities, but as yet the helicopter has not reached the stage in its development where it is economically feasible to utilize it for bulk transport of construction materials over long distances.

Importance of Planning Emphasized

Let us look into a few examples of logistics problems encountered by the RCAF in their construction projects in the Far North. At Resolute Bay, due to climatic conditions, the normal construction season when any outside work can be feasibly carried out is roughly between May 15 and Sept. 15. Unfortunately the time boats can get to Resolute Bay is not until some time in late July or August. Thus at least half of any construction season elapses before any bulk of materials can be laid down on the site. The logistics problem here is thus to determine how best to use the available construction period to suit the means of transport available and the time when it can be used.

In 1952 the RCAF decided to enlarge its facilities at Resolute Bay through the addition of, among other things, more living quarters, a recreation building and a garage. The problem in logistics then was, after first determining the materials required, how and when to get them to the site. For the bulk of the materials this was not really a problem, as it was fixed by the available boat, and by the climate.

The real problems were those of making use of the time prior to the arrival of the boat, and what materials should be flown in to allow work to proceed during this period, so that all outside work could be finished in the six weeks available after the boat. It was finally and logically determined that the foundation materials should be flown in. This was done and the project proceeded according to schedule, until sometime after the boat had left, the forgotten or short-shipped items were noticed.

Here is where distance makes logistics such a problem. On a project in our more populated areas a telephone call will usually bring prompt delivery of these small but important items. Unfortunately telephones and the means of delivery are not available in the Far North. One example of the co-ordination and effort required concerned a valve, short-shipped because of unavailability at the time of the boat. The new buildings were framed in, the heating lines were run in and the next phase, that of interior finishing, was ready to commence. But there was no heat available and the weather was deteriorating.

When the article was located an aircraft was dispatched to the nearest landing field, which was at Chicago. This aircraft returned to Winnipeg where a special customs clearance had been arranged, then proceeded to Fort Churchill where a North Star from Montreal on a regularly scheduled flight was standing by to complete the journey to Resolute Bay. This particular problem and its solution involved the co-ordinated efforts of three government departments and two commands of the RCAF.

Breakdowns and Storms

Consider another incident which happened along the Alaskan Highway. The project this time was the erection of ten houses with associated services at Watson Lake, approximately 635 miles from the railhead at Dawson Creek. The houses were of a prefabricated type manufactured in Winnipeg. These were shipped by rail to Dawson Creek and thence by road to the construction site. The phasing of the project was such that an advance crew would proceed to the site and prepare the foundations, at which time the components for the houses would be delivered and an enlarged crew could complete the project by winter.

Here again everything proceeded according to plan until it came time to erect the first house. The precut sills were not on the site. Investigation revealed they had left Dawson Creek on the first truck dispatched with housing components. Further investigation revealed that this vehicle was broken down 120 miles from Watson Lake with a broken wheel on the semi-trailer.

The nearest spare was in Calgary, although a similar trailer was at Fort Nelson, 200 miles from the broken down vehicle. The problem was finally solved by taking a wheel off the trailer at Fort Nelson, flying it to Watson Lake, driving it to the stranded vehicle and effecting the repairs on the spot. Time lost was approximately 7 days with a crew of 4 men partially idle for that time.

Another incident in the same area will illustrate how complete

ly unforeseeable events can upset the most thorough logistics planning. The project in this case was a runway repair project at Fort Nelson. Arrangements were made to have the required asphalt delivered by tank car to Dawson Creek, then trucked to the project.

Here again the project was proceeding according to plan until the final fog sealing of the runways was commenced. Snow fell one day and stayed around for about four more. While snow at this time of the year, early September, was not a record it was most uncommon. It was not long till the available storage was filled, the distributors were filled and the carrier trucks were still arriving with more. Also a tank car was sitting at the railhead building up demurrage. This resulted in having to pay waiting time for the carriers and demurrage on the tank car.

Logistics Affects Technical Aspects

These examples illustrate how great distances add tremendously to the normal logistics problems of delivering the materials on site when required. Here is another example of how distance and climate add to the problems in planning a construction project in the Far North. The RCAF is presently engaged in planning a project, the locale of which falls within our definition of the Far North. It has been determined that for part of it tractor train transport is the only feasible method. This means movement during the winter months.

For another part of this project it has been determined that airlift by helicopter is the only feasible method. The helicopter, as you know, is a comparatively new machine. As yet its fuel-payload-range ratios are not good. It has therefore become necessary to fly materials by fixed-wing aircraft to adjacent lakes during the winter when ice is available for landing strips, and then by helicopter to the actual sites.

Construction will take place during more seasonable weather. Construction crews must be transported to these sites and this is possible only by helicopter. Further, all their supplies must be airlifted to them by helicopter even in many cases their water. Because of this it becomes necessary to hold the size of these crews and their length of stay to a minimum. This means that the buildings must be of a design to permit speedy erection. Here we see then that logistics can govern the technical factor in construction in the Far North.

Economic Problems

Blair Fraser reported in a recent issue of Maclean's Magazine specially dedicated to Canada's North, that one item holding up rapid progress in the civilizing of the North was the cost. This factor cannot be overemphasized. One example will illustrate just how high costs can become in the Far North. Previously it was mentioned that foundation materials were flown to Resolute Bay so advantage could be taken of the short construction season.

Rough figures indicated that the bags of cement flown in were worth approximately $80.00 a bag delivered on the site. This compares with our local prices of around $1.00 a bag. All costs are of course not in this ratio, but all are considerably higher. Because of the long transport material costs are higher. Labour costs also rise considerably as labour demands a premium for work in isolated localities.

In summary then, the following points are stressed when considering construction problems in the Far North. The purely technical problems are not too dissimilar from those found in other localities, although their cause may be different. Because of distances and climate the logistics problem can be most difficult, both during planning and implementation phases. In estimating costs a large factor must be applied to both labour and material items.

Of these three, the logistics problems will present the most difficulties. In logistics you are not considering exclusively inanimate subjects, such as steel or wood, the behavior of which, under given conditions, may be accurately forecast. Eventually you must consider two subjects, both of which can become most animate, and whose behavior, in many instances, is most unpredictable, the human being and Mother Nature.

POWER, PAST, PRESENT AND FUTURE

(*Continued from page 783*)

in many lands to minimize the need for imported fuel, and the world production of industrial alcohol will probably be greatly increased to provide much-needed liquid fuel. Indeed, one of the problems of the Atomic Age will be the provision of small mobile power units, and it may be that part of the answer will be found in the use of nuclear energy via a fuel cell. As far as can be seen at present, nuclear energy will be made available to the people as electricity. Electric rail and road transport will assume a new importance.

In sum, therefore, man having evolved during a million years has, over the past 250 years, developed a mode of living which is unique in human history. This achievement has thus lasted for only 0.025 per cent of his sojourn here and already it has made great demands on the energy resources of our planet. Unless he is able and willing to match his technology to the unfolding needs of the situation, he has no prescriptive right to a continuance of this latest civilization, and the history of civilizations discloses that discontinuity—decay and rebirth—is the normal method by which successive stages have been reached.

However, today man is equipped with a knowledge of natural laws (science) and an ability to harness these laws to his needs (engineering) that were absent in all previous civilizations, and there is good reason for thinking that the present mode of living can be greatly prolonged if he will but use this knowledge and ability aright. The test is one of competence in the political sense to learn how to live together in peace, and in the technical sense to unravel the unsolved relationships in nature and constrain them to serve his ends.

These twin challenges must be met if civilization is to endure. It is an exciting situation. The need for more and better physicists, chemists and engineers was never more clamant, the results of achievement were never more worth while, and it is extremely important that the prospect should be fully explained to the rising generation on whose shoulders the responsibility for continuity lies.

We stand before the portals of an epoch. It is the privilege of scientists to unlock one of the doors through which humanity may pass to the enjoyment of a fuller and a freer life for the next 5,000 years.

Let us all see to it that man is worthy of his achievements.

What Industry Expects of The Young Engineer in the First Five Years

by

Francis J. Curtis,

Monsanto Chemical Company,
St. Louis, Missouri.

A paper delivered at the annual meeting of the Engineers' Council for Professional Development, Cincinnati, Ohio, October 29, 1954.

"All is not sweetness and light" would seem to be the attitude of industry with regard to engineers and the first five years. We must remember that when we speak of industry we are speaking very largely of the opinions of many who are anywhere from one half to a full generation older than the beginning engineer. As far as I can find out in history, no older generation has ever approved of a younger, and each in his turn goes through the same metamorphosis; so let us not take too disconsolately the criticisms which are always offered as to the failings of the younger generation. We can be assured that the fault is never entirely on one side; however, this is no reason at all for not working on these criticisms, if only to make certain that the new generation will grow up sufficiently well as to be able to criticize its following one in the same manner.

I should state in the beginning, since I have spent all my life in the chemical industry, the remarks I make apply only to chemical engineers. However, I am very certain that they are general enough and that the situations are sufficiently prevalent for them to apply to any group of engineers.

Fundamentally, industry expects that a college graduate will be a man not a boy. Maturity in engineering may not go along at all with maturity in character. There is surprisingly little criticism of engineering ability and training but a great deal in the field of character. The program of the training committee of E.C.P.D. represents a big forward step in solving many of these troubles but it deals, largely, with the post-graduation stage.

Previous to Graduation

In the 1953 report of E.C.P.D., page 15, there is a very pregnant sentence which shows that the committee is quite alive to this situation. It states, "It has become increasingly apparent that the time to begin to talk to the young man about professional development, is not after graduation." With this observation, I am thoroughly in sympathy. Chemical engineering was invented by design engineers, is taught by design engineers, and for design engineers. The trouble has been that too good a job was done in making them. We in industry have pushed these chemical engineers into many fields for which they were not specifically trained. We have put them in chemical research, in which those who take to it do surprisingly well, and in production, sales, commercial development, business research, and management. I must take my full share of responsibility for this development. When I first went into production in the early twenties the men in charge, at least in our plant, were not technical. This was changed rapidly. Likewise, when I went into sales, in the beginning I was the only technical man in the whole sales department. This also has been changed rapidly. I now begin to wonder whether we were right.

The training which the engineer obtained in college did not and does not specifically fit him for these activities. The reason behind this expansion was the belief that engineering is excellent mental training for anything. I have always been impressed by the fact that a lawyer will take on any kind of a job, legal or not, because he knows his legal mental training will back him up. I believed and still believe that as far as mental training is concerned, the same is true of engineers. However, I have now come to think that in a great many cases they do not have this point of view themselves.

It may be interesting to see the breakdown of chemical engineers in Monsanto:

	%
Commercial development ...	2.5
Administration	3.5
Sales	9.9
Research	19.1
Engineering	21.0
Production	44.0

Many engineers left college, and many still leave college, without any conception of this. The thought that life was to be the designing of columns and the figuring of heat transfer. Many were shocked to hear that there is such a thing as shift work in life. A very recent survey at one of our production plants shows that 33 percent of the members of supervision, practically all chemical engineers, think that their training and ability is not being sufficiently utilized. I do not worry about the criticism on ability because very few people think that their real ability is recognized, but I am upset by the fact that so many engineers feel they are not using their training. As a matter of fact, they would only look upon their training as general rather than particular, they would see that the habits of analyzing problems, weighing evidence, putting together conclusions developed through the study of chemical engineering are used every day of their lives.

It would be my recommendation to the training committee not to take my word on this situation but to make a careful study with a number of companies and develop a program based on the results.

Decision on the Job

I feel that man's job is very important to him. I realize that there is quite a school of thought which advocates a good deal of shifting around but it is a school with which I cannot find myself in agreement. Starting to work in a

dustry is difficult enough anyway for a man who has spent his life in school. If he gets off on the wrong foot, it may take years to recover and he may never get over the effect of an initial failure on himself and on future employers. I have been appalled at the reasons given for many decisions on the first job. Quite a few are based on an additional five dollars a month, which is the most picayune reason I can think of. Many are concerned with location: they don't want to leave the West Coast or Texas, they want to be near Cape Cod or Long Island for sailing, or they may want to be in a big city or in a little town. Apparently, almost any motivation is bigger than the opportunities of the job.

Such thinking is not really a matter of engineering training but of character and of sense of values. I do not know whether the fault is in the home, in the schools, or in the general atmosphere of the time, but if a man twenty-one years of age is controlled by motivations such as these, he is a boy, not a man.

Industrial Training

Above all, I do not wish to leave the impression that all of the fault is in the home or college. Until almost yesterday most industries used the "sink or swim" method as a means of sorting out those who were to succeed and those who were not. Fortunately, in the last ten years this attitude has greatly changed and most companies now recognize their obligations. Those who are doing nothing about them are getting very rare. The whole field of industrial training is in more of a flux than is academic education. If you analyze chemical engineering courses in one standard university, you will find that they are equivalent and similar to those in another. This is not true in industrial companies.

Based on the "man not boy" concept, we do not favour in-plant classes even when conducted by the famous case method. We feel by this time the man must begin to learn judgment by holding a job and learning from his failures. Of course, he may regard a low mark as a failure but it is not quite the same thing as one which involves a loss to the company about which he hears plenty or one which at long last affects his own pay check. I do not think there is any substitute for actual doing when a man reaches the point where our young engineer out of school and on the job is. On-the-job coaching is supplemented by management development conferences on various facets of the business. These necessarily vary depending upon the field in which the man is working. The kind we favour most is the so-called slanting type, where all levels of supervision, from foreman up to plant manager, take part but no man sits in the same group with his own superior. Obviously, this is practical only in large plants. Departmental meetings also take place but they are more for specific technical matters than management training.

The key point of the whole system is the appraisal interview whereby each man sits down with his immediate superior at least once a year and goes over with him a performance review in which they discuss his activities in the various facets of his job, talk over where he has done well and where he has done poorly, and lay out a plan for his future development to correct the defects brought out. An important point in this whole system is that it must be carried out by the line organization and not by a staff department. The latter can be of invaluable assistance in giving information in training and techniques and in contributing the inspiration to keep the system going, particularly by persuading the older members of the line organization that helping younger men in this way is not mollycoddling.

However, no progress can be made by the best training system in the world unless the men being trained are motivated by desire for self-development. I was very glad to see the emphasis put on this factor by the report of the training committee. As long as they hang back, we can get nowhere and I don't care how much money is spent on training courses, consultants, or anything else.

We believe also in out-of-plant schooling and one of our divisions has a partial assistance program. I do not feel that companies should pay all the expenses of outside school training since it is a well known fact that no one appreciates anything that is free. I should like to point out, however, that policies of this kind are quite difficult for multiple plant companies since it may well be that there are many locations which are not fortunately situated with respect to universities and, therefore, some plants get to be favoured more than others. Rightly or wrongly, this is the problem to be faced.

What Do We Expect?

We expect therefore that a man should study carefully the openings which become available to him and realize that he is no longer in school. If he wants to use only his school training, he should stick to the jobs that do use it and not chase after those which offer more money but may require 90 per cent of his attention on costs, human relations, and getting out or disposing of the goods. He should cooperate and work hard on all the programs put forth to improve him and help to improve these programs by judicious criticism. He should realize that when he came from school he was only an embryo not a finished product and that what he does not know is much greater than what he does. He should recognize that his chemical engineering has trained his mind to analyze problems, to form clear conclusions, and to act, and is, therefore, of value in any business which he may undertake although it may be far from engineering *per se*.

Have We Pushed the Engineer Too Far?

I pointed out earlier the distribution of chemical engineers in one company and I am sure that an analysis of almost any chemical company would show somewhat similar figures. It is quite true that in most of these jobs design engineering plays little or no part. Have we, therefore, made a mistake and pushed the engineer too far? Some of us are beginning to think so. This year we expect to start again hiring liberal arts candidates for sales. Whether we will go further, I cannot as yet say but I think that we will do some experimenting. At least it would not take too much of a move in this direction to solve the problem of the shortage of engineers.

What About the Future?

If the engineer is to hold the place he has made for himself, the schools must recognize that their production line can no longer be a single one. In this I feel that the training committee of E.C.P.D. can be of great help.

Discussion of Technical Papers

A Method of Computing Maximum Snow Loads

by M. K. Thomas, Meteorological Division, Department of Transport, Toronto
The Engineering Journal, February 1955, page 120

S. D. Lash, M.E.I.C.[1]

I am grateful to Mr. Thomas for explaining the snow loads prescribed in the 1954 edition of the National Building Code (*Engineering Journal* February 1954) but I wish that he had not given a misleading impression of the loads prescribed in the first edition of the Code.

In Table 1 of Mr. Thomas' paper it is suggested that these loads were 101 lb. per sq. ft. in Winnipeg and 8 lb. per sq. ft. in Regina. These figures if true would have been fantastic. What the Code said was "Roofs having a slope of 20 degrees or less shall be capable of supporting a vertical live load of from 20 to 40 pounds per square foot of roof surface, the value to be assumed depending upon the probable snowfall and rainfall in the locality in which the building is to be erected". It was further stated that, *as a guide,* the formula $L = S + R$ (quoted by Mr. Thomas) should be used, but in this formula L was not the load but was related to the load by a table. As a consequence the recommended snow load at Winnipeg was 40 lb. per sq. ft. and at Regina 20 lb. per sq. ft.

There was undoubtedly room for improvement in the rather crude approach of the first edition of the Code but it is questionable if there is any sound basis for the figures given in the new Code.

In Kingston, for example, the new Code gives 55 lb. per sq. ft. as compared with 40 lb. per sq. ft. in the old. My own observation, based on fourteen years residence in Kingston, is that snow loads on roofs of ordinary proportions are virtually non-existent. I have not heard of any structural failures in Kingston from this cause and we have our share of old and weak roofs. I cannot imagine why it should be considered necessary to increase design loads by a substantial amount.

The Author

As professor Lash points out, there was probably not enough explanation given in the paper of the snow loads as suggested in the National Building Code, 1941. It should have been pointed out in the paper that the upper limit of the snow load was arbitrarily given as 40 lb. per sq. ft. I would suggest that in Professor's Lash's discussion he is referring to Vancouver and Regina, rather than Winnipeg and Regina.

Professor Lash's comments regarding the presence of roof failures in Kingston, are interesting. A collection of such observations from engineers and architects across Canada would provide information of value. It is my understanding that the Division of Building Research of the National Research Council have such a project under active consideration and that they hope to commence the assembly of such records next winter.

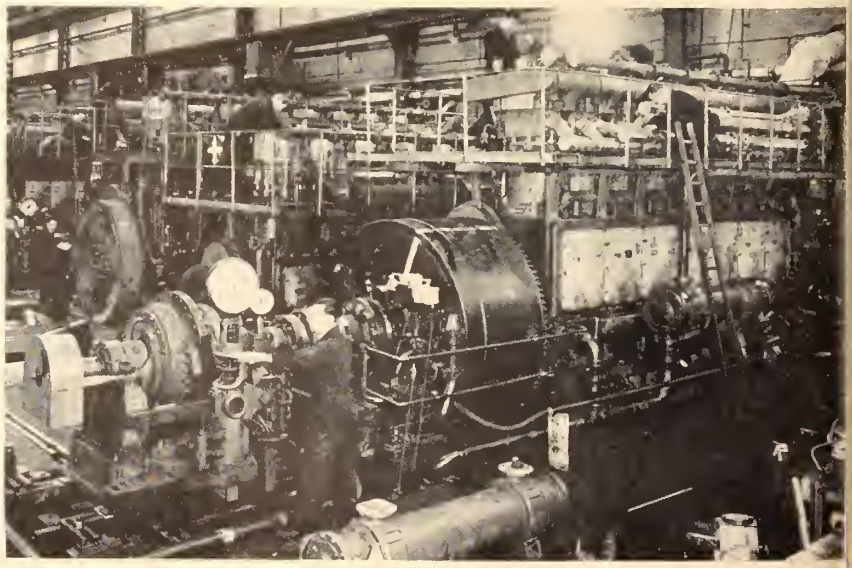
[1]Professor of Civil Engineering, Queen's University, Kingston, Ontario.

Machinery for New Train Ferry

Diesel power has been chosen for the new C.P.R. train ferry "Princess of Vancouver", built for the run between Vancouver and Nanaimo, B.C.

The main propulsion machinery is of the multi-engine type, driving twin screw propellers through fluid couplings and twin input reverse-reduction gearboxes. Each propeller is driven by two 7-cylinder turbo pressure-charged diesel engines, each rated at 1575 b.h.p. at 333 r.p.m. continuously. Three additional auxiliary units are of 450 kw. each, 450 volts, 3-phase, 60-cycles, at 0.8 p.f.; these alternators are driven by three 8-cylinder diesel engines, each developing 780 b.h.p. at 514 r.p.m. To comply with classification requirements there is an emergency set consisting of a 265 b.h.p., 1200 r.p.m. auxiliary diesel engine coupled to a 150 kw. alternator.

Illustrated is one of the propulsion units on test at the works of the National Gas and Oil Engine Co. Ltd.



Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

PRIDE IS FOR PEOPLE

Canadian Metals, v. 17, n. 8, July, 1954, p. 5.

It sometimes seems to us that many who laud Canada for her rich sources of mineral wealth are often like sycophants who praise a rich friend only in order to share selfishly in the wealth. To a wealthy person of high honour and sharp brains summer friends must be as much nuisance as flies. Flies, however, make no secret of their intent and need no schizophrenic masks to hide their feelings.

Birthday time, which we have now just passed, is often considered a suitable time to make proclamation of patriotism or admiration. The almost shopworn statistics of our wealth are trotted out for show.

True, we are proud and happy about our great mineral resources. We are also proud of our people and what they have done over these many years to make us a power of note. Actually we should be more proud of our men and women than of our vast raw wealth, for the former are developed by our Canadian environment, while nature alone created the latter.

Canadian Inventions

Let us then hear more about our inventions and plans, completed and otherwise. Let us hear of Lord Rutherford, who in 1902 in Montreal, stated the theory of atomic disintegration. Let us know more of our present day Shawinigan Power scientists who are developing in Canada a new and cheaper process for making titanium.

Let us know more about Dr. Abraham Gesner, who, a century ago in Halifax, extracted oil from coal beds. The new oil replaced animal and vegetable lighting oils. Gesner called it Kerosene. Alexander Graham Bell started his inventions in Canada. Marine fog horns were first developed in this country.

There is no limit to these illustrations if we take the trouble to really examine our history. But more than inventions are involved. The creation of Canada in 1867 was a master work, so was our transcontinental railway (assailed as fantastic in its day).

We will stop here, but we could extend this list for a long time. The point for pride is not what we have, but how we use it. Our wealth is a blessing, and we have used much of it with intelligent aggressiveness. Let that be remembered and made known, and true Canadians celebrate our birthdays to come with tales of our cultural, political and technical knowhow.

To merely cite the facts of our natural endowment is vain boasting; to be only swayed by them when recited by true or false friends is to invite flattery and eventual downfall.

CAN WE AFFORD TO DE-SALT SEA WATER?

Power Engineering, v. 58, n. 8, August, 1954, pp. 86-87.

Recent years have marked a decided increase in engineers' preoccupation with the problems of extracting fresh water from the sea. Unfortunately, the subject is of such interest that its complexity is often minimized for popular consumption, and this has led to much befuddled thinking and some interesting if fantastic schemes.

On the other hand, it may be fortunate that the public is so interested. Present thinking indicates that plants for the desalting of sea water will be extremely large and expensive—if significant amounts of fresh water are to be produced—and that the public will have to foot the bill.

Not only will the plants be expensive to build, but they will be very expensive to run. While it is not an iron-clad general rule, it is usually true that less expensive plants cost more to run because of less effective recovery of wasted power. This assumes, of course, plants of equal capacity.

No "Perfect" Solution

Despite the many workable techniques conceived to extract fresh water from sea water, no one technique offers a "perfect" solution to all the requirements of public water supply. These requirements are: (1) Fresh water production in terms of millions of gallons per day, (2) at less than $0.40 per 1,000 gal. for cities, (3) at less than $0.06 per 1,000 gal. for irrigation, and (4) with a minimum effect on fuel resources.

Even theoretically, a plant extracting fresh water from sea water (35,000 p.p.m. impurity) must expend 2.6 k.w.h. unrecoverable energy for each 1,000 gal. of fresh water. Add another 10.4 k.w.h. per p.s.i. head for every million gallons pumped to estimate induction and distribution costs. Since most water supplies, municipal or agricultural, are consumed well above sea level, the pumping costs cannot be ignored.

Some engineers believe the lowest purification costs are promised at this time by a new process called electrodialysis. This process employs unlike plastic membranes in pairs which screen out anions or cations respectively. Migration of the ions to their respective opposite poles is induced by positive and negative electrodes on opposite sides of the pairs of membranes. Migration is interrupted when the ions encounter a membrane which refuses passage to particles with their electrical characteristic. When sea water (or other solution) is introduced between two membranes with opposite permeability characteristics, the anions will flow through one membrane while the cations flow in the opposite direction through the other membrane. This leaves purified water between the unlike membranes, the purity depending on electrical charge at the electrodes, the residence time in the field of influence, and the condition of the membranes.

Electrodialysis

Both power and equipment costs for electrodialysis promise to be lower than for other methods of purification, at least partly because of the following characteristics:

1. The water is not heated or vaporized, thereby eliminating thermodynamic losses.
2. Action is taken against the im-

purity ions rather than the water. Since these are in lower concentration, it would seem to require less energy to remove the ions from the water than vice versa.

3. It is not necessary to raise the pressure in the system, therefore avoiding pumping equipment and power costs for process pressures. It also permits lighter construction of equipment with the attending savings.
4. As concentrations in the water are decreased, the power requirement decreases. In distillation systems, the farther along the process, the more power it takes for the extraction of additional pure water.

The latter characteristic makes electrodialysis especially valuable for the purification of waters with higher initial purity because of the close relationship of power requirements to the number of ions to be removed. It is expected that this property will lead to the use of electrodialysis in processing brackish water in some western states for local consumption.

Compression Distillation

Runner-up in the fresh water business is the compression distillation system. Compression distillation is inherently simple, and it has the advantage of a long history of use. It is fairly certain that advantages characteristic of the traditional compression distillation systems will apply as well to the modified version due out of the laboratories soon. The major difference seems to be that the liquid is agitated violently by some means to speed its evaporization, but insufficient information is at hand to justify predictions or conclusions.

It would seem apparent that engine-driven systems offer the greatest economy—especially if a cheap, continuous source of fuel were available. Sewer gas might be the answer if plants were located near the sewage treatment plants for large cities.

Many systems for the purification of sea water have been proposed, and some of them make sense. Among the systems which may develop favorably through such activities are the following:

Freezing:—Problems are equipment investment, end-point purity.

Solar Evaporation: — Problems are size and cost of equipment, plus difficulties of condensation in hot climates where the method might otherwise be practical theoretically.

Super-Critical Distillation: — Problems are corrosiveness of high-pressure, high-temperature water, scale formation, uncertain equipment costs.

Claude Process:—(Temperature difference of sea waters). Problems are size and cost of equipment, restricted number of practical locations. All these may eventually be resolved by the right situation in which waste heat from other activities can be utilized, but the plant will still be large.

Detailed studies by competent engineers and economists indicate that plans to finance sea water purification through the sale of mineral by-products are not likely to prove practical.

WHAT DO YOU KNOW ABOUT TRADE MARKS?

G. E. Maybee, Q.C., *Industrial Canada*, v. 55, n. 43, August, 1954, pp. 44-45.

1. A trademark is a mark used by a person for the purpose of distinguishing or so as to distinguish, wares or services manufactured, sold, leased, hired or performed by him from those manufactured, sold, leased, hired or performed by others.

2. Registration gives the owner the exclusive right to the use throughout Canada of the trade mark in respect of such wares or services. The term of registration is fifteen years; it is renewable for further terms of fifteen years each.

3. Registration of a trade mark will not be granted if it is "primarily merely" the name of a person or a surname; or is descriptive of the character or quality of the wares or services; or is the name of the wares; or is confusing with another trade mark or trade name previously used or made known in Canada; or is a mark the use of which is prohibited.

4(a). Trade marks that have acquired distinctiveness may be registered upon furnishing the Registrar with affidavits establishing long, exclusive, and extensive use in Canada.

4(b). If the mark is otherwise unregistrable because it is clearly descriptive or misdescriptive, or because it is primarily merely the name or surname of a person, registration may be obtained based on registration in the country of origin if the mark is not without distinctive character.

5(a). To be entitled to registration a trade mark must have been:

1. Used in Canada; or
2. Used in a Union (Convention) country and made well known in Canada by distributing or advertising the wares in printed publications or radio or television broadcasts; or
3. Used and registered in a Union country of origin, even though not used or made known in Canada.

5(b). An application may be filed for registration of a proposed trade mark; the application may be allowed but registration will be withheld until evidence of use in Canada has been deposited within six months of the allowance.

5(c). After three years from the date of registration, the Registrar may require evidence that the trade mark is used in Canada and may cancel the registration if the mark is not used if there are no special circumstances excusing such lack of use.

6. Provision is made for the registration of certification and association trade marks, union labels, and distinguishing guises. A distinguishing guise is a shaping, wrapping or packaging of wares; it may be registered only if it has become distinctive.

7. Use of certain marks, such as Royal or National flags arms, crests and emblems is prohibited.

8. An application is advertised in the Trade Marks Journal before registration is granted. Anyone objecting to registration must file an opposition within one month.

9. Trade marks are assignable and are deemed always to have been assignable separately from the goodwill of the business with which they are used.

10. A trade mark owner may permit others to use his trade mark under his control, but they must first be registered as Registered Users. Licensing of trade marks prior to the effective date of the Act may be validated if application for registration of the licensee as a registered user is made within one year from that date.

11. The Registrar may on application by the registered owner correct any error or change the name, address or description of the registered owner of a trade mark or of his representative for service in Canada, and limit or extend the wares or services for which the trade mark is registered.

12. After a mark has been registered for five years it cannot be invalidated on the ground that someone else had used it previously unless it is established that the registrant knew of such previous use.

13. It is not necessary to indicate on the goods or packages that a trade mark is registered, but it is advisable to do so.

14. The Act provides that no person shall make any false statement tending to discredit the business, wares or services of a competitor; do anything likely to create confusion between his wares or services and those of a competitor; adopt any other business practice contrary to honest industrial and commercial usage; or use another person's trade mark so as to depreciate its goodwill.

15. Action for infringement of a trade mark or for unfair competition or to enforce any of the provisions of the Act may be taken in the Exchequer Court of Canada or in the superior court of any Province. The Exchequer Court has exclusive jurisdiction in proceeding to expunge a trade mark registration and on appeal from the refusal of the Registrar of Trade Marks to grant a registration.

16. Trade Marks registered under any previous Act shall remain in full force and effect.

17. All trade marks falling due for renewal on or after July 1, 1954, are renewable for fifteen year terms, regardless of the term of the original registration.

Trade Mark Rules

1. Registered Canadian Trade Mark Agents may sign, file and prosecute trade mark applications without a written appointment of agent or power of attorney.

2. A Canadian representative for service must, however, be appointed if the applicant is a non-resident and has no place of business in Canada. The appointment may be signed by the Canadian Agent, who may appoint himself.

3. A separate application is required for each trade mark but a single application is sufficient for all the wares and services with which the mark is used.

4. Unless the trade mark consists merely of a word or words, a drawing is required in quadruplicate.

5. If the trade mark is other than a word or words, three specimens of the trade mark must be filed.

6(a). An application for recognition of an assignment or transfer of a trade mark must be accompanied by the original instrument of assignment or transfer, or by a copy certified by a notary public or a public officer authorized to issue such a copy, or by other evidence of transfer. No special form of transfer is prescribed.

6(b). The application for transfer may be signed by an agent and must include the address of the new owner and a representative for service in Canada if the new owner is a non-resident.

8. If the applicants for registration of a Registered User are related companies (i.e. if one directly or indirectly owns or controls a majority of the issued voting stock of the other) the application must give particulars of the conditions or restrictions, if any, proposed with respect to the permitted use of the mark. If the applicants are not related companies, the application must in addition give particulars of the relationship between them and the degree of control proposed by the owner of the trade mark over the permitted use. A copy of the contract between the owner of the trade mark and the Permitted User should be filed. If the proposed Registered User is a non-resident a representative for service in Canada should be appointed.

Legalization of applications executed abroad is not required. The Rules do not specify before whom affidavits must be taken, but it is believed that, when required, affidavits may be sworn before any official who has authority to take affidavits in the place where the affidavit is sworn.

DIESEL FUELS AND STEAM

W. E. Wilkinson, *Power and Works Engineering*, v. 49, n. 579, September, 1954, pp. 316, 327.

Since Dr. Diesel abandoned pulverised coal as a fuel for his engines, various grades of mineral oils have been almost universally used. Moderate success has been achieved in some experiments using separately injected oil and water as a fuel. But nearly always the difficulties of corrosion of the exhaust pipe and the tendency of water and oil not to mix but to react as separate quantities have made the results of these experiments commercially inapplicable.

So far as the writer is aware, emulsions of oil and water have not been widely experimented with. Some time ago, a butter factory on the North Coast of New South Wales found itself cut off from its normal fuel supply by floods. The engineer resorted to the simple expedient of using cream, which was in plentiful supply. The engines ran perfectly for days, until normal fuel supplies were again available.

Emulsion of Oil and Water

Let us consider the advantages as fuel of an emulsion of oil and water. Fuel costs, of course, would be diminished. The problem of erosion of the exhaust pipe should be overcome. Not only would these advantages accrue, but it is believed that the "diesel knock" could at last be eliminated and great efficiency be produced.

The heavy crude oils emulsify easily and would probably be more satisfactory as fuels in an emulsion form. It is more difficult to emulsify light oils, but it can be done.

Secondly, having made an emulsion, would it be sufficiently stable to allow itself to be sold and used commercially as a fuel? It is believed that it is not even necessary to produce a stable emulsion. A simple inexpensive agitator could be easily fitted to the engine to emulsify the fuel immediately prior to its injection into the cylinder.

Having once achieved an emulsion, the fuel may be used in normal engines without any alteration or addition with the possible exception of the agitator. The combustion of the oil content of the emulsion will produce a temperature of at least 3,000°F. in a normal engine. This will instantly change the water content to steam, exerting a pressure which would be maintained during a larger portion of the stroke. Although the instantaneous expansive force caused by the explosion might be less than one caused by the injection of pure oil, the total power output may still be greater than normal.

The turbulent condition of the expanding charge would cause the steam to combine with the wasted carbon dioxide of the oil to form carbon monoxide, which would explode.

"Watermatic" Engines

A consideration of the use of emulsions in normal engines has led the writer to believe that a diesel engine can be run on water alone. Realising the immense implications that would follow the use of such a fuel, the writer commends the following experiment to anyone willing to try it. Make a plain steel cylinder to take a 20-to-1 compression stroke, attach it to the crankcase and cylinder head of an ordinary engine, and lag it to retain heat instead of cooling it. Run the engine in the ordinary way on oil or petrol until, say 1,000°F. is produced at the cylinder head, then switch over to pure water as a fuel. The instantly formed steam would drive the piston, and the small quantity of water would

not absorb much of the heat of the cylinder. The cylinder and piston would soon become red hot at the top with each stroke. The heat produced by the compression of the air would build up with the running of the engine and conduct downwards. This cylinder could even be heated by a small auxiliary source externally, just sufficient to compensate the loss of heat absorbed by each injection of water, and so at least maintain the 1,000°F. produced each stroke by compression. In this way there might result a very convenient form of "hot spot" steam engine with a positive abutment.

If these "watermatic" engines should prove a success, a special alloy steel would probably be required to resist corrosion at red heat, and lubrication may present some problems. But both these problems have been solved before in connection with high-temperature steam engines. The advantages of water as a fuel should encourage the solution of any difficulty. Should corrosion or encrustation from impurities in the water occur, a short run on oil emulsion would probably expel it.

Mathematical calculations—and they have been extensive—have not yet disproved the foregoing claims. It remains to have the various matters tested by experiment.

THERMAL PROBLEMS OF HIGH PERFORMANCE FLIGHT

David Rendel, *Aircraft Engineering*, v. 26, n. 305, July 1954, pp. 220-223.

In very high performance aircraft —that is aircraft flying at high speeds and high altitudes—the thermal problems confronting the mechanical engineer are becoming progressively more and more severe. Atmospheric temperature ranges of upwards of 100°C combined with thermodynamic effects due to the high speeds, widely varying air pressure and moisture content are encountered and very rigid temperature limits for the various component parts of the aircraft have to be met with equipment of a minimum size and weight and without materially affecting the overall performance of the machine.

The properties of the Earth's atmosphere vary, of course, both geographically and with time. In a rapid climb to 40,000 feet at say 20,000 f.p.m. the ambient pressure will be reduced by 80 per cent at a rate of about 6 p.s.i. per minute, the external temperature will drop at 35°C. per minute and the moisture content will fall to zero. During this process the "heat-flows" to and from all parts of the aircraft have to be so adjusted that the local temperatures never exceed their limiting values.

Conditions are further complicated by the effects of speed. The temperature rise can be upwards of 100°C. at Mach numbers of 1.5 and the stagnation pressure at this speed more than three times ambient.

The temperature limitations on the aircraft structure will, in general, depend on the material used and the stresses it is subjected to, questions which are outside the scope of this paper. Here it is only necessary to draw attention to the desirability of having uniform steady temperatures in the aircraft structure and to contrast this requirement with the widely differing limits for aircrew, equipment, fuel and stores.

Considering first the aircrew, we find that the limitations here are rather complex since they depend on the interrelation between temperature, humidity and air velocity over the body and are materially affected by the sort of clothing which the man is wearing and also by the degree of acclimatization which he has achieved to his previous environment.

For equipment—radio, electrical and electronic apparatus—temperature limits vary widely according to its nature and the components inside it. Generators, cameras, radar sets, ammunition and armament all have very rigid limitations on operating temperature which differ widely from each other. Humidity control is also a factor in the design of certain classes of equipment and care must be taken to avoid large temperature differences between the equipment and its surrounding air.

The fuel is another item in the aircraft with a limited temperature range. Aircraft hydrocarbon fuels have a low-temperature limit because of freezing-out of water and eventually progressive solidification of the liquid. At higher temperatures this vapour pressure increases leading to high fuel losses if the tank is vented or unacceptable weight penalties if it is not.

At low speeds and on landing in bad weather, ice formation due to freezing of liquid cloud droplets on wing leading edges and intakes and other forward facing parts of the aircraft can be a serious hazard and can only effectively be overcome by the provision of large quantities of heat in the vulnerable areas, to melt and if possible evaporate the ice. The temperature to which the surfaces must be raised has obviously to be above freezing point and preferably much higher and for economy the heated areas must be kept as small as possible and as near the outer surface as possible. The requirements are particularly critical in the case of transparent areas where in addition to the icing problem we have also a hazard due to interference with vision through condensation on the surface when its temperature is below that of the boundary layer air.

Heat Generation or Loss

It is clear that heat is generated or lost in the aircraft in two ways. Firstly, local external atmospheric conditions; and secondly, heat sources or sinks within the aircraft.

However, these two cannot be treated separately. All those parts of the aircraft—such as the cabin and radio equipment—which require air conditioning in addition to temperature control, must draw their air from the atmosphere, unless stored air is carried within the aircraft; the temperature of this atmospheric air has to be maintained at the correct value. And where mechanical cooling is provided the heat extracted has eventually to be dissipated into the atmosphere unless large thermal capacities are provided within the aircraft with suitably low initial temperatures.

At present it seems that we shall have to set aside upwards of 50 h.p. to cool an aircraft of, say, 100,000 lb. A.U.W. at $M=2$, even taking no account of heat arriving through the aircraft skin (up to 10^5 C.H.U./hr. at $M=2$) nor of the penalties associated with additional air intakes and heavy ducting and machinery. When we take all these things into account as well it is clear that the power involved in cooling will, as Mach numbers increase, rapidly approach that now required for propulsion and some alternative solution will be needed. The only available solution we can at present visualize is to use the thermal capacity of the aircraft.

An aircraft is such a complex structure and the heat transfer laws associated with its flight through the atmosphere lend themselves so little to precise analysis, that only very approximate estimates can be made of the temperature variations in space and time that will occur in it. These uncertainties are fundamental and cannot be eliminated entirely no matter how involved the analytical method that we use or how costly the computing machinery we devise

The Engineering Institute's Sixty-Ninth Annual General Meeting

Convened at the Royal York Hotel, Toronto, Ont., May 10-13 1955.

Those members who, for their own good reasons, were unable to attend the 69th Annual Meeting in Toronto in May, missed one of the most interesting and enjoyable sessions the Institute has held in recent years. The thousand who did come, representing all of our Canadian territories from Newfoundland to the Yukon, experienced the stimulation that comes from mixing with friends, old and new, under the familiar beaver banners. No one could fail to sense the spirit of unity, strength of purpose, and good will that prevailed everywhere throughout the three day meeting.

From east to west: F. H. Clark, chairman of the Corner Brook, Newfoundland Branch; President D. M. Stephens; and Lieut-Col. Malcolm C. Sutherland-Brown, councillor representing the Yukon Branch.

The Business Meeting

Registration actually began on the afternoon of Tuesday, May 10, and after a further hour on Wednesday morning the business side of the program went into action with the opening of the Annual General Meeting at 10.20 a.m. with president D. M. Stephens in the chair. Proceedings moved smoothly and successfully through an agenda which included, principally, the elections to honorary membership, awards of medals and prizes, reports of council, finance committee and treasurer, financial statement, Harry F. Bennett Education Fund, reports of other committees and branches, relations with industry, and the election of new officers. Names and details concerning the awards of medals and prizes will be found elsewhere in these pages.

Election of Officers

The general secretary presented the list of the newly elected officers of the Institute as follows:

President

R. E. Heartz, Montreal, Que.

Vice-Presidents

Western Provinces
R. M. Hardy, Edmonton, Alta.

Province of Ontario
M. A. Montgomery, Kitchener, Ont.

Province of Quebec
R. L. Dunsmore, Montreal, Que.

Meeting of Council in the library of the Royal York Hotel on May 10.

Councillors

Branch	*Representative*
Newfoundland	G. R. Jack
Corner Brook	H. B. Carter
P.E.I.	E. K. MacNutt
Halifax	G. F. Bennett
Amherst	L. E. Burrill
Saint John	A. G. Watt
Fredericton	P. C. Levesque
Saguenay	B. L. Davis
St. Maurice Valley	E. T. Buchanan
Lower St. Lawrence	L. P. Dancose
Eastern Townships	G. J. Cote
Montreal	W. H. Gauvin C. G. Kingsmill
Ottawa	R. E. Hayes
Brockville	H. B. Brewer
Kingston	H. G. Conn
Belleville	S. Sillitoe
Port Hope	G. T. Hunter, Jr.
Toronto	M. McMurray
London	D. D. C. McGeachy
Border Cities	W. R. Mitchell
Nipissing & Up. Ot.	G. L. Hood
Sudbury	R. H. Moore
Lakehead	G. S. Halter
Winnipeg	C. V. Antenbring
Saskatchewan	J. J. Schaeffer
Edmonton	E. K. Cumming
Kootenay	H. P. Hamilton
Cent. Br. Columbia	M. L. Wade
Vancouver	H. T. Libby
Vancouver Island	W. A. Bowman
Yukon	M. C. Sutherland-Brown

Dr. Stephens said that he derived a great deal of satisfaction, as did those in the audience, from the fine slate of officers that have been elected.

In referring to the incoming president he observed that there is work ahead of the Institute right now that compares in significance with that which was done in 1886 and 1887 in the organizing of the old Society, or as that done in 1918 when the name of the society was changed. He was very pleased that the man who was going to be in charge of Institute affairs for the coming year, with all these great responsibilites and opportunities ahead, was the man who had headed up the Committee on Confederation. He thought it was a good omen that the person who had done so much good work for the committee was now going to take over the increasing responsibilities of the presidency.

Dr. Stephens stated that not only was Dr. Heartz qualified by reason of the work which he had done on the Committee on Confederation but also by the years of service which he had rendered to the branch and the Institute through a great variety of posts. All these things qualify him eminently for the high office to which he had been elected.

Perhaps the most important single item on the agenda, at least the most eagerly awaited, was the report of the Committee on Confederation. The president stated that at the meeting of the "old" Council held the previous day the report of this committee had been discussed in detail. At this Council meeting, which was attended by all councillors — continuing, outgoing and incoming, there were present also by invitation all members attending the branch officers conference.

Dr. Stephens explained that as Dr. R. E. Heartz, the original chairman of the committee, was to take over the presidency of the Institute at this annual meeting, it had been necessary for him to resign the chairmanship. At the time Council accepted his resignation it appointed Dr. I. R. Tait to replace him. It was Dr. Tait who had presented the final report to the previous day's meeting of Council.

The president called attention to the fact that the report itself had asked that, with the acceptance of the report, the committee be dismissed and a new one appointed in its place. Therefore, upon the acceptance of the report, Council had asked Dr. Tait to accept the chairmanship of the new committee. At the same time Council proposed that Messrs. Heartz and Stephens collaborate with Dr. Tait in selecting the personnel for the new committee.

Dr. Tait reviewed briefly the history of the activity of the committee. He stated that since the proposal which had been brought forward by Mr. Herbert Smith had been received, the idea of confederation had spread rapidly across the country.

Dr. Tait outlined the committee's activities which had culminated in the report presented to the annual meeting of Council. In his opinion real progress had been made. It would be the idea of the new committee to meet with the Dominion Council committee in an endeavour to arrive at a common understanding and a proposal for confederation between the provincial professional associations and the Engineering Institute.

Vote of Thanks to Retiring Officers

On the motion of J. B. Stirling seconded by James A. Vance, it was unanimously resolved that a vote of thanks be extended to the retiring president and members of Council in appreciation of the work which they have done for the Institute during the past year.

Dr. Stirling said that beyond the words of the resolution he would like to refer particularly to the outstanding work done by the retiring president, Dr. Stephens. In his opinion only a past-president could appreciate the amount of work involved in the presidency. In spite of the fact that Dr. Stephens had taken on the presidency just at the time when the work of his employers was in great need of his attention, he had carried out his duties fully and to everyone's satisfaction.

Dr. Stirling said that also he would like to comment on the service to the Institute which had been given by the retiring vice-president, Dr. I. R. Tait. He observed that Dr. Tait's services had been most unusual and helpful. He served extra time as vice-president inasmuch as he was asked to finish out the second year of office for his predecessor who had taken on the presidency. Also he had given generously of his own time in all the affairs of the Institute.

Mr. Vance, as another past-president, supported fully everything that Dr. Stirling had said and he seconded the motion.

Dr. Heartz, in acknowledgment of the introduction from Dr. Stephens, expressed his appreciation of the honour which had been done him in selecting him for the presidency. He hoped to meet each person at the meeting and those who were not there he looked forward to seeing in his travels across the country.

The Professional Meeting

The professional part of the program commenced at 2.00 p.m. on Wednesday 11th with the presentation of a series of technical papers and discussions, on a wide variety of subjects. This technical program, which extended over the three days of the meeting, was the largest attempted by the Institute so far and included 30 papers and two panel discussions. The topics covered, not only by Canadian authors but by invited visitors from the U.S.A. and United Kingdom, were drawn from many fields of engineering thought and activity, augmented by the local colour of major developments in Ontario.

Attendance at the technical sessions was for the most part good, and the papers were evidently well received, several active discussions having to be cut short for lack of more time.

Some of the papers have already appeared in the *Journal*, and it is hoped that the remainder can be published in future issues. The program presented at the meeting was, with some minor changes, as given on pages 474-476 in the April *Journal*.

Wednesday's proceedings closed in a very enjoyable and informal atmosphere in the evening when over four hundred members and guests joined for a cocktail reception and dinner in the Royal York Banquet Hall. M. W. Huggins, chairman of the Toronto Branch presided at the head table, and those attending were later favoured by the speaker with one of those fine addresses for which our retiring president Dr. D. M. Stephens has become so well known.

Other Activities

Thursday afternoon offered members three choices of interesting visits to projects in the Toronto area, covering the automobile, aircraft, and hydro-electric power industries. The assembly plant of the Ford Motor Company, at Oakville, and the Orenda Engine and Air-

The student conference under the chairmanship of D. C. MacCallum.

Participants include Eskil Johnson (U.B.C.); H. D. Atkins (U. of Alta.); John Campbell (U. of Sask.); D. W. Craig (U. of Man.); Paul Walters (U. of Toronto); B. R. Carter (R.M.C.); Andrew Blair (Queen's); Michael Orlander (McGill); Jean Roquet (Ecole Polytechnique); Jean Villeneuve (Laval); George Keith (U.N.B.); Don. J. Kawaja (N.S.T.C.); R. B. Gair (observer from U. of Man.); Lieut.-Col. B. W. Henselwood, representing the Army; Wing Commander W. Grant, representing the R.C.A.F.; Commander Sims, representing the R.C.N.; V. M. Clarkson, representing the Civil Service; Colonel L. F. Grant, E.I.C.; and Professor M. L. Baker, N.S.T.C.

Meeting of the International A.S.M.E.-E.I.C. Council on May 13.

Left to right (seated): D. M. Stephens, out-going E.I.C. president; Thompson Chandler, vice-president, A.S.M.E.; and R. E. Heartz, incoming president, E.I.C.; (standing): K. H. Platt, assistant secretary, Institution of Mechanical Engineers; Professor W. G. McLean, vice-president, A.S.M.E.; H. S. van Patter, M.E.I.C.; G. N. Martin, M.E.I.C.; J. G. Hall, M.E.I.C.; D. G. Darling, Ontario Section, A.S.M.E.; C. E. Davies, secretary, A.S.M.E.; L. A. Wright, general secretary, E.I.C.; and Colonel H. G. Thompson, executive assistant general secretary.

craft plants of A. V. Roe Canada Limited, at Malton, cover large areas and called for rather more physical effort on the part of the interested visitors than the more compact and highly attractive exhibit at Islington, where they saw the Ontario Hydro models of the Niagara and St. Lawrence River power developments. All three visits were well patronized.

The same evening there was a large attendance at the annual dinner of the Association of Consulting Engineers of Canada, which was honoured by the presence of Rt. Hon. C. D. Howe, HON.M.E.I.C., as guest speaker. Edgar A. Cross, M.E.I.C., the new president of the Association was in the chair.

The latter part of the evening was devoted to sound and vision—separately, in the form of a demonstration of high-fidelity recordings, presided over by Leonard Speed, and, under the aegis of K. B. Jackson, a showing of three-dimensional slides in colour. In addition, sound and vision were combined most successfully in a screening of the colour film "Leonardo da Vinci" which, as Dr. Wright explained, is now the property of the Institute and is intended for showing by branches, as well as being issued on loan to schools and other interested agencies. Although the film naturally deals with Leonardo's artistic accomplishments, the almost incredibly far-sighted engineering achievements of this remarkable man are ably and comprehensively treated. The session concluded with a short colour film ("See How They Fly") showing, by slow-motion photography, the complexities of form and motion involved in the flight of birds.

The President's Dinner

The president's dinner was held at the National Club on Tuesday evening, May 10. At this gathering the president has the opportunity to bring together the colleagues and associates of his year of office, and as many of the past presidents as are able to attend. Dr. Stephens took advantage of the occasion to thank most sincerely all who had helped him during the year.

Messages of good will were exchanged with past president A. J. Grant who was regrettably unable to be present, though he affirmed his participation in spirit on what was also the occasion of his 92nd birthday. However, actually present to lend their dignity to the occasion were a goodly number of "old timers" whose dates of joining the Institute, seemed almost to go back to the Crimea! Several of them spoke, and in a most interesting and informal way they outlined many phases of the Institute's past and current activities. All expressed confidence in it's future, possibly soon under professional confederation.

In accordance with what has now become an annual custom the retiring president Dr. Stephens was presented with a copy of the book "Half-hours With Great Scientists" by Charles G. Fraser.

The dinner concluded with the introduction of the president elect Dr. R. E. Heartz, who reaffirmed his own confidence in the solid and

progressive future lying ahead of the Institute.

The Ladies' Program

No account of an annual meeting would be complete without mention of the special program arranged for the lady visitors, and this is especially true of the feminine activities arranged so capably in Toronto by Mrs. C. D. Carruthers and her committee. Many very complimentary comments were overheard here and there during the meeting.

Starting with a morning coffee hour each day at 10.00 a.m., the principal events provided for the ladies included a fashion show and tea at Simpson's Arcadian Court, visits to the Art Gallery or Museum, luncheon at the Guild of All Arts, and a trip to see a flower exhibition at Casa Loma presented by the Garden Club of Toronto. The ladies of course were welcome at all functions on the general program, and many took advantage of this invitation.

The Special Conferences

Included in the full program of the meeting, and starting actually on Tuesday the 10th, there were several other important conferences and meetings. Highlighted among these were the annual Students' Conference with delegates from universities and colleges across the Dominion, the Branch Officers' Conference, a meeting of the "new" Council and a general meeting of the Ontario Division.

Dr. F. Kenneth Hare of McGill University speaks on "Canada's Northward Expansion" at the banquet. His address was very well received.

His Worship the Mayor of Toronto, Nathan Phillips, pays tribute to the engineering profession as he welcomes delegates to the city he represents.

Readers are asked to note that it is not the *Journal's* intention to report the discussions and conclusions reached at these meetings in this issue. The July *Journal* will carry a full account of the personnel present, the resolutions passed, and the official minutes of the business meeting. Many more pictures taken during the Toronto meeting will also appear at that time.

The Banquet and Dance

We believe that all those present for the occasion will agree that the climax of the meeting was the magnificent banquet on Friday evening, followed by the reception and dance. After the head table guests had marched in and assembled, to the tune of the bagpipes, events one after another made a memorable program.

The seven hundred or more who attended received the speakers with enthusiasm, and endorsed with genuine applause the awards of medals and prizes. A special source of pride to all Institute members came at the moment when past president and now field secretary Colonel L. F. Grant, HON.M.E.I.C.,

Colonel L. F. Grant accepts the 75th Anniversary Medal of the American Society of Mechanical Engineers from Thompson Chandler, vice-president, A.S.M.E., while the guest speaker, Dr. F. Kenneth Hare, applauds.

E. V. Leipoldt, vice-president, Shawinigan Engineering Company, congratulates author R. S. Thain of the Defence Research Board on his paper, "Low Frequency Radio Communications and Engineering".

received from Mr. Thompson Chandler, vice-president, A.S.M.E., a special medal struck by the American Society of Mechanical Engineers, on the occasion of their 75th anniversary year, in recognition of his outstanding work as chairman of the Engineers' Council for Professional Development since 1952.

A strong challenge was made to the Canadian universities by the principal speaker Dr. F. Kenneth Hare, of McGill University, who spoke with refreshing wit on the subject of Canada's northward expansion—a subject obviously close to his heart. Dr. Hare's fine address will receive further attention in the next issue of the *Journal*.

After the introduction of the new members of Council, the banquet proceedings ended with the "long walk" and induction of the new president Richard Edgar Heartz.

Shortly afterward president Heartz and his wife, together with his predecessor D. M. Stephens and Mrs. Stephens, informally received members and guests prior to going on to the dance. A happy ending to the meeting was provided by the music in the ball room, where the banquet guests were joined by many who arrived later.

The traffic panel appears on television program "Tabloid". Left to right: C. E Campeau, M.E.I.C., Montreal; H. F. Burns, Jr.E.I.C., Winnipeg; W. E. P Duncan, M.E.I.C., chairman, Toronto; H. R. Burton, Toronto; and Murray Bosley, Toronto. The program was voted a considerable success.

Television Appearances

On two days of the meeting the Institute had representatives appearing on the C.B.C. television program "Tabloid." The first of these was on Thursday afternoon at which time the panel on traffic discussed their problems for the TV audience.

The second appearance was on Friday afternoon when Dr. Lillian Gilbreth, HON.M.E.I.C., was interviewed on the same program.

The results seem to indicate that the engineers handled themselves very well through this medium. It seems evident that longer sessions dealing with other subjects of interest to the public would be suitable for telecasts on future occasions.

The Meeting Arrangements

This record of the 1955 annual meeting could not be concluded without some special words in tribute to the work of the Toronto Branch committee under the general chairmanship of C. D. Carruthers. The way these gentlemen undertook their tasks, and the results achieved, can be held up as examples of how planning and efficiency can get things done.

During the several months of preparation prior to the meeting constant liaison was maintained with Mansfield Street in Montreal and the success of the entire program proves what can be achieved when branch and headquarters go into high gear together for a common purpose.

Members of the Canadian Committee of the International Conference on Large Electrical Systems meet on May 12 to discuss presentation of papers by the committee at the Paris conference in May, 1956, which will be attended by representatives from nearly all major countries including Soviet Russia. Left to right: Dean Adrien Pouliot, dean of engineering, Laval University; Harold H. Turner, president, Canadian General Electric Company, Toronto; H. L. Hurdle Montreal Engineering Company, Montreal; H. H. Rogge, president, Canadian Westinghouse Company, Hamilton R. L. Hearn, chairman, Hydro-Electric Power Commission of Ontario, Toronto; G. A. Gaherty, president, Montrea Engineering Company, Montreal; Fred L. Lawton, chief engineer, Aluminium Laboratories Limited, Montreal; B. G Ballard, vice-president (scientific), National Research Council, Ottawa; E. V. Leipoldt, vice-president, Shawinigan Engineering Company, Montreal; and T. Hogg, consulting engineer, formerly with the Hydro-Electric Power Commission of Ontario, Toronto.

Month To Month

JAN. FEB. MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Registration in the Yukon

Canadian engineers will be interested to hear of a development which has just taken place in the Yukon Territory. The officers of The Engineering Institute of Canada Branch there have appealed for "an ordinance respecting the practice of professional engineering". The petition has been accepted and the ordinance has been enacted.

The situation is slightly different from that which exists in the provinces. In the first place, the document is called an ordinance instead of an act, although it does create an Association of Professional Engineers.

Some of the differences are that the ordinance specifically provides that nothing therein shall restrict an architect in the practice of architecture, nor shall it be related to the practice of a Dominion Land Surveyor except that such surveyor "shall not style himself nor hold himself out as a professional engineer unless he is registered or licensed under this ordinance".

Another specific exemption applies "to any member of the armed forces of Canada or of visiting forces as defined in The Visiting Forces North Atlantic Treaty Act, while actually employed on duty with such forces".

Another clause provides that the Act "shall not prevent any person from assisting in the execution of any professional service or creative work of a kind described in the definition of 'practice of professional engineering' in Section 2, where a professional engineer directly supervises and assumes full responsibility for such service or work".

The officers and Council of the Association are to be chosen by the members of the Association from their own membership. There is no provision for representation of government.

One outstanding difference is that qualifications for membership are not specified as being related to the candidate's educational qualifications. The main item states that the applicant shall be "of good standing as a Member of an association or corporation of professional engineers of any province of Canada or of the Engineering Institute of Canada".

Another feature that will have popular appeal is that "every member who becomes a member of the Association shall be exempt from payment of the annual fee for his first year of membership". Incidentally, although a specific fee is not mentioned, provision is made for a maximum fee of $50.00 a year.

Engineers everywhere will wish the new Association every success. It is of particular interest and satisfaction to the officers of The Engineering Institute to know that it was the officers of the Institute Branch that made the application and that will constitute the officers of the new organization. Success to them!

Seventy-Five Years Young

This is the diamond jubilee year of the American Society of Mechanical Engineers. The project of its organization originated with Professor John E. Sweet of Cornell University, who discussed it with 29 other engineers at a meeting in New York on February 16, 1880. Two months later, on April 7, 1880, the Society was formally launched. Within a year it had a membership of 189 and a bank account of $2500.

The fame of many of the 189 died with them, but some are still remembered — Alexander Holley, who introduced the Bessemer steel process into the United States; Robert Briggs, the originator of our standard pipe thread; Thomas Pickering, the inventor of the spring governor; W. E. Ward, the builder of the first concrete house and R. H. Thurston, professor of mechanical engineering at the Stevens Institute of Technology, to pick a few more or less at random.

From its start the A.S.M.E. has regarded its responsibilities to the public seriously. The frequency of boiler explosions—one about every six hours in 1910—often with fa-

Cover Picture

The recent annual meeting brought together officers representing most of the Institute's branches. The Branch Officers Conference, shown in the cover picture, is an important phase of the work done at the annual meeting.

C.P.R. Photograph.

talities and always with property loss, led to the formation of the Society's Boiler Code Committee in 1911. Today its standard boiler code has been adopted in 38 states and territories, in eight Canadian provinces, in the Commonwealth of Australia and in a number of other countries The A.S.M.E. elevator code, just revised, has been as successful as the boiler code in reducing accidents wherever it has been adopted.

One of the society's accomplishments in standardizing which comes close home to all of us is in fire hose couplings, so that apparatus from one city can help out in another. This project was undertaken jointly with the National Board of Fire Underwriters and the American Water Works Association. And, of course, it was vitally concerned in the negotiations with British and Canadian engineers which led to the rather recent adoption of standard machine screw threads for the English-speaking world.

We of the Engineering Institute have special reasons for sincerely congratulating the American Society of Mechanical Engineers on the magnificent record it has established in the past 75 years and for just as sincerely wishing it continual progress and an even more influential position in the engineering world in the years to come. For long we have been fortunate enough to enjoy very close relations with it; the help and advice so gladly given us by its officers have many times been invaluable.

That it does not think too badly of Canadian engineers is shown by the fact that three of its recent presidents are Canadians or members of the E.I.C.: Dr. A .G. Christie, M.E.I.C. (1938-39), W. L. Batt, HON.M.E.I.C. (1941-42) and Dr. L. K. Silleox, M.E.I.C. (1953-54). These three it counts among its honorary members along with Norris R. Crump, M.E.I.C., Dr. Lillian M. Gilbreth, M.E.I.C., R. E. Heartz, M.E.I.C., Hon. C. D. Howe, HON.M.E.I.C., and Lt. Gen. A. G. I. McNaughton, M.E.I.C. And, of course, many of our other members are also members of the A.S.M.E.

With its 40,000 members and 83 local sections, its monthly journal —one of the best—its four other regular publications and its 200-odd codes, standards, handbooks and the like, it does much to influence constructively the thinking of all engineers, not just that of its own members. A non-member and probably not eligible for membership, this writer is impressed by the A.S.M.E.'s down to earth approach to its problems. While by no means unaware of the troubles of the engineering profession, both past and present, any solutions it may suggest are sure to be for here and now, flexible enough, however, to be easily modified as conditions change. That they may fall short of somebody's ideals is no defect to be any good a solution must be workable.

So to the American Society of Mechanical Engineers the Gaelic toast: "May you live richly to eat with relish the chicken that scratches over your grave!"

Foreign Competition

Recently a young Canadian engineer sent to headquarters a list of refinery, petrochemical and chemical plants which had been designed and in some instances built in Canada by non-Canadian firms, in the last four years.

The list includes forty-three plants. All but four of them were designed by engineers who do not have any engineering office in Canada. The four plants engineered in Canada were designed by three firms all of which have their main office in the United States with only subsidiary organizations in Canada. Our informant reports that two out of the three have recently closed down their Canadian office and have returned to the United States.

The volume of business involved in the construction of these plants is $428,000,000. Of this, $33,000,000 was planned by American firms with offices in Canada. It will be admitted generally that a serious situation is pointed up when this many plants have to be designed outside Canada. It is true that in many instances there is a certain amount of technical knowledge which is controlled by some of the American consulting firms. However, it may well be contended that this condition should not go on indefinitely. If the protected processes involved are not made available to Canadian engineers, perhaps the Canadians should develop substitute processes of their own so that the country can be freed from the domination of non Canadian organizations.

Some people contend that Canadians not only are not competent now to design such plants, but are not likely to be competent for many years to come. However, the engineer who wrote us is himself in that field of work. He has been with some of the American companies and his opinion goes like this: "The argument that it would be impossible to do the work here is untenable because (1) the few jobs that have been done in Canada have been completed successfully (2) there are many Canadian chemical and other engineers now living in the United States who probably would be glad to return and staff engineering companies in Canada. For instance, when I was working for a certain American company in California there was one project on which the project engineer and two of the four process engineers were graduates of the University of British Columbia.

"The seriousness of the present situation is painfully apparent to me. I returned to Canada to work for an American company with a Canadian office. When they were about to go out of business I joined another American company operating in Canada. Now they are closing their engineering office here and I have been transferred to the States."

Probably there is no field in which Canadian engineers do less work than the field of chemical, petroleum and petrochemical industry. In view of the tremendous opportunities for this sort of activity in Canada, the time must come when Canadians have a chance to do this work for themselves. Surely we are not to go on all the rest of our lives paying this huge price to foreign organizations for our ignorance or our lack of initiative

Our Readership Survey

Except for the relative few who have been receiving cards each month, most of our readers are probably unaware that a *Journal* leadership survey is in progress and has been going on since last November. Because the results have been so encouraging, it was decided to publish a review and digest of the first six full months' returns, November through April.

The message, reproduced herewith, which appears on the address half of the double card, will probably best explain what we are trying to do. (See at right.)

In addition, on the return half of the card, there is space for the reader to use in making comments or suggestions if he wishes. The one hundred mailed each month are selected absolutely at random from our trays of stencils, except that we are working across the country gradually, from West to East, in "batches" representing about one-twelfth of our membership. A proportion of members, juniors and students has been established, roughly, so that all grades of membersip are included.

The first fact established by the returns, and the most gratifying one, was the amazing number of reply cards being received. Of the first 600 sent out, over the initial six months' period, no less than 314 have been completed and returned, or slightly over 52 per cent. According to the best information we can obtain, this knocks the stuffing out of any readership survey record we have heard of so far! In general, a return of 15 per cent is "good", and 25-30 per cent "exeellent". What would you call ours? We can only thank the readers, who have demonstrated their interest in the *Journal's* welfare so decisively.

The Detailed Results

To get down to the detailed results, as tabulated for the same six months, the overall reader preference for the different sections of the *Journal* turns out like this:

1. Technical Papers
2. Business and Industrial Briefs
3. Personals
4. Abstracts of Literature
5. Advertising
6. Employment
7. Month to Month
8. Branch and Association News
9. Library Notes

The first item was no surprise. After all, it is for the technical papers that the *Journal* really exists, and if they were not popular we would soon have few readers. They have been an easy first, every month so far, but the second and third place winners are interesting. At least, we on the editorial staff did not expect the briefs and personals to rate so high. From there on down, the results show a varying degree of reader interest, with the standing changing up or down a little for the remaining sections as each month's cards came in. The branch and association news, and library notes, have had a rather slim following so far in comparison with the others, but very few readers have suggested that any section be scuttled. It has been pleasing to learn that our advertising is read and enjoyed to the extent shown in the standing. This is in spite of quite a few who cry—"less advertising!"

Other Observations

Several other general observations come to mind in looking over our notes. The highest rate of returns *so far*, by areas (which includes from Vancouver Island to Montreal), has been from Southern Ontario, where 61 per cent of the members mailed back their cards. Against that, we must point out that the most suggestions and comments have come from readers in the West. With regard to the suggestions themselves, they have been hot and cold, good and bad, constructive and damning, according to taste and temperament—but always interesting, and ultimately of great value to us. For instance, many readers have asked for some listing of contents on the front cover. This demand has been so insistent that something has been done about it already.

Last, but not least, we have received a generous number of bouquets too. Nothing is more like the cool water in the desert to the small group who put the *Journal* together on the mezzanine floor high up in the headquarters building. It is nice to know that we have so many loyal friends and supporters. The readership survey is turning out to be a big success, and we are depending on you to keep it rolling. To those in Eastern Quebec and the Maritimes—please watch for the yellow card in your mail in the next few months. But no one need wait for the survey card. If you have something to tell us, any old piece of paper will do, anytime.

> Dear Reader:
>
> In a continuing endeavour to improve the interest and value of the *Journal* we wish to learn more about what the readers think of it. You are one of a hundred members being consulted this month to get some personal opinions. Others will be canvassed in future months. Will you please take a few minutes to complete the attached card?
>
> The sections of the *Journal* are listed alphabetically. Please indicate those which interest you most by listing your preference by numbers "1, 2, 3" etc. or, if you wish, by simply marking an "X" opposite each. Your name need not necessarily be given, but we would like to have your grade of membership. Every completed card dropped in the mail will be appreciated.
>
> L. AUSTIN WRIGHT, M.E.I.C.,
> *Editor*

World Power Conference

The Canadian National Committee of the World Power Conference met again in Ottawa on April 14 with Major General Hugh Young, M.E.I.C., in the chair. Plans for the regional meeting of the Conference to be held in Montreal in 1958 were advanced considerably. It was reported that arrangements had been concluded with the Mount Royal Hotel and the new Queen Elizabeth Hotel for the necessary accommodation.

A considerable portion of the meeting was taken up with discussions of a topic for the Conference and for the arrangement of papers.

Consideration was given also to the fifth World Power Conference which is being held in Vienna in 1956. Arrangements were made for the presentation of three papers from the Canadian Committee.

It was reported by the honorary secretary that following the decision of a previous meeting invi-

tations to join the Canadian National Committee have been sent to eleven persons. Acceptances had already been received from the following: A. E. Grauer, president, British Columbia Electric Company; W. J Bennett, president, Atomic Energy of Canada, Limited; A. W Southam, managing director, British Newfoundland Corporation, Limited; W. E. Uren, chairman, Dominion Coal Board; D. M. Stephens, chairman and general manager of the Manitoba Hydro Electric Board; A. L. Forsyth, president, Dominion Steel & Coal Corporation; F. L. Lawton, The Saguenay Power Company; The Hon. E. E. Fournier, chairman, New Brunswick Electric Power Commission, and Henry D. Hicks, chairman, Nova Scotia Power Commission.

It was agreed that the next meeting of the Committee would be in September.

Secretary Retires

Wm. N. Carey, executive secretary of the American Society of Civil Engineers, retired from that office on May 1 On April 22, a group of about forty-five secretaries and a few officers of E.J.C. gave him a "send off" at the Engineers' Club of New York. This picture shows the head table with Dean Thorndike Saville, president of the Engineers' Joint Council, at the left end, and John Warner, secretary of the Society of Automotive Engineers next, then Colonel Carey and C. E. Davies the chairman, secretary of the American Society of Mechanical Engineers. Then comes S L. Tyler who just recently retired from the secretaryship of the American Institute of Chemical Engineers. Admiral Geo. Hussey, president of the American Standards Association is nearest the camera. Messrs. Carey, Davies and Tyler are familiar figures at meetings of the Engineering Institute.

National Aeronautical Establishment

Statement by the Rt. Hon. C. D. Howe, Minister of Trade and Commerce, and the Hon. Ralph Campney, Minister of National Defence.

Long-term plans for the research facilities comprising the National Aeronautical Establishment, at Ottawa, including construction of a super-sonic wind tunnel at Uplands Airport, may well mark a new and exciting era in Canadian aviation research.

NAE was created in 1951 to provide research and development facilities adequate to meet the needs of the expanding RCAF. Additional requirements were flight and structural testing facilities for Canada's civil aircraft industry.

The establishment comprises several small research wind tunnels of varying speeds, and engine, structures and thermodynamics laboratories all at the National Research Council's Montreal Road site. The flight research section, formerly at Arnprior, Ont., moved in 1953 to Uplands Airport and occupied a large research hangar completed last year and financed by the Defence Research Board.

NAE scientists have achieved an impressive series of accomplishments. An important flight test program has provided valuable information on the stability and control characteristics of tailless aircraft. A "wing flow" technique developed to obtain data on models at or near the speed of sound, has provided Canada with a valuable trans-sonic aerodynamic testing facility.

NAE scientists have contributed to the launching phases of the guided missile being developed for the RCAF. In addition the rotating parachute designed at NAE primarily for supply drops, is being studied for further applications.

Other Government agencies have been helped by the establishment in a variety of ways. An airborne magnetometer, developed to detect magnetic deposits, is proving invaluable in aerial geological surveys. Canada's mapping program has been aided materially through a radar altimeter, another airborne device which provides accurate variations in ground profiles. NAE scientists have developed as well airborne radioactivity detectors now used widely in Canada for detecting ore bodies.

In addition to its normal operations, NAE is currently carrying out aerodynamic investigations relative to high speed jet aircraft.

Because of its lengthy experience in the field of aviation and allied research, the NRC has operated the entire establishment during its revolutionary phases. When the Uplands' facilities become more self-sufficient with installation of the new wind tunnel, they will be separated from the National Research Council's Montreal Road elements and operated as a Defence Research Board laboratory.

Designs for the tunnel are now being completed and construction will begin during the summer. Installation will take about three years. To be housed near the flight research section, the tunnel will cost almost $3,500,000.

Installation of this versatile modern research tool has become a necessity to support current and future Canadian development of military aircraft and supersonic air-defence guided weapons. Existing tunnels in Canada lack the variety of facilities necessary for

jet and missile-age developments. The Uplands installation will be an essential component of Canada's air defence program.

To be comparable in function with and complementary to similar high speed tunnels in the United Kingdom and the United States, it will have a minimum working section of four to five feet square and a speed range of 200 to 3,000 miles per hour. The installation's versatile characteristics will facilitate checking of theoretical estimates involving speeds, manoeuvrability, controllability and economy of construction of the developments under consideration.

With the separation of the elements that now comprise NAE, the Uplands' facilities will be taken over by DRB. Those on the Montreal Road will remain with NRC where fundamental aeronautical research, both for military and civil purposes, will be stressed. The scientists at both sites will continue to work closely together however, to fulfil military and civil requirements.

Long-term objectives for the Department of National Defence will be new types of aircraft and guided weapons. Research assistance to Canada's civil aeronautical industry will continue as in the past. The overall program planned for both sections will be comparable with the type of research and development carried out at Britain's famed Royal Aircraft Establishment at Farnborough.

Until the two sections separate, NAE will continue its operations under J. H. Parkin who is also director of the NRC Mechanical Engineering Division.

The National Aeronautical Research Committee, which provides policy and development guidance for the NAE, will continue to act in an advisory capacity following the separation of the two sections. Committee members are Dr. Omond M. Solandt, HON.M.E.I.C., chairman of the Defence Research Board; J. R. Baldwin, deputy minister of the Department of Transport; D. A. Golden, deputy minister of defence production; Air Marshal C. R. Slemon, chief of the Air Staff, and Dr. E. W. R. Steacie, president of the National Research Council.

Academic Performance

The Facts on Engineering Student Mortality

This article is reprinted from "Engineering and Scientific Manpower", Newsletter No. 55, March 24, 1955, issued jointly by the Engineering Manpower Commission of the Engineers Joint Council, New York, and the Scientific Manpower Commission, Washington. The Canadian situation was described in the May 1955 *Journal*.

Those who have participated in guidance programs know that there is a widespread belief that engineering student mortality is unusually high and the impression prevails that it is much higher than in other educational disciplines. An article on "Graduation and Withdrawal Ratios for Engineering Students," by Henry H. Armsby, in the November 1953 issue of *Higher Education*, the monthly publication of the U.S. Department of Health, Education, and Welfare, provides illuminating information on this point.

The article is based on data on graduation and withdrawal ratios of engineering students obtained in a study recently completed by the Educational Testing Service, of Princeton, N.J. This study, made for the U.S. Coast Guard, has been published by Edueational Testing Service under the title "Four-Year Follow-Up Study of 1948 Freshman Entrants to Engineering Colleges."

The published figures are based on a survey made in November 1952, for which 101 engineering colleges furnished virtually complete data covering more than 13,000 1948 freshman entrants. These institutions constitute a good cross section of the engineering colleges of the United States. The data do not include students engaged in cooperative programs.

Of the entering students covered by the survey, 33% were graduated in engineering in four years or had satisfactorily completed four years of a five-year program of engineering studies; 11% of the entrants were still enrolled in July 1952, and it was expected that most of these would graduate by June 1953. During the four years, 56% had withdrawn or had been dropped from engineering.

From an earlier study conducted by the Office of Education during the academic year 1931-32 in a smaller group of institutions, it was learned that 30% of engineering students graduated in four years, and 62% dropped or withdrew. Corresponding figures for other disciplines included in the same study were: arts and sciences, 29% and 67%; commerce and business, 24% and 67%; home economics, 31% and 65%; agriculture, 34% and 60%; education, 42% and 53%. Unfortunately, there are no data on these other disciplines for comparison with the results of the 1952 study by Educational Testing Service.

The E.T.S. study also revealed wide variations in the graduation ratios among the 50 largest institutions. These ratios ranged from 9% to 62%. The general average for engineering schools that are parts of universities was 27%, whereas for the independent engineering schools it was 41%; the average for publicly supported institutions was 25%, for private institutions 46%.

Some students who were graduated in four years had academic difficulties: 26% of them had, at some time, repeated one or more courses; 11% had attended one or more summer sessions; and 12% had been on probation for one or more terms. Again there were wide variations among individual institutions. More than half of all withdrawals occurred during or at the end of the first year of college. As percentages of the original entrants, the withdrawal figures were as follows: 32% of all freshmen were dropped or withdrew by the end of the first year, an additional 16% during or at the end of the second year, 6% during or at the end of the third year, and 2% dropped during the fourth year. Almost half the voluntary withdrawals from engineering were made to effect changes in curriculum. These constituted 21.5% of the total withdrawals. Of those who voluntarily withdrew, 28% were students in good academic standing; 7% were reported as having withdrawn for financial or family reasons, and only 6% because of dislike of engineering.

Two of Dr. Armsby's conclusions are quoted below:

Unfortunately, comparable figures for the other disciplines are not available, but it seems likely that the engineering schools are graduating at least as many of their entering students in 4 years as are schools in most other disciplines.

lines to which students are admitted upon graduation from high school.

It is practically certain that improved programs of selection and counselling in junior and senior high schools and in colleges and universities, better teaching at all levels, and more ample financial assistance for needy students, could materially reduce "student mortality" in all disciplines.

Scientific Determinism

From time to time the *Engineering Journal* is indebted to the Humanities Association of Canada for addresses or articles which have a particular interest for engineers. Once again the *Journal* is in that position and quotes herewith an editorial from the recent issue of the bulletin of the Association.

The editorial is in the nature of a review of the book "The Physical Basis of Personality" by Professor V. H. Mottram. Doubtless the best way to appraise it would be to read the book. Perhaps quotation of this reference to it will lead members of the Institute to follow that recommendation. Herewith is the editorial.

In the second edition of his book, "The Physical Basis of Personality," Professor V. H. Mottram enlarges and reinforces his earlier discussion of the arguments against scientific determinism. One of the arguments to which he alludes is that all kinds of human endeavour — artistic, scientific, philosophic and religious — have a common basis in "judgment": they are all subject to man-made rules, standards of value, degrees of accuracy, propriety, and so on. The important characteristic of this judgment is that it is *human*; and, since it is applied to science, art, philosophy and theology alike, it provides an effective contradiction to the determinist-materialist point of view.

But, asks Professor Mottram, is this argument sound? No doubt a kind of judgment lies at the roots of all forms of intellectual endeavour; but there is a manifest difference between art, philosophy and religion on the one hand and the sciences on the other. "In science the genius blazes the trail, but the humbler person can follow the trail. Moreover, the follower of the genius using the same or similar techniques *comes inevitably to the same conclusion*." In the end, all the scientists reach general agreement on principle and thus immutable laws are established. This ultimate unanimity would account for the almost universal trust that science enjoys and the intellectual stranglehold it exerts on the modern world.

There is, in contrast, no fundamental agreement in art, music, literature philosophy or religion. The intelligent amateur may consider Raphael to be the greatest painter, Tchaikovsky the master musician, Tennyson the supreme poet, Hegel the archangel of thought, and Newman the first of theologians; while his professional tutors may prefer Leonardo, Debussy, Wordsworth, Whitehead and Martin Luther, with no more convincing or "authoritative" apolog to support their views.

Unhampered by such disagre ments, the scientists (argues M tram) "seem to be getting som where, whereas the rest (the h manists and the artists) seem to getting nowhere. There is no co cinnity among their adepts."

This, in a rough nutshell, is t scientist's prejudice against us. is easy to dismiss, but difficult confute. Some of us — notably the fields of philosophy and lit ary criticism—have tried to soft it by introducing scientific meth into our studies. Others conte that the ways to truth are ma and varied: *saepe via obliq praestat quam tendere recta*. T swiftest, the most systematic, not necessarily the surest. By c ting the Gordian knot, Alexan may have won the empire of As but meanwhile, neglected, t flower of Greek culture wither away.

Distinguished Visitor from France

The Engineering Institute of Canada was honoured recently by a visit from Dr Paul Chambadal of the "Electricité de France". Some of the officers of the Institute had an opportunity to entertain him at dinner in the University Club on the evening of Monday, May 2.

Dr. Chambadal heads up a division of research with the Electricity Board of France, and is interested particularly in gas turbines. It is this interest that brings him to Canada and the United States.

The Institute was able to arrange for Dr Chambadal to spe a day with Professor Mordell McGill, looking into the wo being done by Professor Mord on solid fuels for gas turbines. Chambadal reported that he h found Professor Mordell's wo among the most interesting that had seen in any place in the wor

In view of the fact that the El tricité de France and Dr. Chamb dal are making some real progr in the field of gas turbines, it w suggested that he might return Canada within two or three yea time and present a paper on wh had been achieved in that count

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

Development of Power

As Ontario Hydro and the Power Authority of the State of New York enter their first full year of major construction on the vital St. Lawrence Power Project, the main activity in 1955 will centre on the powerhouse, Long Sault Dam, and Iroquois Dam, channel improvements, dyking, the new St. Lawrence Transformer Station, and the re-arrangement of certain power lines.

This year will see the powerhouse area pumped out and excavation for the international structure well advanced. This calls for the removal of some 3½ million cubic yards of earth and 320,000 cubic yards of rock. Hydro and its partner, the Power Authority of the State of New York, will share the work.

Activity will also move upstream, above the village of Iroquois, to the Galop Rapids area where work will commence on excavations for channel improvements. Other similar channel improvements, though on a smaller scale, will be undertaken at Sparrowhawk Point and in the vicinity of Point Three Points and Ogden Island.

A major portion of this year's work program on the power phase will revolve around the building of dykes on the Canadian shore. During the next three years, about three miles of dyking will be completed north and west of the Canadian section of the powerhouse. Its function will be to contain the headpond or water storage area created by the Long Sault Dam and powerhouse.

Although initial power is not scheduled for delivery until the fall of 1958, re-arrangement this year of certain transmission lines is necessary to tie-in with construction plans for both the power project and the Seaway. The power lines associated with Hydro's Niagara Mohawk power interchange and the Cedar Rapids circuit are to be dismantled, and replaced by lines to bypass Barnhardt Island. This job will be completed by July, 1955. The lines presently stretch from the United States mainland across Barnhardt Island to Hydro's Cornwall Transformer Station near the powerhouse site.

In May, construction will get under way on the St. Lawrence Transformer Station about 1½ miles north of the international powerhouse. The station will eventually contain switchyard facilities for the Canadian section of the development, and will be ready for operation in April, 1956. It will replace Hydro's Cornwall Transformer Station which must be dismantled owing to flooding in the area.

New York State Power Authority

On the American side of the river, the Morrison Knudsen-Walsh-Perini-Kiewit-Utah group, lowest bidders on the Long Sault Dam structure, were awarded the contract for this work on April 1st, at a price of $25,972,000. Merritt, Chapman and Scott-Savin Construction Co., received the award in April of the contract for the New York State Power Authority half of the international powerhouse substructure at $36,200,000, the lowest of 6 bids. Quantities in this structure 1,565 feet long and 160 feet in height, include 1,600,000 cubic yards of earth excavation and embankment, 890,000 cubic yards of concrete and 30,000 tons of steel. Completion is scheduled for September 1958. Several advertisements for proposals on the supply of electrical equipment and sluice gates will also be opened within the next few weeks.

Other phases of construction scheduled for 1955 by N.Y.S.P.A. include construction of the Iroquois Dam, and channel improvements, for both of which tenders will be opened May 27. Here, rock and earth excavation should be well under way before the end of the year, with the prospect of some concrete work being started.

Hydro Electric Power Commission of Ontario

Since the international sod-turning ceremonies last August, Ontario Hydro had awarded nine contracts totalling some $31,000,000 to the end of April, for construction work and the supply of material and equipment associated with the Canadian section of the development. Construction was completed on the first contract awarded in August 1954 for the erection of a project office building, two miles west of Cornwall. Work is proceeding on the field hospital and staff house.

In September 1954 the Commission awarded a contract to Mannix-Raymond Ltd. of Montreal for two cofferdams and the dewatering of the powerhouse site. The first structure, a 500-foot long rock-and-earth fill barrier spanning the channel between Barnhart and Sheek Islands above the powerhouse site, was completed last winter to the elevation required for winter operations. The second, a 4,500-foot cofferdam some 2¾ miles downstream and immediately below the powerhouse site, is now being built between Barnhart Island and the Canadian mainland.

In November, a contract was awarded for 1,193,000 barrels of cement to cover most of Hydro's powerhouse requirements. The supplying of one year's requirements of steel reinforcing bars for the Canadian half of the powerhouse was awarded in January. Hydro also let a contract in February for the production of crushed rock and manufactured sand concrete aggregates for this structure.

Two Canadian firms, Canadian General Electric Company Limited and Canadian Westinghouse Company Limited, were each awarded a contract in February, 1955, for the manufacture and installation of eight 60,000 kva. generators for the powerhouse. A contract was also awarded to English Electric Company of Canada Limited, for sixteen 75,000 horsepower turbines and governors. Deliveries commence in March, 1956. On April 5, tenders closed for 14.4-kilovolt

indoor station type cubicle switchgear, as well as for the supply of thirteen 86,000 kva. power transformers for the Canadian half of the powerhouse. Bids for the Ontario-Hydro half of the International Powerhouse structure were opened on May 10. Completion is called for as of September 1958. Award of this contract will be reported in the next issue of the *Journal*. Bids have been asked for the construction of a subgrade and structures on some 39¾ miles of C.N.R. mainline double track relocation between Cornwall and Cardinal, Ontario, to be completed before November 30, 1955. Tenders close on May 17. Bids will be opened May 24 for construction of the first section of the Cornwall dykes.

Development for Navigation

In addition to contracts for dredging 10 miles of channel in the Lachine Section and four contracts for dredging in Lakes St. Louis and St. Francis, reported in our May issue, Canada's Seaway Authority in April awarded the first contract for overland excavation through the Caughnawaga Indian Reserve on the South Shore, to Miron Frères at $1,153,000. This 4,200 ft. stretch involves 800,000 yards of earth and shale and a similar amount of limestone, as well as a cofferdam for the Lock below Lachine Rapids. Completion is scheduled for November 1956.

Another contract for 4,900 feet of dykes and channel in the Lachine Section opposite Montreal was advertised early in May. Bids closed on May 25. This stretch, adjoining the eastern end of the dredging contract awarded last fall, will connect up the Seaway channel with the upstream end of the Montreal Ship Channel.

On the American side of the International Section, Dutcher Construction Co. were awarded the contract for excavation of the Grasse River Lock at $2,200,000. Work has already started, as reported here last month. Tenders on another contract for the Massena Dykes along the 6 mile central stretch of the Long Sault Canal, involving some 12 million yards of excavation, were opened early in May, with joint venture Morrison Knudsen-Peter Kiewit the lowest of three bidders at $6,452,450.

Meantime, another major link in the navigation channel, namely, the Beauharnois Canal, is proceeding in the Soulanges Section on the Canadian side. On this huge dredging operation on the 15½ mile bypass of the rapids between Lake St. Francis and Lake St. Louis, commenced 25 years ago by Beauharnois Power Co., dredging is being continued by Hydro-Quebec as part of their giant Beauharnois Power development, ultimately to contain 2,200,000 installed horsepower.

Today this canal, on which 160 million yards of material has already been excavated, can at times carry the entire usable flow of the river to the 28 turbines now installed, rated at 1½ million horsepower. Completion of the canal will take another ten years, and involves removal of a further 60 million yards of clay, boulders and rock, together with the navigation lock at its lower end alongside the Beauharnois powerhouse, to make the canal an integral port of the Seaway navigation channel.

Here three big dredges with combined capacity of 17,000 horsepower, and costing $8 millions, are operating eight months of the year. Two are suction dredges owned by Hydro Québec. The third is a dipper dredge operated by Marine Industries Ltd., on a cost-plus contract. The entire operation employs 600 men in the operating season and half that number in winter.

World's Largest Dredge

The largest of these dredges is the "Hydro-Quebec", the world's most powerful cutter-head suction dredge. Commissioned in 1952, it has already worked one full season. Working in boulder-clay, it excavates between two and three million yards per eight month season and would handle twice that amount of boulderless marine clay.

The smaller 26 inch suction dredge, which has removed over 100 million cubic yards of stiff marine clay since 1930, averaging 5 million yards per season for 22 years or 50,000 yards per day over a 5½ day week, operates in front. Following behind it, the "Hydro Québec" works on the underlying boulder-clay, crushing boulders and pumping 15,000 cubic yards per day through its 36 inch discharge line at the rate of 50,000 gallons per minute with its 8,000-horsepower suction pump.

When the clay and boulder-clay are removed, if the canal bottom is not yet down to the full 27 foo depth, the 8 yard dipper dredg goes to work on the boulders an spots of ledge rock on the bottom This machine removes some 2,50 cubic yards daily or half a millio yards per season of rock and boul ders, dumping it into scows whic dispose the material on the dyke 3,400 feet apart on either side o the canal. It handles boulders u to a size of 38 inches weighin 1,500 lb., crushing them and pump ing them ashore.

By designing the canal at a ver flat slope, almost full use is mad of the entire 83 feet of head be tween the two lakes, while the flo in the canal is kept down belo a velocity of 2½ feet per second allowing the surface to freeze ove in winter, thus preventing the fo mation of frazil ice. Costs for re moval of material per cubic yar are 8 cents for marine clay, 8 cents for boulder clay, and $2.0 for rock and boulders crushed an pumped ashore by dipper dredg

Montreal Proposes Alternative for Highway Traffic

At a meeting in Ottawa on Apr 19 called by the Federal Minist of Transport, the Hon. Geor Marler, Seaway Authority officia heard proposals from the city Montreal dealing with the situatio created by construction of t canals along the south shore the river opposite the city.

Basically, the City suggest that material dredged from t channel should not be dumped deep water, but should be d posited on the north bank of t dyke to widen it, thus making roo thereon for an expressway alo the canal bank. Vehicular traf between the south shore and t Island of Montreal, said ci spokesmen, could be organiz without the need for the comp cated 'cloverleaf' proposed by Se way Authority engineers at t south end of Jacques Cart Bridge, or the complex double l span arrangement suggested f Victoria Bridge.

Traffic from Montreal, they su gested, could move off the Jacqu Cartier bridge at St. Helen's I land, thence by a shallow and r latively short tunnel under t Seaway channel to join the hig way system on the south sho At the Victoria bridge a causew could be built west of the brid from Nun's Island, passing unc

the Seaway channel by a similar tunnel.

The city has been informed, however, that due to the delay such changes would cause in the design of a new layout and structures, and due to the cost of such a scheme raising the total Seaway cost beyond the amount voted by parliament, present plans for additional traffic lanes on bridges, with lift spans over the Seaway channel, would not be changed.

Economic Aspects to Be Studied by McGill Group

Announcement was made early n May of an independent econmic study to be undertaken by he McGill University School of Economics, under the joint sponorship of the Committee for Ecomic Development and the Ford oundation Fund for Adult Educaion. Headed by Dr. J. T. Turner, f the School of Business, Univerity of Indiana, now director of the arketing program at McGill, asisted by Dr. D. E. Armstrong and Dr. Irving Becher and an advisory roup of some 20 prominent Canaian industrialists, it will be finnced through a grant-in-aid of 25,000.

The Federal Department of ransport undertook such a study few years ago, but the results ere never published. During the te "forties" much broader studies ere made for the U.S. Senate oreign Relations Committee by e U.S. Department of Commerce, anticipation of consideration of e Seaway Treaty by U.S. Senate d Congress. Since then, however, any economic changes, and a new rm of agreement between Can- a and the United States for carng out the project, have taken ace.

Initially, special emphasis will on the effects on the City of ontreal. Later the study will be dened to cover the entire project, shipping, international and interional trade via the Seaway and mpeting routes, expected changes the volume of trade and in the ative shares to be handled by Seaway, railways and highway nsport. An interim report is ualized in less than a year.

Following this, several years dy on other aspects is planned, h as the effect of the Seaway new industries and on the reation and expansion of existing s; population shifts; markets; income and employment patterns; income distribution by regions and factors for determining the relationship between on-site and offsite employment.

Royal Commission on Shipping

Numerous Briefs to the Royal Commission appointed to investigate Canada's coastal shipping trade have already been filed. The last date for their acceptance is June 30. About mid-July, public hearings will take place across Canada, probably in each provincial capital, plus certain ports such as Vancouver, Montreal and Saint John, as well as in Ottawa.

Submissions are already in from British shipping interests who oppose restrictions on U.K. shipping. British vessels now enjoy free entry to the 30 million ton St. Lawrence and Great Lakes trade. Canada's four maritime provinces are planning a united stand for protection of their interests, and will probably recommend a comprehensive study of the effect of the Seaway on the Maritime's economy.

Seaway Authority President Speaks at Quebec

Addressing the Canadian Manufacturers Association's annual dinner in Quebec City on April 22, the Hon. Lionel Chevrier stated that "The Seaway presents no danger to the prosperity of this city. It is not, however, an automatic switch to prosperity. The principal reason for making Quebec into a prosperous port is the assurance to shipping of a return freight load. Your port must become a profitable port-of-call for shipping companies. To assure this return freight load means re-orienting the industry of this city, deliberately establishing a plan of expansion in conjunction with the economic evolution of the country and the markets of the world."

Speaking of the advantages from the Seaway to the province of Quebec in general, Mr. Chevrier listed these under five headings. With its completion, at least 20 million tons of Ungava ore would be shipped annually, thus adding to the flow of primary products without interfering with the development of heavy industry in Canada.

Secondly, reduction in the cost of transportation, particularly in the case of timber, pulp and paper was an important element in the selling price and would benefit the province, he pointed out.

Thirdly, the construction period would provide work for several thousands of on-site workmen within the province, as well as many thousands more off-site in factories and foundries, mines and mills, workshops, offices, and in transportation.

Fourthly, the metallurgical industry would derive immense benefits, he predicted. Some day iron ore would be partly, if not totally processed within the province. Quebec's heavy industry had up to now been a processing industry. One must hope that financiers of vision may establish blast furnaces within the province.

Lastly, a notable benefit should be realized by the river ports of the St. Lawrence, said Mr. Chevrier. With Great Lakes freighters coming right down the river, more than one river port might see itself transformed into a trans-shipment port. Quebec must be ready to rebuild her industry in terms, necessarily of the 20th century, but yet more in terms of the 21st century. "This," he said, "is the prime requirement for very survival."

New National Highway Safety Body

The first National Highway Safety Conference, held at the Chateau Laurier, Ottawa, May 24, 25 and 26 was attended by 350 delegates from every province of Canada, with observers from United States, England and one from Spain. By resolution passed unanimously at the last plenary meeting of the Conference a permanent national organization was set up for the first time for the promotion of highway safety in all parts of Canada. The name of the organization is to be "Canadian Highway Safety Conference" or in French "Conférence Canadienne Sécurité Routière."

Quoting from the resolution "the object of the organization shall be to focus attention on the vital importance of highway safety; to promote the exchange of views as to ways to prevent accidents on the highways, roads and streets of the nation; to formulate recommendations for a program of action and to take steps to carry out that pro-

gram; to promote the co-operation of all agencies having to do with the construction or use of highways in the interest of highway safety; to secure and distribute information relating to the use of highways, accidents and losses on highways, and the means of preventing them; and generally to take any other steps to promote safety in the use of highways, roads and streets throughout Canada."

Headquarters are to be at Ottawa and the organization is to have several classes of members including: the organizations which sponsored the National Highway Safety Conference and other national, provincial and local organizations concerned with the use of highways and highway safety, and the various classes of users of highways and individuals interested in the subject of highway safety; and such others as may be considered desirable. The resolution also made provision for steps to be taken to incorporate the new organization.

Chairman at the meetings, who continues as head of the new organization during its formative period, was Hon. Brooke Claxton, vice-president of Metropolitan Insurance Company and former Minister of National Defence. The meetings were held under the distinguished patronage of the governor general and provincial lieutenant governors. The opening message from His Excellency the Governor General was read by Rt. Hon. Thibaudeau Rinfret, former chief justice of Canada.

Major groups with an interest in road safety were represented at the National Highway Safety Conference, such as federal, provincial and municipal governments, business, industry, finance, commercial and private road users, road builders, women's groups, youth groups and individuals. The program was so arranged that all representatives were enabled to take a personally active part in deliberations leading to the formation of the new body.

There were ten "delegate divisions" to which the delegates attached themselves according to their interests. These related to agriculture, business and industry, education, labour, organizations (motor, safety, fraternal, service, etc.), public information media, public officials, public transport, women's organizations, and youth groups. These ten divisions had their first meetings in separate locations immediately after the first plenary session. At these first meetings they allocated their members as representatives to one or other of five "functional committees" who then met to consider and draft reports on the principal subjects of road safety. These committees related to 1) Engineering, 2) Enforcement, 3) Education, 4) Motor Vehicle Administration, and 5) Public Action.

Drafts of these reports were then brought back to the delegate divisions for further study and as possible aids toward making out their own reports. Reports of both the functional committees and delegate divisions were finally submitted to the conference for purposes of record and future guidance. Along with a number of written submissions previously sent in to the conference by interested organizations, they should be of great assistance in formulating courses of action for the new body.

All reports were in general agreement upon the advisability of forming a permanent national highway safety organization. The reports, too, pointed out a woeful lack of uniformity between the different provinces in the matter of legislation, rules, regulations, and practices relating to highway traffic. Even in such simple matters as highway signals, signs and markings there was opportunity for greater uniformity.

Recommendations brought forward by the Engineering Committee which was under the chairmanship of Alan K. Hay, M.E.I.C., general manager Federal District Commission, are as follows:

1. A Canadian manual on Uniform Traffic Control Devices should be prepared as the best means of bringing about uniformity in roadway signs, markings and signals. This should include standards as to signs covering maintenance and construction operations.
2. It is recommended that warrants be prepared for the protection and elimination of grade crossings on a priority basis. The preparation of such warrants should be the joint effort of the Board of Transport Commissioners, the railway, street, and highway authorities.
3. Where vehicle volumes and roadway conditions require increased protection for the pedestrian, there should be provided additional facilities such as marked cross walks, side walks, loading islands, or in special cases, overpasses or underpasses. The protection of school crossings is especially in need of attention. Such pedestrian controls can be more effective if supported by uniform legislation.
4. There is a definite need for traffic engineers and traffic divisions in municipal and provincial departments concerned with street and highway problems. It is recommended that traffic departments be set up and that engineers be provided with training in traffic techniques. Courses for the training of traffic engineers should be established in Canadian universities.
5. It is recommended that greater emphasis be given to safety considerations in the design of vehicles and auxiliary equipment. Subordination of safety features for the sake of appearance and economy should not be condoned. Vehicle and auxiliary equipment should receive compulsory inspection at stated intervals.
6. Principal highways and streets should be modernized so that their geometric design will assist in providing safe traffic operating conditions for vehicles and pedestrians. Uniform Canadian standards covering design construction and maintenance should be developed for this purpose.
7. Uniform speed limits and speed zoning based on factual investigations and suited to local needs are recommended.
8. It is recommended that there be co-operation between the federal and provincial governments in the matter of highway planning. Planning surveys should be conducted to provide facts
9. Research into human and physical factors of traffic safety should be emphasized and expanded.
10. It is recommended that the planning and regulation of land use be correlated with the planning of streets and high-

ways so as to preserve adequate widths of right-of-way and also to regulate access to the highway or street from private property. It must be recognized that the regulation of access is important to safety. Public education and support of regulation is urgently required.

11. It is recommended that modern lighting be provided on urban streets and on the more hazardous sections of suburban and rural highways, especially where there is considerable pedestrian traffic. Lighting of street and place names is also important.

Apart from the business directly relating to the formation of a permanent organization there was an interesting program of addresses and other features. At the evening banquet the main speaker was Dr. G. F. Rowbotham, Durham University, Durham, England. Dr. Rowbotham, an outstanding neurological surgeon in the United Kingdom who spoke from his knowledge of and experience with head injuries as resulting from highway accidents, said "Of the people that die on the road, 70 per cent succumb as a result of injuries to their heads." Conditions in England, he said, are such that an Englishman in his active lifetime has a 1 in 200 chance of being killed on the roads, and some degree of injury is almost inevitable.

At the noon luncheon held on the first day Franklin M. Kreml, Director Transportation Centre, Northwestern University, Evanston, Ill., spoke on problems relating to the supervision of traffic and traffic law enforcement. Col. Kreml, a recognized international traffic authority and one-time member of Gen. Eisenhower's staff when the invasion of Europe was being planned, conducts a special training school for traffic engineers and police officers and works in cooperation with the National Safety Council and police officers of United States and other countries.

"The term 'accidents' is, strictly speaking, a misnomer," said Col. Kreml. "The events to which we apply this label are caused, a large percentage of them, by preventable factors. Among these are physical defects in the roadway and the vehicle. The most prominent and influential are 'defects in the driver' in knowledge, in ability and in attitude. These causes must be systematically and scientifically reduced if their symptoms, the 'accidents' are to be reduced. This is the job for government, broadly and effectively supported by organized civic leadership."

The responsibility of the individual in the matter of accidents was referred to time and again during the Conference both in the set addresses and the discussions. W. A. Wecker, O.B.E., president of General Motors of Canada Ltd., observed in an address at the opening plenary meeting that "it is a shocking commentary on our twentieth century morals when safety engineers say that lack of simple courtesy causes most highway accidents."

Hon. Gordon E. Taylor, president of Canadian Good Roads Association and Alberta Minister of Highways, also gave his listeners something to think about when he said that "close to fifty per cent of the persons killed in Canada was the result of the driver of the vehicle going beyond the stipulated speed limit."

An interesting demonstration of the effects of alcohol upon driving ability was furnished through the courtesy of Commissioner L. H. Nicholson, of the Royal Canadian Mounted Police. The delegates travelled on the second afternoon to the R.C.M.P. laboratory at Rockcliffe to witness driving tests by subjects who had been given commercial alcoholic beverages according to their own individual tolerances and their body weights in sufficient quantity to be almost but not quite at the drunken stage.

Plans for the tests were previously examined and passed upon by an advisory committee of scientific and medical personnel. They also included examinations for clinical symptoms of impairment in the legal sense, and psychophysical tests for impairment of visual and muscular ability. They are all part of a regular sequence of tests being undertaken with the idea of contributing something toward a clarification of the present problem of arriving at a satisfactory definition of the terms "impaired" and "intoxicated."

The Trans-Canada Pipe Line

An abstract of an address delivered to the Canadian Institute of Mining and Metallurgy, on April 20, 1955, by

A. P. Craig,

Vice-President, Trans-Canada Pipe Lines Limited.

The Trans-Canada pipe line qualifies as a pioneer on two counts; it is certainly pioneering a completely new industry in Canada, the long distance transmission of natural gas; and it has some of the problems that are expected and normal to any pioneering venture.

The physical characteristics of the project have been discussed so often that it is not necessary to quote statistics here on pipe sizes—miles, tons of steel, etc. Suffice it to say that this project, estimated to cost approximately $350 million will be the longest large-diameter gas pipe ever built.

A few basic "round" figures will paint a broad picture of this great national project.

First, it involves exploration for and development of the natural gas fields in Alberta and in other provinces, the cost of which will run into hundreds of millions of dollars. Then comes the gathering, stripping and cleaning of the gas before it can be delivered to the pipe line. This will cost close to $100 million. Next there is the project for transmission of the gas to Eastern markets, estimated to cost $350 million during the first three or four years. And, finally, there will be from $150 to $200 million spent by gas distributing utilities building systems to deliver the gas to homes and factories.

The project is feasible only if investors are willing to provide the necessary funds, and that depends on the signing of contracts for the purchase and sale of gas. This results in producers, distributors and Trans-Canada "horse-trading" to find that middle ground in price of gas that satisfies the financial requirements of both producer and distributor and also encourages continuing exploration and development and enables the sale of large volumes of gas. Coordinated timing of each element of this procedure is important so that the

enormous amounts of capital involved are put to productive use as quickly as possible.

The supply of Canadian natural gas to the Canadian and to certain United States markets is inevitable, because this energy source is as necessary to the development of higher Canadian standards of living and to the expansion of Canadian industry as is transportation and communication.

The use of natural gas as a fuel has grown much faster than has oil or coal during the last 15 to 20 years because:

It is more economical.

It is more dependable.

It is more controllable.

It is more economical because, in addition to being priced competitively, it requires no inventory of stored fuel; no capital invested in storage tanks, pumps or conveyors; and no labor cost in building and tending fires, removing ashes, or handling of fuel to furnace.

It is more dependable because an adequate supply is always available. Gas sold for firm delivery is ready for use 24 hours of every day. Coal and oil must be ordered. There is no trouble from stoppage in pipelines and burners; pipelines and equipment are less affected by weather, heat and cold, insuring continuity of service; fire hazard is less; and natural gas is non-poisonous.

It is more controllable because its heat content is uniform; it produces a more uniform temperature and furnace atmosphere; and automatic controls can be more easily applied.

There is one more important reason why the use of Canadian natural gas in Canadian and United States markets is inevitable. That is because proven United States reserves have decreased from a 30-year supply in 1949 to a 23-year supply in 1954, whereas Canadian proven reserves are growing fast and exploration has barely begun.

The importance of natural gas as a raw material for synthesis is contributing heavily to the fast growing petro-chemical industry.

Trans-Canada Pipe Lines tried hard to do a two-year job in less than one year. It came very close to accomplishing it, but didn't quite make the grade. Trans-Canada has actually been in business only since July 26 last. It was only nine months ago that the pipeline company received its permit from the Board of Transport Commissioners to build a natural gas line from Alberta across Saskatchewan, Manitoba and Ontario to Montreal.

A few weeks earlier, Alberta, through the Petroleum and Natural Gas Conservation Board, granted permission to Trans-Canada to export 4.35 trillion cubic feet of natural gas from the province over the next 25 years. This permission covered gas surplus to Canada's needs sufficient for long-term export to Minnesota.

Financing long-distance gas transmission lines makes two stringent demands, a fact not generally recognized. Enough gas must be sold in advance on a firm 20-year basis to pay the fixed charges on the line and to return a reasonable profit to investors, and enough gas must be contracted for in advance from producers at fixed prices to supply the sales contracts.

The line is going to cost close to $350 million and the fixed charges on this expenditure mean that most of the markets and supply sources would have to be under contract before it could be financed.

Both the Alberta and Ottawa permits required that the company show evidence of ability to finance by April 30 of this year. It was apparent, as this date drew close, that, while progress had been made, the deadline could not be met. Because everyone concerned was anxious that the project get started this year, an appeal was made to the federal government for interim aid in financing the project, but no generally acceptable form of aid could be negotiated to carry out original construction plans for this year.

To bring a project the size of Trans-Canada to its present stage is a costly procedure. $12 million has already been spent on market and engineering studies, on project design, on hearings before the Alberta Conservation Board and the Board of Transport Commissioners, on building organization and negotiating contracts for the purchase and sale of natural gas, and on the construction of the line which brings United States gas temporarily from the border to Toronto. During the past year, expenses have been running between $300,000 and $500,000 per month.

Any program requires a reasonable extension of Trans-Canada's permits, which expire on April 30. It is in the national interest to extend these permits, because Trans-Canada has already accomplished so much in nine months.

An experienced organization has been developed and offices established to handle the administration, engineering, construction and sales functions. A $350 million pipeline system has been designed, 2,250 miles of right-of-way have been surveyed; considerable property has been put under option, sources of pipe, compressors and other material and equipment costing over $100 million have been lined up. Supervision contracts with an outstanding pipeline construction organization have been entered into. Earlier market surveys have been brought up to date by Trans-Canada and new market surveys have been made by the several large distributors.

It is one thing to make a preliminary market survey and quite another to produce one on the basis of which a distributor and Trans-Canada Pipe Lines will sign a contract which *guarantees* the delivery and purchase of anywhere from $50 to $200 millions' worth of gas with a number of stringent conditions to be observed.

It is only in recent weeks that several of the large distributors have completed these surveys and been able to talk firm quantity and price figures. These up-to-date and carefully made surveys indicate a larger economic market than was shown in Trans-Canada's earlier surveys. Incidentally, these estimates are based on only 40 to 50 per cent as great a per capita consumption as is actually experienced in the United States.

Gas purchase and sales contracts have been negotiated with six of eight producers and five or six of the largest distributors to the point where Trans-Canada has firmly contracted for the purchase and resale of approximately one-third of the gas required to finance the whole project. Purchase and sale contracts for the remaining two-thirds of the gas have been under active and continuous negotiation for several months and announcements of further firm contracts are due before long.

A $51½ million pipeline has been built from Niagara to Toronto and leased to the Consumers' Gas Company to enable last winter's conversion of Toronto to natural gas and the build-up of this large and important market preparatory to the arrival of western gas.

The Consumers' Gas Company has demonstrated that the conversion of appliances from manufactured to natural gas can be done swiftly and safely with little inconvenience to the householder. The outstanding success of the Consumers' conversion program has eliminated the unfounded suspicion about the inconvenience of conversion. Relatively few complaints may have given a contrary impression.

The residential and commercial uses and advantages of natural gas are fairly well understood. In the first year or two of service residential and commercial markets will probably use about 30 to 35 billion feet of gas annually, or about one-third of the total gas that will be sold by Trans-Canada. By the fifth year this market could take 70 to 80 billion feet or more, nearly one half of the gas hauled by Trans-Canada and will produce two-thirds of the revenue.

Natural gas is a new fuel for most of Canada. In fact, the Province of Alberta and the southwestern part of Ontario are the only areas in this country that have had experience with it. In the United States, however, as far back as 1938 natural gas was supplying almost 12 per cent of the nation's energy requirements, while bituminous and anthracite coal together supplied 50 per cent. Petroleum accounted for 34 per cent, water power 4 per cent, and natural gas 2 per cent.

By 1952, the total energy requirements had risen by 80 per cent and the demands on all energy sources had increased considerably. Coal's share had dropped to 34 per cent; petroleum's had risen slightly to 39 per cent; and water power's was about stationary. Natural gas, however, had almost doubled its share to 23 per cent. Much of this increase is attributable to the industrial use of natural gas.

The spectacular natural gas discoveries in Alberta have coincided with a still-increasing demand on the part of expanding Canadian industry and increasing population for new energy supplies. A project to bring this need and the means of fulfilling it together on a national basis was not only necessary and desirable, it was inevitable.

It is Trans-Canada's role to provide a link between the gas producers in western Canada and the homes and industries along the 2,300-mile route of the pipeline between the Alberta-Saskatchewan border and Montreal. The 540 million cubic feet per day allowed by the present Alberta permit represents new energy equal to four St. Lawrence Seaway projects. The value of this project lies not only in the amount of new energy it brings to the Canadian economy, but also—and perhaps this is an even more important consideration—in the ability of the pipeline to bring a most efficient fuel to areas which have been unable, as yet, to realize their full economic potential because of problems of fuel supply.

The impact of a new fuel—a new source of energy—on an economy is great. This is especially true when the area concerned is rich in other natural resources and is occupied by a progressive-minded and highly-skilled population. Under these circumstances, a new and economic fuel can start a chain reaction of industrial development and improvement in living standards that will continue to expand as long as skill and imagination are applied to its use. When natural gas is this new fuel, the impact is even greater, for in addition to its characteristics cleanliness, safety, efficiency and economy, it is without doubt a most versatile fuel, in fact, one of the most versatile of all our natural resources.

The American Gas Association estimates that science has already developed more than 25,000 applications of natural gas in industry. In the United States three out of four new petrochemical plants announced last year were to use natural gas as a raw material.

Alberta is now feeling the economic impact of a petrochemical industry based, to a large extent, on natural gas. Canadian Industries have opened a $15 million polythene plant on the outskirts of Edmonton, using ethylene derived from the ethane in Alberta natural gas. Canadian Chemicals has also brought a plant into production near Edmonton. It uses natural gas, wood pulp and petroleum gases in the production of an extensive list of organic chemicals, as well as cellulose acetate and acetate fibre and yarns. Sherritt-Gordon Mines is also contributing to the diversification of the Alberta economy with a development to process ores from the company's property at Lynn Lake, Manitoba. Ammonia derived from natural gas is used as a leaching agent in a metallurgical process that yields nickel, copper sulphide, refined cobalt and ammonium sulphate fertilizer. There are also a number of large industrial projects in the planning stage, located from Winnipeg to Montreal, which prefer natural gas as a raw material and as a fuel. These projects are anxiously watching the progress of Trans-Canada.

The first year or two of Trans-Canada service may find the industrial market taking 60 to 70 billion cubic feet per year and by the fifth year this total could approach 100 billion cubic feet.

Thirty-five Years Ago

Comment on the *JOURNAL* of February 1920

Not long ago one of my neighbours was good enough to drive me from my home to the down-town section of Montreal, a distance of six or seven miles. He did all the talking, a steady stream of complaint because so much of his usual route was closed for street widening operations, part of the program to make it a little easier to get about the congested old city.

One may wonder what he would have said if all the suggestions made by James Ewing, M.E.I.C., in "Replanning Montreal and District" in the *Journal* for June, 1920, had been carried out. Without going into detail, Mr. Ewing proposed a good many pretty sweeping changes in Montreal's layout, though he had a low opinion of mere street widening: "(It) has . . . proven to be extravagant and prodigal and the results in no sense commensurate with the cost." In pleading for more open spaces, he said they would offer "a fine solution to the automobile parking problem (which) bids fair ultimately to become a vexation of the first magnitude." How true!

Mr. Ewing did not live to witness the establishment of the city's planning department, nor to see

the many changes which it is making in the city's appearance. If none are spectacular, at least they do add up to a considerable improvement in convenience and amenity.

G. B. Smith described the Central Ontario system of the Hydro-Electric Power Commission, covering the area from Whitby to Kingston and from Prince Edward County to Fenelon Falls and Tweed. It is not possible from Mr. Smith's paper to make even an approximate guess as to the power then being supplied through this system, but it seems to have been well in excess of 21,500 kva. and there were 370 miles of 44,000 v., 60 cycle transmission lines on wooden poles. The Queenston hydro-electric plant at Niagara was about ready to deliver power, some of which might reach this system, with a frequency change from 25 to 60 cycles. Perhaps some readers in the H.E.P.C. may be impelled to compare 1920 with 1955; the results would probably startle them.

J. M. Allison's "Cotton Rope for Power Transmission" would not appear in the *Journal* today for the simple reason that there is now probably nobody who could write a paper on this subject. Cotton rope had given a good account of itself; one rope 41 years old was still in use in 1920. That it was better than its competitors for power transmission was shown by the fact that makers of manila rope and wire rope used it in their own plants. Rope drives were far more common in England than in America, but the old Armstrong-Whitworth rolling mill at Longueuil, Que., had one, where twelve 1¾-in. ropes were used over sheaves 9 ft. and 6 ft. in diameter and only 15 ft. on centres. Some idea of the power which could be transmitted by cotton rope was given by Mr. Allison's table; it varied from 1 hp. for a ½-in. rope at 1,000 ft. per min., to 70 hp. for a 2-in rope at 6,000 ft. per min.

T. J. Lafrenière, M.E.I.C., chief sanitary engineer of the Superior Board of Health of Quebec, had something to say in this *Journal* about the workings of the Quebec Health Act. There were then 440 waterworks in the province, supplying about 1,400,000 people; 860,000 of them got filtered water, 170,000 got water which had been chlorinated and the rest—about 370,000—received their drink as nature provided it. Dr. Lafrenière is still on the job, but his title is now chief engineer of the Ministry of Health and his responsibilities have been many times increased.

The Status of Engineers

The editor of the *Journal* announced the committees for the annual meeting for 1921 in Toronto and the dates of the regional professional meetings at Niagara Falls and at Halifax in September and October, 1920. He noted that an amendment to the Ontario Highways Improvement Act now required that "every engineer . . . of a county . . . shall be a graduate in civil engineering of a university of recognized standing, or a member of the Engineering Institute. . . . " This was thought to be evidence that the status of engineers was improving. Another tribute was the preference expressed by the British Government for Canadian engineers for posts in Mesopotamia, " . . . placing . . . the . . . seal of merit on the Canadian engineer and singling him out as having no superior. . . ."

Engineering employment was noted as "fairly satisfactory", graduating students were "getting more responsible work . . . than a few years ago" . . .; some even "had the choice of several positions." A graduate of the last few years who was not offered such a choice would rightly think very little of himself.

Council met on April 27, 1920. A proposal to increase the maximum age of students to over 25 years and to reduce the minimum age of juniors below 35 years was referred to the Bylaws Committee and to the Board of Examiners and Education. Among the names of new members appeared that of W. P. Dobson, now research consultant to the H.E.P.C., and among the new associate members was R. L. Hearn, now chief engineer and general manager of the same organization. Francis Hankin became an associate.

Apropos of draftsmen, a correspondent said that those from the Old Country were driving Canadians out of the drawing office. Another correspondent wanted the *Journal* to start giving engineering advice and asked, among other things. "What are the physical properties of antimonial lead?" The editor answered these questions as best he might, but suggested that information of the kind this correspondent wanted could be found in many reference works, of which he gave a short list.

The employment bureau took a full page to set out its wares. It had some 20-odd positions open and there were four members looking for jobs. It also had a transit for sale.

The Branches

Legislation was still much to the fore. The Calgary Branch submitted a summary of the situation in Alberta, following the passage of the engineers' act there, and the Saint John Branch had a similar summary of the New Brunswick act. The latter also congratulated itself for getting into the newspapers to the tune of about 6 columns in a year. Some publicity hounds, the New Brunswickers of that day! On the other hand, the Saskatchewan Branch reported its activities in just two lines.

The Border Cities Branch and the Montreal Branch described the presentation of Gzowski Medals to George F. Porter, M.E.I.C., and to Phelps Johnson, M.E.I.C., and George H. Duggan, M.E.I.C., respectively, for their paper, "The Design, Manufacture and Construction of the Superstructure of the Quebec Bridge." The Toronto Branch presented a gold badge of honorary membership to Dr. W. H. Ellis, late dean of the Faculty of Applied Science and Engineering of the University of Toronto. Not to be outdone, the Montreal Branch presented similar badges to Lord Shaughnessy and to Sir John Kennedy. And the Ottawa Branch presented a gold badge to the Governor-General.

The personals tell us that E. A. Ryan, A.M.E.I.C., had opened a consulting office in Montreal, specializing in the mechanical and electrical equipment of buildings. He is still practising, but is the only one of those mentioned in these personals whose name is still on the Institute's rolls. *Sic transit gloria mundi!* A number of these personals are accompanied by portraits of their subjects, one at least 20 years old. Up to date personal photographs are not easy to come by; ask any engineering editor.

During these early years the *Journal's* advertising was remarkable for its uniformity. Its volume hardly changed from issue to issue and its makeup was not inspiring. There was, of course, no colour.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Dominion Council's Annual Meeting

The 18th annual meeting of the Dominion Council of Professional Engineers was held on May 18, 19 and 20 at the Newfoundland Hotel in St. John's. For the first time in history all of Canada's ten provinces were represented. The newest entry, the Association of Professional Engineers of Prince Edward Island, was represented by W. R. Brennan. Others attending the meeting were: Alberta, J. J. Hanna and R. M. Hardy; British Columbia, L. B. Stacey and J. A. Merchant; Manitoba, Professor J. Hoogstraten and G. W. Moule; New Brunswick, D. O. Turnbull; Newfoundland, C. A. Knight, M. A. Foley, A. Jack and E. Dickinson; Nova Scotia, John E. Clarke, Professor M. L. Baker, A. N. Murray, Dr. A. E. Cameron and A. E. Flynn; Ontario, J. R. Montague, L. M. Medland, Colonel W. L. Sagar and J. M. Muir; Prince Edward Island, W. R. Brennan; Quebec, Georges Demers, Leopold Nadeau and J. H. Legere; Saskatchewan, R. Bing-Wo.

G. Demers

It was also noted that the engineers in the Yukon Territories had recently organized a professional association but they were unable to send an observer to this meeting.

The business sessions were presided over by the president of Dominion Council, Colonel W. L. Sagar of Ontario. They extended through Wednesday, Thursday and Friday and were marked by an atmosphere of friendly co-operation. Many of the current problems of the engineering profession were discussed and several recommendations were made for consideration by the provincial organizations.

On Thursday afternoon a press release confirmed the election of Georges Demers (Quebec) as president for the year 1955-56. Other officers elected were: J. E. Clarke (Nova Scotia), vice-president, and L. B. Stacey (British Columbia), member of the executive. J. H. Legere (Quebec) was appointed secretary-treasurer for a two-year period.

Welcomed visitors to the meeting were Dr. D. M. Baird of the Canadian Institute of Mining and Metallurgy, J. W. Gore of the National Council of State Boards of Engineering Examiners, and G. A. Blackburn of the Civil Service Commission of Canada.

Throughout their stay in St. John's, visiting delegates and observers were treated to the famed Newfoundland hospitality. Following the formal welcome by civic officials, visitors were treated to a round of receptions and parties which culminated in a cocktail party and banquet at beautiful Bowring Park. The local branch of the Engineering Institute of Canada and the Newfoundland Association of Professional Engineers acted as joint hosts at this event. The climax of the gathering was the entertainment featuring folk songs and stories by Bob McLeod and various excellent films on the scenic beauty and attractions of "the Newfoundland sportsman's paradise". It was generally agreed that the Newfoundland engineers had done a superlative job as hosts on their first assignment.

Before closing the meeting the delegates accepted the kind invitation of Saskatchewan to hold the 1956 meeting in Saskatoon. The date of this meeting will be announced by the executive at a later date.

Quebec

Annual Meeting in Quebec City

The 1955 annual meeting of the Corporation of Professional Engineers of Quebec was held on Saturday, April 2, at the Chateau Frontenac Hotel in Quebec City.

As the by-laws of the Corporation had previously named Montreal as the place of the annual meeting, it was necessary to conduct a referendum of the membership, and to present an amended by-law to the governor-general of the province before the Quebec meeting could be legalized.

New Officers

The new slate of officers for 1956 was announced at the meeting. G. Lorne Wiggs succeeded Georges Demers as president; T. A. Monti succeeded Mr. Wiggs to the office of vice-president; and R. A. Phillips succeeded Dr. Monti to the office of honorary treasurer.

New councillors of the Corporation were introduced during the meeting. Outgoing members of Council were R. F. Shaw, D. C. McCallum and Daniel Wermelinger. Succeeding them were Guillaume Piette, Leo Roy and R. A. Emerson.

The guest of honour at the reception and annual banquet was F. X. Berlinguet of Trois Rivieres. Mr. Berlinguet boasts the distinction of being Quebec's oldest engineer, having celebrated his 100th birthday a few weeks prior to the annual meeting.

Dr. T. A. Monti

Art Exhibit

Considerable interest was shown in the Engineers' Art Exhibit which has become a feature of Quebec's Annual Professional Engineers' Meeting. Con-

sisting of paintings in oil and water colour by professional engineers who participate in artistic endeavours as a hobby. the display received favourable comment from the press, visiting guests, and fellow engineers.

The meeting was enthusiastically received by members residing in Quebec and the surrounding regions, and its success was a fitting tribute to the many persons in Quebec City who shared responsibility for its organization.

Ontario

News of the Members

O. L. L. Esperance continues as chief metallurgist with Renfrew Aircraft & Engineering Company Ltd., Renfrew, Ont.

This company succeeds Cockshutt Aircraft Ltd., which has recently been taken over by Aluminum Castings Ltd. of Glasgow, Scotland. The Renfrew Aircraft & Engineering Company will continue in production of aircraft components as in the past operating with the present plant and staff.

J. H. Irvine, of Ottawa, is the 1955 president of the City Engineers Association, with **V. R. Currie,** also of Ottawa, vice-president, and **E. E. W. Oke,** Waterloo, Ont., secretary. Trustees for the year are **G. H. Richards,** Brantford; **A. E. Chalmers,** Peterborough; and **F. M. Woods,** Guelph.

The retiring president is **Nicol MacNicol,** of Forest Hill Village, Toronto.

E. A. Washburn, of the Public Utilities Commission, Stratford, Ont., has been elected vice-president of the Association of Municipal Electrical Utilities for the coming year. District directors elected include **F. G. York,** Ottawa; **W. H. Powell,** Peterborough; **A. A. Kidd,** Cochrane; **J. A. Torrance,** Etobicoke; and **C. S. Phelps,** Sarnia, Ont.

At the concurrent meeting of the Ontario Municipal Electric Association, vice-presidents representing districts in Ontario included **C. J. Halliday,** Chesley; and **W. E. Wright,** Port Credit.

Lorne T. Raham, of Ford Motor of Canada Ltd., Windsor, has been transferred from time study and methods engineering to plant layout and material handling engineering.

D. H. Corker has joined the Toronto Hydro Electric System as an electrical engineer in the distribution planning and design department, Toronto. Before making this change, Mr. Corker was employed by Canada Wire & Cable Ltd.

Leonard A. Jenkins has left his former employment with Canadian Allis-Chalmers Ltd., in St. Thomas, Ont., and is with the De Havilland Aircraft of Canada Ltd., Toronto, in the capacity of an electrical engineer in the guided missile division.

H. E. Oliver has joined The Rohn & Haas Co. of Canada Ltd., West Hill, Ont., as a technical representative. Before making this change, he was employed by Canadian Wallpaper Manufacturers Ltd., Staunton Division, Leaside, Toronto, as a chemical engineer.

J. H. Robinson, who has been associated with Gypsum Lime and Alabastine, Canada Ltd., Toronto since 1922, and latterly as general manager, has been appointed a vice-president of the company. Before joining the organization he was employed in the gypsum industry in the United States.

In 1951, Mr. Robinson was appointed general works manager of the Gypsum Lime and Alabastine operations in Canada and in the following year was elected to the directorate. His appointment as general manager was made in 1953.

Stephen R. Knott, Toronto, has been named general manager of W. Fearnehough (Canada) Ltd., whose parent organization is located in Sheffield, England.

Mr. Knott, who graduated in engineering from the University of Toronto in 1940, has had a wide experience in sales and engineering in Canadian industry. During the war he was on active service for four years with the R.C.A.F.

R. M. Robinson, the general manager of the electronics division of the Canadian General Electric Co. Ltd., was the recipient, on behalf of the company's employees at the Royce Works, Toronto, of the R. B. Morley Award. This award, presented through the Industrial Accident Prevention Association, was in recognition of 2,152,896 accident-free work hours from April 22 to November 25 of last year at the Royce Works. This led records of over 1,000 plants reporting safety statistics to I.A.P.A.

Melvin M. Brown, of Canadian General Electric Co. Ltd., has been transferred as a sales engineer to Sarnia from the company's Castlefield Ave. office in Toronto.

Albert R. Brown is now engaged on Ampex instrumentation sales with Canadian General Electric Co. Ltd., 830 Lansdowne Ave., Toronto. His former position was that of television engineer with Canadian Radio Manufacturing Corp. Ltd., Leaside.

H. E. Ansley, of the engineering department of the Canadian Pacific Railway, has been transferred from Montreal to Vancouver, B.C. His address there is in care of the vice-president of the Pacific Region, C.P.R. Station, Vancouver, B.C.

J. F. Godsell, of Ottawa, who was formerly on the staff of the Civil Service Commission, is now with the harbours and rivers engineering branch of the Dominion Department of Public Works, Ottawa.

Eric E. Embacher has entered into private consulting practice at 6 Walker Ave., Toronto. A graduate of the Technical University of Vienna, Mr. Embacher was engaged in consulting work in Austria before coming to Canada.

H. N. Hill, of Peacock Bros. Ltd., has been made manager of the company's new branch office in Winnipeg, Man.

Before joining Peacock Bros., Mr. Hill, a Toronto graduate in engineering, was with the engineering staff of International Nickel Co. of Canada Ltd., and consultant with Cochrane-Dunlop Hardware.

A. S. Dennison is now residing in Toronto and is assistant plant manager at Delany & Pettit Ltd., 133 Jefferson Ave., Toronto. Prior to this change Mr. Dennison was located in Windsor with the Ford Motor Company.

A. M. McLeod, of R. H. Nichols Ltd., Toronto, has been appointed a vice-president of the company in which he has been a director for several years.

Mr. McLeod graduated in electrical engineering from the University of Alberta. During the war he served on the Inspection Board, U.K. and Canada; was inspecting officer Electrical Engineering Directorate, and Lieutenant (Electrical) Royal Canadian Navy.

D. W. Ambridge, C.B.E., of Toronto, has been elected to the board of directors of Canada Iron Foundries Ltd.

Mr. Ambridge, who is president and general manager of Abitibi Power & Paper Co. Ltd., is also president of Provincial Paper Ltd., chairman of the board of Alaska Pine & Cellulose Ltd. and a director of Montreal Trust Co. Canadair Ltd., Canada Steamship Lines Ltd., and the National Industrial Conference Board.

After twenty-five years with the Ontario Research Foundation, Toronto **Dr. Owen W. Ellis** retired as director of engineering and metallurgy on December 31 last. His retirement also marked almost to the day, the 50th anniversary of his entry into engineering as an apprentice in England, January 2, 1905.

Born in Swindon, England, Dr. Ellis obtained his B.Sc. in metallurgy at Birmingham University in 1914, and in 1916 obtained his master's degree and later his doctorate from the same university.

During the first World War he was at the Royal Ordnance Factories, Woolwich, England, latterly as chief metallurgist. In 1921 he came to Canada and until late in 1924 was assistant professor in the department of metallurgy at the University of Toronto.

During the period 1925-6 Dr. Ellis was associated with the Mellon Institute in Pittsburgh and from 1926 to 1929 a research engineer with Westinghouse also in Pittsburgh. In 1929 he joined the Ontario Research Foundation in Toronto.

Succeeding Dr. Ellis in the Ontario Research Foundation appointment is **P. E. Cavanagh,** who was Dr. Ellis' assistant prior to his retirement.

E. W. Vaughan has left the engineering staff of Canadian Brazilian Service Ltd., in Toronto, and has become associated with Parsons, Brinckerhoff, Hall and Macdonald, 51 Broadway, New York, N.Y.

Arthur A. Webster has moved from Ottawa, to Columbo, Ceylon. His address is c/o The High Commissioner for Canada, Box 1006, Colombo, Ceylon.

K. J. Hammond has recently joined the Kirkhof Electric Co., of Grand Rapids, Mich., as an electrical engineer

Manitoba

Group Insurance

The Council of the Association of rofessional Engineers of Manitoba at ıeir last meeting discussed the pos- bility of providing Group Insurance ɔr the membership at large. It was ıeir opinion that the scheme suggested y the insurance company was reason- ɔly good and that if the members were ıterested, the plan would be adopted. he insurance company was then asked ɔ make a survey of the members at ıeir own expense and if the survey ıowed enough were interested, they ould offer the plan, since a large par- cipation is required for efficient oper- ion of a group plan.

Accredited Engineering Schools

This Association has compiled a list accredited engineering schools, grad- ıtes of which are acceptable for mem- ɔrship, provided the necessary profes- onal experience is not lacking.

Golf Tournament

J. Sill, chairman of the Golf Com- ittee for many years, has announced ntative dates for the annual golf tour- ıments. They will be held at Elm- ırst June 21 and September 13. All embers are urged to attend.

Standing Committees

As a result of a previous questionnaire was found that many of the members e interested in serving on the follow- g standing committees: Advisory, embership, Board of Examiners, and ıblic Relations.

News of the Members

J. Sumner, chief engineer; **A. K. ıercy,** chief mechanical engineer; and **V. S. Buckler,** chief electrical engineer, all of the firm Green Blankstein Russell and Associates, architects and consulting engineers, of Winnipeg, attended the 69th Annual Meeting of the Engineering Institute of Canada in Toronto.

G. W. Moule, contract engineer of the City of Winnipeg Hydro Electric System, and a member of the Council of the Association, represented the Council together with **Professor J. Hoogstraten** at the 1955 Dominion Council meeting.

Gerald B. Williams, past president of the Council, and chief engineer of the Manitoba highways branch, has resigned effective June 1 to become chief engineer of the Federal government's "special projects" division of the Public Works Department. Mr. Williams will go to Ottawa and will be in charge of Trans-Canada highway construction and possibly construction of the Alaska highway.

New Members

The following were accepted for registration as members of the Association of Professional Engineers of Manitoba on April 21, 1955: **William Kesteven Roots, Morris Aaron Chocinov, Lorne Stewart Maclure, Keith Raymond Ebbern, Carl George Fritz, Thomas James Erskine, Melvin Russell Jones, Arthur Bruce Roberts, Berl Barney Marantz, Magnus Harper Bayne, Arthur John Watson.**

The following were transferred from other associations: **Moses Dimentberg, George Hershfield, Donald Wm. Gordon, Owen C. Kells,** (all of Ontario), **Ronald J. Kinsley, John McFetridge** (both of Alberta) and **James T. J. Raleigh** of Saskatchewan.

British Columbia

Engineers in the News

R. E. Potter has resigned his position a member of the Public Utilities ɔmmission and will establish a private m as consulting engineer. Mr. Potter is a member of the Commission since 51 and recently has been on extended ıve of absence.

N. L. Williams, of the B.C. Engi- ering Co., has recently left for Chalk iver where he will be on a design team r power reactors to develop electric ɔwer and will be working with **W. M. 'alker** who has been there for some nc. Both Mr. Walker and Mr. Wil- ıms have been sent to Chalk River r their firm, B.C. Electric.

E. S. Bengston, who used to be with e English Electric Co., has returned Vancouver and taken up employment th H. A. Simons Ltd.

W. J. Swanson, who has been with Crown Zellerbach Canada Ltd. at Ocean Falls, has gone to Eastern Canada where he has taken up a position with Foundation Co. of Canada in connection with the Defense Early Warning system in the Arctic.

E. A. Peura has accepted a position with the Vancouver Rolling Mills.

J. Dong recently started work for Swan, Wooster and Partners. He had previously been with Bohna, Miller and Co. Ltd.

J. D. Sandrin, formerly with H. A. Simons Ltd., has accepted a position with Rader Pneumatics & Engineering Co. Ltd.

B. R. MacFarlane has left B.C. Forest Products Ltd. to join MacMillan and Bloedel Ltd. at their Franklin River Camp B.

H. J. Wiese has accepted a position with Crippin Wright Engineering Ltd. He has been employed by the B.C. Engineering Co.

J. G. MacDermot, of St. Louis, has been appointed assistant general manager of Monsanto Chemical Company Overseas Division. Mr. MacDermot graduated as a chemical engineer from the University of British Columbia in 1939, and prior to 1950 had been manager of Monsanto's Vancouver operation.

C. W. Lowman has accepted the position of resident engineer for the Department of Public Works on the building of the B.C. Correctional Institution at Haney. He was previously engaged by the Interprovincial Pipe Line Co. in charge of construction of a large pumping station at Cromer, Manitoba.

S. A. F. Watts, who has been with the B.C. Forest Service and who recently returned from a six weeks' vacation in Mexico, has accepted a position with the Marwell Construction Co.

C. A. Boom, previously employed by **A. L. Swanson,** is now working for H. A Simons Ltd.

Leonard Esser has been appointed production manager of Westminster Iron Works Co. Ltd. Mr. Esser has been with the company for the past two years.

F. M. Cazalet has been elected chairman of the Vancouver Branch of the Engineering Institute of Canada. Other officers elected were: **C. P. Jones,** vice-chairman; **E. S. Hare,** treasurer; **W. G. Heslop, C. H. Maartman, J. T. Turner, R. F. P. Bowman, J. C. Oliver,** committee members.

W. E. Stone, who was with **F. W. Urry,** is now working for Western Reinforced Steel Service Ltd.

R. M. Bibbs recently was named executive assistant to the vice-president, **Tom Ingledow,** of the B.C. Electric. Mr. Bibbs has been with the company for ten years since his graduation in 1945 and has held assignments in general sales, accounting, industrial relations, transit and gas.

W. C. Mearns, who has been operation manager for the B.C. Electric in Victoria, has been appointed acting director of research and administration control. He will take up his new post at the beginning of July.

F. A. Forward, head of University of British Columbia department of mining and metallurgy, was one of the four Canadians honoured at the annual meeting of the Engineering Institute of Canada in Toronto May 11-13. The award is for outstanding engineering achievements. Recently honoured by International Nickel for outstanding metallurgical achievement, he will receive an honorary membership in the Institute.

B. A. Netupsky, of the B.C. Engineering Co., will be leaving the company shortly to go with Crippen Wright Engineering Ltd. as a design engineer.

A. S. Morton has accepted a position with H. A. Simons Ltd. He was previously engaged by the Sydney Roofing and Paper Co. at Victoria.

Institute Awards

Following the closing banquet of the sixty-ninth annual general and professional meeting of the Institute held in the Royal York Hotel, Toronto, the award of honorary memberships and of prizes and awards of the Institute was announced. Presentations were made to those honorary members and award winners who were present.

Honorary Members

The Institute has awarded honorary memberships this year to four distinguished engineers. They are, **John Edwin Armstrong,** C.E., formerly chief engineer, Canadian Pacific Railway Company, Montreal; **deGaspe Beaubien,** C.B.E., D.SC., B.SC., consulting engineer, Montreal; **Edward Phillips Fetherstonhaugh,** LL.D., D.SC., B.SC., formerly dean of engineering and architecture, University of Manitoba; and **Ira Percy Macnab,** LL.D., D.SC., B.SC., general manager, Public Service Commission of Halifax. The citations which accompany the awards are as follows:

John Edwin Armstrong, Hon.M.E.I.C.

John Edwin Armstrong is a former American who has taken an important part in the building of Canada.

He was born in Peoria, Ill., and graduated from Bradley Polytechnic Institute in 1905 and from Cornell University in 1908 with the degree of civil engineer.

When Mr. Armstrong retired in 1951 as chief engineer of the Canadian Pacific Railway Company he completed a long and noteworthy railroading career, having started at an early age in 1901 with the Toledo, Peoria and Western Railway and moving in 1908 to the Pennsylvania Lines West of Pittsburgh. It was in 1912 that he came to Canada and became associated with the Canadian Pacific Railway at Montreal as assistant engineer. Mr. Armstrong became a Canadian citizen in 1921. He was appointed assistant chief engineer in 1928 and in 1939 became chief engineer of the company.

John E. Armstrong, Hon. M.E.I.C.

In spite of the heavy duties of his professional position, Mr. Armstrong found time to participate in the activities of various societies. Three organizations to which he made special contributions are: the American Railway Engineering Association (A.R.E.A.), the Canadian Standards Association (C.S.A.) and the Engineering Institute of Canada. He has been a director, chairman of standing and special committees, a vice-president and president in 1934 of the A.R.E.A. He was made an honorary member of this Association in 1953. In the C.S.A. he was appointed to the main committee in1941 and to the executive committee in 1945. He has been a member of the Engineering Institute since 1917. He was on the finance committee from 1939 to 1947, became vice-president in 1945 and president in 1949. He has also been active in the Kiwanis Club of Montreal for many years.

Of outstanding importance to the Institute was Mr. Armstrong's chairmanship of the special committee on the Engineering Features of Civil Defence in 1942. Working closely with Professor Fred Webster, Great Britain's expert on the effects of bombing, his committee organized groups across Canada, and assembled a great volume of information. The proceedings were subsequently published and constituted Canada's text book on that subject. In 1953 Mr. Armstrong was awarded the Julian C. Smith Medal of the Institute for achievement in the development of Canada.

Dr. deGaspé Beaubien, Hon.M.E.I.C.

Dr. deGaspe Beaubien was born at Outremont, one of the constituent municipalities in the metropolitan district of Montreal. He was graduated in engineering at McGill University in 1906, and was on the staff there for a short time as a demonstrator.

In 1908 he set up business with some of his associates as a consulting engineer and has remained in that field ever since.

During World War II he was very active in the administrative work dealing with recruitment for the reserve army, rehabilitation, and post-war planning. He was joint chairman [illegible] the National War Savings Committ[illegible] and a member of the National W[illegible] Finance Committee. His work for h[illegible] country was fittingly recognized by t[illegible] award of a C.B.E.

Dr. Beaubien has found time to ta[illegible] part in the administration of sever[illegible] business enterprises in the Montr[illegible] area. He has been on the executi[illegible] committee of the Canadian Chamber [illegible] Commerce, and on the main committ[illegible] of the Engineering Standards Associ[illegible] tion.

Among other services rendered [illegible] public bodies he has been president [illegible] the Canadian Club of Montreal, t[illegible] Rotary Club of Montreal, the Cerc[illegible] Universitaire, and the Royal Automobi[illegible] Club of Canada. His interests in traf[illegible] matters and highway safety have alm[illegible] been a lifetime interest, through t[illegible] Quebec Safety League.

In 1945 he was given the honorary d[illegible]

Dr. deGaspé Beaubien, Hon. M.E.I.[illegible]

gree of Doctor of Science by the Ur[illegible] versity of Manitoba.

He joined the Institute as a Stud[illegible] in 1903, later he served the organizati[illegible] on many committees and in many offi[illegible] including treasurer and vice-preside[illegible] He was president of the Institute [illegible] 1944.

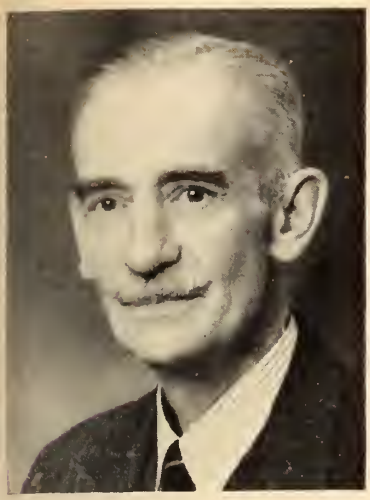
Dr. Edward Phillips Fetherstonhaug[illegible] Hon.M.E.I.C.

Edward Phillips Fetherstonhaugh, t[illegible] former dean of engineering of the U[illegible] versity of Manitoba, has been a leadi[illegible] figure in the development of engineeri[illegible] education in the West.

He was born in Montreal, and [illegible] ceived his early education at Montr[illegible] High School. He graduated with honou[illegible] in electrical engineering from McG[illegible] University in 1899.

For the next four years he was as[illegible] ciated with Fetherstonhaugh and Co[illegible] pany, patent solicitors, as manager [illegible] their Ottawa office. While in Ottawa [illegible] held a commission in the Ottawa Fi[illegible] Company of the Royal Canadian En[illegible] neers, thus commencing the milit[illegible] career in which he was later to d[illegible] tinguish himself.

Returning to McGill for two sessio[illegible] first as demonstrator and then as l[illegible] turer, he pursued further studies in 1[illegible] and 1906 and then received his ea[illegible] engineering experience in the Pittsbu[illegible] shops of the Westinghouse Electri[illegible]



Dr. E. P. Fetherstonhaugh, Hon.M.E.I.C.

nd Manufacturing Company, coming to heir Winnipeg office as electrical engineer in 1907.

It was in June 1909 that he began his long career as an educator by assuming the newly established chair of electrical engineering at the University of Manitoba. He was appointed dean of engineering in 1921 when separate faculties of the University were organized, and subsequently became dean of engineering and architecture. As teacher and administrator Dean Fetherstonhaugh won the esteem and confidence of the many students who received their professional schooling under his direction until his retirement in 1949.

His teaching and administrative work were interrupted during World War I for service overseas with the Canadian Engineers in France and Belgium, first as a lieutenant in the First Field Company and later as field engineer with the rank of major. His services in the field were recognized by the award of the Military Cross and by mention in dispatches.

In 1923 he took over the command of the University of Manitoba C.O.T.C. and was promoted to the rank of lieutenant-colonel. He relinquished the command in 1929.

As a consulting engineer, Dean Fetherstonhaugh contributed many reports, investigations and plans for the Dominion and provincial governments, as well as for municipalities and private concerns in western Canada. Among these activities may be mentioned his membership on a board of three engineers appointed in 1923 to report on the engineering and economic aspects of the Manitoba Power Commission's system, and his appointment in 1929 jointly by the City of Winnipeg and the Winnipeg Electric Company as chairman of a board studying the problem of electrolysis and soil corrosion of underground water pipes. In 1937 he became a member of the National Research Council of Canada, attending all its meetings and many meetings of its subcommittees.

He has also served on a number of government and public boards and directorates including the Advisory Board of the Royal Military College (1931 to 1935), and the Board of Trustees of the Winnipeg General Hospital (1923 to 1936).

The support of Dean Fetherstonhaugh has been felt in projects seeking to establish and maintain the status of the engineering profession in Canada. He has been active in the affairs of the Engineering Institute of Canada and the Association of Professional Engineers of Manitoba. He joined the Institute as a Student in 1899, becoming an Associate Member in 1908, and a Member in 1920. He was chairman of the Winnipeg Branch in 1921 and served on the Council from 1923 to 1925. In 1945 he was elected president.

Distinctions that have been awarded to Dean Fetherstonhaugh include the honorary degrees of D.Sc. from McGill University in 1945, and LL.D. from the University of Manitoba in 1947. He was also awarded the Julian C. Smith Medal of the Institute in 1945.

Dr. Ira P. Macnab, Hon.M.E.I.C.

Throughout its long life, the Institute has been fortunate in having in its membership, some, if not all of the really colourful members of the profession who have achieved great public distinction right across Canada. Conspicuous in such a group is Dr. Ira P. Macnab of Halifax.

The gentleman whom we honour now was born in Nova Scotia which you will acknowledge was a natural advantage to him. Before taking up his academic training he spent seven years as an apprentice and general machinist at Amherst, N.S.

He started his course in engineering at Mount Allison University and finished at Nova Scotia Technical College, receiving the degree of B.Sc. in mechanical engineering in 1913.

His professional career began with the Nova Scotia Light and Power Company but shortly thereafter he moved to Calgary to work with the Riverside Iron Works. Later he was engaged by the Royal Securities Corporation to inspect some recently acquired properties in South America. In 1925 he was made general manager of the Venezuela Power Company and then in 1931 was transferred to the Monterey Railway Light and Power Company. In 1931 he returned to Halifax to join the Nova Scotia Board of Commissioners of Public Utilities.

In 1947 Dr. Macnab was made general manager of the Halifax Public Service Commission, a position which he still occupies.

Dr. Macnab is another of those members of our profession who proves by his actions that the engineer's interests are universal and that he is a willing servant of the people. His interests include service on the local county municipal council, chairmanship of the Nova Scotia Disaster Relief Committee of the Red Cross, chairman of the Halifax City Planning Commission, chairman of the Halifax Welfare Federation, chairman of the Community Chest, and a member of the executive of the Halifax Civil Defence Committee. Just recently he was president of the Halifax Board of Trade. He is Nova Scotia director of the recently created Atlantic Province's Economic Council.

In engineering organizations he has been particularly active. He was one of those who had most to do with the

Dr. Ira P. Macnab, Hon.M.E.I.C.

establishment of the Halifax Branch of the Institute. He was chairman of the branch in 1938 and later councillor, then vice-president.

During these years he was also closely associated with the Association of Professional Engineers of Nova Scotia, being president in 1949, at which time he was also vice-president of the Institute.

Another interest is the American Water Works Association and its Canadian Section. His services to this organization were recognized by the award of the George Warren Fuller Memorial Medal.

He is a governor of Mount Allison University and vice-president of the Alumni. Also he is a governor of the Nova Scotia Technical College. He has been honoured by both institutions with a Doctor of Laws from Mount Allison and a Doctor of Engineering from Nova Scotia Technical College.

In other words he is quite a guy!

The Sir John Kennedy Medal

This award was established in 1927 to commemorate the great services rendered to the development of Canada, to engineering science and to the profession by the late Sir John Kennedy, past president of the Engineering Institute of Canada. It is awarded as a recognition of outstanding merit in the profession or of noteworthy contributions to the science of engineering or to the benefit of the Institute. The award this year was given to John Bertram Stirling, M.E.I.C., president of E. G. M. Cape & Company, Montreal. The citation which accompanied the award was as follows:

Dr. John B. Stirling, M.E.I.C.

Dr. Stirling was born at Dundas, Ont., and after receiving his early education there, proceeded to Queen's University from which he graduated in Arts in 1909, and in Engineering in 1911. Following graduation, he worked on construction projects in the Prairie Provinces as well as in Ontario until 1917. He then joined the Canadian Expeditionary Force and served overseas with the Royal Canadian Engineers until the end of the war.

In 1915 Dr. Stirling joined the staff of E. G. M. Cape and Company, engineers

Dr. J. B. Stirling, M.E.I.C.

Dr. Richard L. Hearn, M.E.I.C.

and contractors of Montreal. He returned to the company at the end of the war as supervising engineer on many construction projects throughout Canada. He became a partner in 1928, was made vice-president in 1940 and president in 1950, a position which he still occupies.

Dr. Stirling has been prominent in the affairs of the Canadian Construction Association for many years, and was president of that organization in 1942 and 1943. He served as president of the Corporation of Professional Engineers of Quebec in 1948 and was elected president of the Montreal Board of Trade in 1950. In addition to these many activities he is on the boards of two Montreal hospitals as well as being a trustee of Queen's University and a past-president of the Queen's Alumni Association. In 1951 his alma mater conferred on him the honorary degree of Doctor of Laws.

Dr. Stirling is honorary colonel of the 3rd Field Engineers Regiment of Montreal; he is a member of the executive of the Canadian Chamber of Commerce, and is president of the Better Business Bureau of Montreal.

Few engineers have had longer or closer contacts with the Engineering Institute. He joined the organization in 1913 as an Associate Member and since then has served in practically every office of the Montreal Branch, including chairman, councillor and vice-president. He was president of the Institute in 1952.

John Stirling is one of those engineers that a person likes to bring to the attention of students and young engineers as an example of the good life that may lie ahead for them, and of the good work which they may do for the benefit of their country and their associates. He never tires of doing good work, and the number of his activities never ceases to puzzle his friends and associates, all of whom marvel at his ability to carry on so actively all these extra-mural activities and yet do such a good job as president of his company.

The Institute can never repay, in fact can never express adequately its debt to Dr. Stirling but the award of the Sir John Kennedy Medal may indicate in a modest way something of the appreciation which the Council of the Institute has for him. This medal is awarded for "services rendered to the development of Canada, to engineering science, and to the profession." It is the senior award of the Institute.

I am sure, ladies and gentlemen, you will agree with the member of Council that John Bertram Stirling is worthy of this honour.

The Julian C. Smith Medals

This medal was founded in 1939 by a group of senior members to perpetuate the name of the late past-president of the Institute. It is awarded for achievement in the development of Canada.

This year the two award winners were **Richard Lankaster Hearn,** M.E.I.C., chairman, Hydro-Electric Power Commission of Ontario, Toronto, Ont., and **William George Swan,** M.E.I.C., consulting engineer, Vancouver, B.C. The citations accompanying the medals were as follows:

Dr. Richard Lankaster Hearn, M.E.I.C.

Dr. Hearn was born in Toronto and graduated from the University there in 1913 with the degree of B.A.Sc.

In his earlier years after graduation he worked for the city of Toronto in the roadways and the works department. Later he was with the Dominion Bridge Company and then transferred to the Hydro-Electric Power Commission of Ontario. Through a variety of experience and responsibility he rose to assistant engineer of construction in 1921.

The next year he became assistant engineer with the Washington Water Power Company at Spokane, Washington, but two years later he returned to Canada as chief engineer and secretary-treasurer of H. G. Acres and Company Limited at St. Catharines, Ontario. From 1930 to 1942 he was consulting engineer, then chief engineer with the Dominion Construction Company and H. F. McLean Limited.

In 1942 he returned to his first love, the Ontario Hydro as executive assistant to the chairman. Shortly thereafter he was loaned to the Polymer Company at Sarnia, Ontario, as chief engineer in charge of the supervision of construction.

In 1944 the Hydro loaned him to the Combined Production and Resources Board at Washington, D.C., where he was Canadian technical advisor to t public utilities division. In 1945 at t conclusion of the war he came back the Hydro as chief enginer of design a construction. In 1947 he was made g eral manager and chief engineer. In 1 he became Chairman of the Board.

In 1952 he was made a director the Atomic Energy of Canada Limit and that same year was awarded honorary degree of Doctor of Engine ing by the University of Toronto.

Dr. Hearn joined the Engineering I stitute in 1920 as an Associate Memb He belongs to many technical organiz tions in Canada, the United States a in the United Kingdom.

My source material tells me that I Hearn's personal interests and recre tions include books, photography, mus fishing, and golf. Just how any pers as busy as he has been all his l could find time for any one of these r creations is more than most of us c understand. I am sure, however, we share with him in his ambition to enj such pastimes.

Of such a man as this, it can truly said, he has achieved much in t development of Canada. Therefore, it most appropriate, Mr. President, th the Engineering Institute of Canad should award to Richard Lankast Hearn its Julian C. Smith Medal.

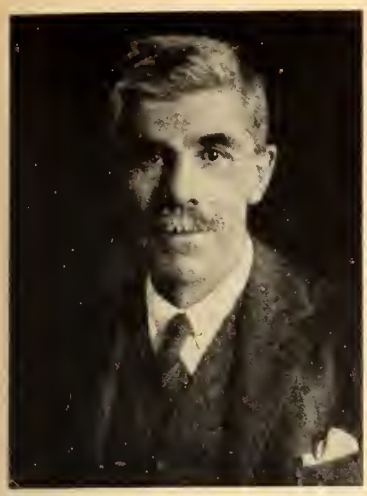
William George Swan, M.E.I.C.

Col. Swan was born at Kincardin Ont. He received his B.A.Sc. fro the University of Toronto in 1906 a the C.E. in 1911.

He served from 1906 until 1920 wi the Canadian Northern Railway, a the Canadian National Railway bridge engineer, resident engineer a division engineer in eastern Canada a in British Columbia.

During World War I he served France and he was awarded the D.S.C the Croix de Guerre and was twice me tioned in despatches. Starting as lieutenant in the 104th Battalion moved to captain and adjutant. Lat he became captain with the 131st Batt lion. In 1916 he transferred to the 2 Battalion of Canadian Railway Troop and became its chief engineer in char of maintenance of light railways wit

W. G. Swan, M.E.I.C.



F. P. Shearwood, Hon.M.E.I.C.

the 2nd British Army in France. At the close of the war he retired with the rank of colonel.

He returned to the Canadian National Railways as district engineer in British Columbia. In 1920 he became chief engineer of the Vancouver Harbour Commission. He continued this association until 1925 when he set up his own consulting engineering office.

In World War II he was appointed director of construction of the War Supply Board. Later he served as chief engineer, Pacific Command, R.C.E.; he was awarded the O.B.E. in the King's Honour List of 1945.

In 1947 he received the Alumni Medal of the University of Toronto.

He is a past-president of the Vancouver Board of Trade, and a past-chairman of the Blood Transfusion Service.

He joined the Engineering Institute in 1906 as a Student and in 1947 obtained Life Membership therein.

From this brief report it will be evident to everyone that Colonel Swan has well earned the Julian C. Smith Medal which is awarded for "achievement in the development of Canada".

Gzowski Medal

Presented each year for the best paper of the medal year on a civil engineering subject, "civil" being used in the limited sense to indicate structural, surveying and construction work generally.

Frederick Perry Shearwood, Hon.M.E.I.C.

Frederick Perry Shearwood of Montreal was awarded the Gzowski Medal for his paper, "The Stabilization of Suspension Bridges," which was published in the January 1954 issue of the *Journal*.

Mr. Shearwood is retired chief engineer of Dominion Bridge Company Limited.

He was born in London, England, in 1866 and received his education by private tuition. Mr. Shearwood went to Brazil in 1884 where he was engaged on railway work for three years. He came to Canada and joined the engineering department of Dominion Bridge Company Ltd. in Lachine, Que., where he rose rapidly to the position of assistant engineer. He was appointed chief engineer in 1921 and consulting engineer in 1937.

Mr. Shearwood is widely known in engineering circles for his association with the design and erection of many of the important bridges and other structures in Canada.

An enthusiastic yachtsman and yacht designer, Mr. Shearwood was for ten years associated with G. H. Duggan in building and racing the boats which brought the Seawanhaka Cup to Canada, and for a long period in the nineties successfully defended that trophy. Many other designs of successful yachts came off the boards of Mr. Shearwood, adding to his skill in this field as in the field of structural design and erection.

Throughout his career he has been an active member of the Institute, joining the Canadian Society of Civil Engineers as an Associate Member in 1892, transferring to Member in 1904. He was elected to Council in 1909 and again in 1921-23, and was a vice-president from 1923 to 1925 and chairman of the Finance Committee at the same time. In 1926 he became treasurer of the Institute and retired from that office in 1930. Mr. Shearwood was elected president of the Institute in 1934. Honorary Membership was conferred on him in 1953.

He was also interested in other engineering organizations, being a member of the American Society of Civil Engineers; and member of the Corporation of Professional Engineers of Quebec. He has served on various committees of the Canadian Engineering Standards Association.

Duggan Medal and Prize

Awarded for papers dealing with the use of metals for structural or mechanical purposes.

Joseph Louis deStein, M.E.I.C.

Joseph Louis deStein, associate professor in civil engineering at McGill University, Montreal, was awarded the Duggan Medal and Prize for his paper, "Rational Design for Building Frames with Semi-Rigid Connections," which appeared in the October, 1954, issue of the *Journal*.

Mr. deStein was born in Regina, Sask. He received his B.Eng. degree from the University of Saskatchewan in 1939 and his M.Eng. degree from McGill University in 1946.

Upon graduation from the University of Saskatchewan Mr. deStein joined the Department of Agriculture, Ottawa, as a field draughtsman for the Prairie Farm Rehabilitation Act. The following year he became associated with the Aluminum Company of Canada as a structural draughtsman in Montreal. He remained with the company until 1945, working as a squad leader and structural designer in Montreal. He was then transferred to Shawinigan Falls, Que., as a resident engineer, but returned to Montreal in 1944 as structural designer on steel, concrete and aluminum.

At this time he completed his studies for his master's degree and joined the McGill staff as a lecturer in the department of civil engineering, was named assistant professor in 1946 and associate professor in 1950.

Mr. deStein joined the Engineering Institute as a Junior in 1940, transferring to Member in 1948. He has been helpful in the work of the Institute and has been the chairman of the Board of Examiners since 1953.

Leonard Medal

Awarded for papers on mining subjects.

Frank A. Forward

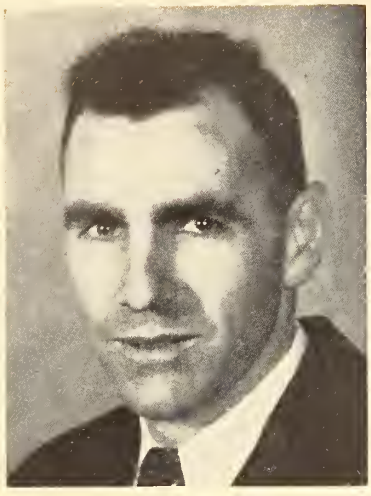
Frank A. Forward, head of the department of mining and metallurgy of the University of British Columbia, was awarded the Leonard Medal for his paper, "Ammonia Pressure Leach Process for Recovering Nickel, Copper and Cobalt from Sherritt Gordon Nickel Sulphite Concentrate," which appeared in the November, 1953 issue of the Canadian Mining and Metallurgical Bulletin.

Mr. Forward was born in Ottawa, Ont., and received his secondary education at Ottawa Model School and Ottawa Collegiate Institute. He graduated from the University of Toronto in 1924 with a B.A.Sc. (honours) degree in chemical engineering, and that year started with the Consolidated Mining and Smelting Company at Trail, B.C.

He remained with the company until

J. L. deStein, M.E.I.C.

F. A. Forward



T. E. Wright

1929 working as an assayer, as assistant metallurgist in the lead and copper smelters, and finally as a research assistant. Mr. Forward was in Australia from 1929 to 1934, associated with Mount Isa Mines Limited, in Mount Isa, Queensland, as assistant lead smelter superintendent. He returned to British Columbia and after a year with B.C. Nickel Mines Limited at Choate joined the department of mining and metallurgy of the University of British Columbia as assistant professor. His appointment as professor and head of the department was received in 1945.

While on the staff of the university Mr. Forward has also accepted consulting assignments for the B.C. Nickel Mines Ltd., Kelowna Exploration Company, Algoma Ore Properties, and the Sumitomo Company of Japan and more recently, the Sherritt Gordon Mines Ltd. During the war he served as technical director for the British Columbia War Metals Research Board, and in 1946 he was engaged by the Chinese Natural Resources Commission to inspect operations in Formosa and China. He is at present continuing in a consultant capacity for various companies on the development of pressure leaching and precipitation processes for uranium ores.

Active in the affairs of the profession, Mr. Forward holds membership in the mining and metallurgical societies of Canada, Britain, the United States, and Australia, and in the Chemical Institute of Canada. He is a registered professional engineer in British Columbia.

Plummer Medal

Awarded for the best paper on a chemical and metallurgical subject.

Plummer Medals have been awarded to **T. E. Wright, Hugh P. Godard,** and **I. H. Jenks** for their joint paper, "The Resistance of Aluminum to some Alkaline Building Materials," which appeared in the October, 1954 issue of the *Journal.*

T. E. Wright

T. E. Wright is with the chemical division of Aluminium Laboratories, Ltd., Kingston, Ont. Since 1947 he has been engaged in corrosion work on aluminum alloys.

He graduated from McMaster University with a B.A. degree in chemistry in 1942. Before joining Aluminium Laboratories he worked successively in a munitions plant laboratory for the Inspection Board of the United Kingdom and Canada and the Polymer Corporation, Sarnia, Ont., in the synthetic rubber industry.

Hugh P. Godard

Hugh P. Godard holds a Ph.D. degree in industrial and cellulose chemistry from McGill University and a master's degree in chemical engineering from the University of British Columbia. An industrial chemist, he worked with wood pulp, copper and gold mining and explosives before joining Aluminium Laboratories, Ltd. in 1945. Since then he has been mainly occupied with the corrosion behaviour of aluminum, on which he has published several papers.

He is active on technical committees in Canada and the United States in organizations interested in corrosion. He has been a member of the board of directors of the National Association of Corrosion Engineers and is a past chairman of their Inter Society Corrosion Committee.

H. P. Godard

I. H. Jenks

I. H. Jenks holds degrees in arts and in science from Mount Allison University, Sackville, N.B. He has worked at Arvida, Que., for the Aluminum Company of Canada, Limited as a chemist and as a chemical supervisor. In 1945 he transferred to Aluminium Laboratories Limited in Kingston where he is head of the publications division and where he is concerned with the writing and editing of internal and external technical literature. He is the author of numerous papers and reports and several handbooks on subjects connected with the technology of aluminum.

He is a past chairman of the Kingston Section of the Chemical Institute

I. H. Jenks

of Canada and is active on committees in Canada and the United States in organizations interested in technical writing.

Ross Medal

Awarded for papers on electrical engineering subjects.

Alexander George Lester, M.E.I.C.

Alexander George Lester, general manager of the special contract department of the Bell Telephone Company of Canada, received the Ross Medal for his paper, "Telecommunications in Canada," which appeared in the October 1954 issue of the *Journal.*

Born in Montreal, he began his long association with the Bell Telephone Company upon his graduation from high school. He spent the years between 1922 and 1929 on engineering studies in connection with the conversion to automatic operation of local telephone service including outside plant, central office equipment and cost comparisons. From 1930 to 1939 he was engaged on engineering studies of long distance plants, and special studies of traffic routing, motor vehicle costs and service cost analyses. For the next two years he worked on co-ordination of the company's program of exchange plant additions, taking a leave of absence in 1942 to serve with the Royal Canadian Signals on the east coast and in Ottawa. He retired at the end of the war with the rank of major.

Mr. Lester returned to the Bell Telephone Company in 1945 as exchange plans engineer and in 1948 was supervisor of plant extension. In 1952 he was named general operations supervisor at company headquarters and later the same year was loaned to the Department of Defence Production of the Federal Government as associate director of the electronics division.

In 1953 he was appointed area plant manager for the toll area, in charge of plant operations in the long distance field, and was promoted later the same year to assistant general manager of

A. G. Lester, M.E.I.C.

he special contract department. In anuary, 1955 he assumed his present osition of general manager of the spe- ial contracts division, having respon- ibility for handling major defence pro- ects in the communications field.

Mr. Lester joined the Engineering nstitute in 1954 as a Member.

John Galbraith Prize

Awarded for the best paper by a unior in the Province of Ontario.

Albert Murray Lount, M.E.I.C.

Albert Murray Lount, M.E.I.C., a part- er of the firm T. O. Lazarides, Lount nd Partners, structural engineers of oronto, Ontario, was awarded the John albraith Prize for his paper, "Pre- tressed Concrete Applied to Roof oists," which appeared in the October, 953 *Journal*. Mr. Lount was a Junior lember of the Institute when the aper was presented to the Institute's nnual meeting in May, 1953.

He was born in Toronto, Ont., and eceived his early schooling in France nd England. He received his degree civil engineering from the Univer- ty of Toronto in 1946.

Upon graduation he joined the On- rio Hydro Commission, and was in harge of the structural department of he consulting engineering division. This epartment designed many structures uring the Hydro's expansion program. lso during this period the department as engaged in development work in estressed concrete. Mr. Lount remain- d with the company until 1953 when e became a partner of T. O. Lazarides, ount and Partners, specializing in the sign of bridges and other structures volving modern methods of structural sign, including grid analysis and pre- ressed concrete.

Mr. Lount joined the Engineering stitute in 1945 as a Student, trans- rring to Junior in 1948 and to Mem- r in December, 1953.

Phelps Johnson Prize

Awarded for the best paper by an English Junior in the Province of Quebec.

Lawrence Abram Carey, Jr.E.I.C.

Lawrence Abram Carey, Jr.E.I.C., of the Montreal Engineering Company, was awarded the Phelps Johnson Prize for his paper, "Labrador Menihek Power Development", which appeared in the May, 1954 issue of the *Journal*.

He was born in Black Cape, Que., and received his secondary education at Moncton High School. He attended the Saint John Vocational School and graduated in 1939 from the electricity section of the school. Mr. Carey received his B.Sc. degree in civil engineering from the University of New Brunswick in 1949.

He joined the Canadian Army Active Forces in 1941 and served overseas in the United Kingdom, Italy and Northwest Europe. He was demobilized in December, 1945 with the rank of lieutenant.

A. M. Lount, M.E.I.C.

Upon graduation from University in 1949 he joined the staff of Montreal Engineering Company Ltd. and was engaged on preliminary investigations of the Mayo Hydro Development in the Yukon, and was connected with the actual construction as assistant engineer in 1951. From 1952 to 1954 he was resident engineer for the company on the Menihek Hydro Development in Labrador. Mr. Carey left for India in September, 1954 to serve as Canadian liaison engineer on the Umtru Hydel Development which is a Colombo Plan aided project being constructed by the Assam Government at Burnihat.

Mr. Carey became a Student Member of the Engineering Institute in 1947, transferring to Junior in 1951. He is also a member of the Corporation of Professional Engineers of Quebec.

L. A. Carey, Jr.E.I.C.

Ernest Marceau Prize

Awarded for the best paper by a French Junior in the Province of Quebec.

Gaston Galibois, Jr.E.I.C.

Gaston Galibois, Jr.E.I.C., of Quebec, was awarded the Ernest Marceau Prize for his paper "Reactive Power Flow on the 66 kv. System of the Quebec Power Company".

Mr. Galibois was born in Quebec City. He studied engineering at Laval University, graduating with the degree of B.A.Sc. in electrical engineering in 1950.

After spending a year on a training course with the Shawinigan Water and Power Company, he was transferred to the engineering department of the Quebec Power Company. He has since been appointed relay and protection engineer.

While at Laval Mr. Galibois became a Student member of the Institute, transferring to Junior in 1952.

Gaston Galibois, Jr.E.I.C.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Dr. Robert William Boyle, M.E.I.C., who retired in 1949 from the position of director of the division of physics, National Research Council of Canada, died in London, England, on April 18, 1955.

Dr. Boyle was born in Carbonear, Newfoundland, in 1883. He was a graduate in electrical engineering of McGill University, obtaining the degrees of B.Sc. in 1905, M.Sc. in 1906, M.A. and Ph.D. in 1909.

He won the Newfoundland Government Diamond Jubilee Scholarship in 1900 and at McGill won the Scott Prize, the General Electric Scholarship, the British Association Prize, the British Association Medal, and an 1851 Exhibition Science Research Scholarship, which he held at the University of Manchester, England.

He returned to McGill to take a position on the physics staff where he remained until 1912 when he was appointed professor of physics at the University of Alberta. During the First World War, Dr. Boyle was on the staff of the British Admiralty in their anti-submarine division, as one of the small group of distinguished scientists who laid the foundations of research activities in the Royal Navy. He resumed his professorship at the University of Alberta in 1919 where he became dean of the Faculty of Applied Science in 1921.

In 1924 Dr. Boyle served as president of Section III of the Royal Society of Canada and in 1925 as president of the Association of Professional Engineers of Alberta. He joined the staff of the National Research Council in 1929 as director of the division of physics and electrical engineering, a post which he held until his retirement in 1949.

In describing the advance of physics in Canada (H. M. Tory, A History of Science in Canada, Ryerson Press, Toronto, 1939), Dean A. Norman Shaw pays this tribute to Dr. R. W. Boyle: "From the first the accepted policy of the University of Alberta was to cultivate the research spirit by actually doing research both theoretical and applied. The practice of this enlightened policy was in large measure due to the vision and action of two physicists, H. M. Tory, the president, and R. W. Boyle, professor of physics and dean of applied science, who each continued their leadership later in the development of the National Research Laboratories at Ottawa. Both Tory and Boyle had come under the influence of Rutherford at McGill in earlier years. Lord Rutherford held that the most gifted teacher was soon seriously limited if he neglected investigation.

"Boyle's ultra-sonics laboratories (in Alberta and NRC) produced a wealth of data on problems of ultra-sonic propagation, energy distribution in beams, reflection, transmission, interference, detection and so on.

"The leading work of Boyle on ultra-sonics is one of the subjects high on the list of distinct advances by Canadians.

Dr. R. W. Boyle, M.E.I.C.

"Under the competent direction of R. W. Boyle, the division of physics and electrical engineering has in a few years, rendered notable services in spite of serious financial limitations arising from the world depression. In addition to meeting the increasing demand for standardization tests, providing advice and grants for researches, and awarding scholarships . . . the physics division has a long list of successful and promising investigations."

In 1941, Dr. C. J. Mackenzie, then president of the National Research Council, said: "Dr. Boyle, as head of the division of physics and electrical engineering, has played a most important part in the contributions which Canada has made to the war, and I am sure that the people of Newfoundland have every right to feel proud of him as one of their most illustrious sons."

Dr. Boyle was a Member of the Association of Professional Engineers of Ontario. He was a Fellow of the American Physical Society, the Acoustical Society of America, and the Royal Society of Canada.

Dr. Boyle joined the Engineering Institute in 1924 as a Member.

Walter Maxwell Fife, M.E.I.C., associ professor of structural engineering at t Massachusetts Institute of Technolo died on April 22, 1955. He had serv on the Faculty of the Department Civil and Sanitary Engineering thirty-three years.

Professor Fife was born in Pet borough, Ont., on June 9, 1890, a attended the Peterborough Collegi Institute. He graduated from the U versity of Alberta in 1913 with a B. degree and received his M.Sc. deg from the Massachusetts Institute Technology in 1922.

During the summers of his universi course, he was employed as a rodm by the City of Edmonton, instrume man for the Dominion Land Surve and as detailer for the Dominion Brid Company in Winnipeg, Man.

From 1913 to 1922, apart from th years' service as a lieutenant in t Canadian Expeditionary Force, he w an instructor and then assistant pr fessor at the University of Alber After completing his graduate studies M.I.T., Professor Fife joined t Faculty as assistant professor of ci engineering. He was promoted to as ciate professor in 1928 and in 1941 w named associate professor of structu engineering. During World War II Pr fessor Fife worked half time on spec war research.

Professor Fife was a Member of t American Society of Civil Engineers, Member of the Boston Society of Ci Engineers and of the American Co crete Institute. He joined the Engine ing Institute as a Junior in 1914, tra ferring to Associate Member in 19 and to Member in 1940.

James Randolph Bissett, M.E.I.C., w had retired in 1953 as district engin with the Department of Northern Affa and National Resources, died in K cardine, Ont., on October 9, 1954, f lowing a lengthy illness.

Mr. Bissett was born in Kincardi on January 8, 1888. He graduated fr the University of Toronto in 1912 w a B.A.Sc. degree.

During the summer months of course Mr. Bissett was engaged in m ing operations in Gouganda, Ont., a in milling and refining silver ores Cobalt, Ont. For a year after his gradu tion he was in charge of the constr tion of a transmission line from Lo Lake to Wahnopitae Power Plant Ontario.

In May 1913 Mr. Bissett began long service with the government wh he was appointed assistant engineer the Department of the Interior, wa

power branch, in Ottawa, Ont. In 1928 he was named senior assistant engineer for the Dominion Water, Power and Reclamation Service Branch. In 1938 he was senior assistant engineer with the Dominion Water & Power bureau, Department of Mines and Resources. Upon his retirement in 1953 Mr. Bissett was district engineer of the Ontario district, Water resources division of the Department of Northern Affairs and National Resources.

Mr. Bissett joined the Engineering Institute in 1916 as an Associate Member, transferring to Member in 1940.

William Jessiman Fletcher, M.E.I.C., consulting engineer and land surveyor of Windsor, Ont., died at his home in Windsor on April 15, 1955.

Mr. Fletcher, who was born in Fletcher, Ont., on October 3, 1885, received his B.Sc. degree from Queen's University in 1910. He taught for a time in public schools in Ontario and spent some months prospecting in the Gouganda district of Ontario for silver. Upon graduation from Queen's Mr. Fletcher was in charge of a topography plane table party for the Canadian Pacific Railway's irrigation department. He was associated with J. J. Newman, Ontario Land Surveyor in Windsor, Ont. and with the Dominion Bridge Company in Walkerville, Ont., before forming the partnership of McColl and Fletcher which was engaged on subdivision surveys, laying out drainage tile, sidewalks, drainage reports and pavements in Sandwich, Tilbury and surrounding country. He was also associate town engineer for Sandwich, Ont., during this period.

Mr. Fletcher enlisted in 1918 in the 16th Field Company of the Canadian Engineers as a lieutenant and served in Siberia in charge of all engineering work, bridges and incineration at Gonostai Barracks, Siberia.

He returned from Siberia in June 1919 and upon his discharge from the Army, opened an engineering and surveying office in Windsor, Ont. He remained in private practice until his death in April.

Mr. Fletcher was a past president of the Windsor Branch of the Queen's Alumni Association. He joined the Engineering Institute in 1919 as an Associate Member, transferring to Member in 1940. He attained Life Membership in the Institute in January 1955.

Bruce S. Taylor, M.E.I.C., senior engineer with the Industrial Development Bank in Vancouver, B.C., died suddenly in Vancouver on March 7, 1955.

Born in Dundee, Scotland, Mr. Taylor received his secondary schooling at Harris Academy, Dundee, and Ottawa Collegiate in Ottawa. He graduated from Queen's University with a B.Sc. degree in chemical engineering in 1929, and returned to the university for one year of post graduate study. In 1930 he joined the staff of the Bell Telephone Company of Canada as a facilities engineer with the Quebec district traffic department. From 1933 to 1935 he was facilities and budget engineer in the Quebec division traffic department becoming equipment engineer in the general traffic department, eastern area, in 1935.

At the outbreak of World War II Mr Taylor obtained a leave of absence from the company and served with the Canadian Artillery until the end of the war.

He returned to the Bell Telephone Company in 1945 to the general traffic department as special studies engineer. Mr. Taylor became associated with the Industrial Development Bank in 1946 in Vancouver, B.C., as industrial engineer.

Mr. Taylor joined the Engineering Institute as a Student in 1929, transferring to Junior in 1946 and to Member in 1947.

Ragnar John Mattson, M.E.I.C., director of the Paul Anderson Construction Company in Vasteras, Sweden, died suddenly on February 28, 1955, in Vasteras, Sweden.

Mr. Mattson, who was born in Vasteras on March 16, 1894, received his secondary education at Vasteras Preparatory, Grammar and High Schools. After graduating from the Swedish Army Cadet School in 1915, he received his civil engineering degree from the Royal College of Engineering in Stockholm in 1920.

Upon graduation Mr. Mattson was employed as a structural steel designer with the Republic Structural Iron Works in Cleveland, Ohio. Later that year he joined the Carnegie Steel Company in Pittsburgh, Pa., as boiler maker. He returned to Sweden in 1921 and was employed as research engineer with the Swedish Engineering Academy in Stockholm. After two years spent working in Germany Mr. Mattson returned to the United States and became associated with the Foundation Company in New York as designer, engineer. In 1928 he was transferred to Montreal and joined the Foundation Company of Canada Ltd., where his new duties consisted of marine engineering including design of floating plant caissons. In 1941 Mr. Mattson joined the Aluminum Company of Canada in Montreal. After five years with the company he became connected with Canadian and General Finance Company Ltd. in Toronto. Later in 1946 Mr. Mattson went to India as project officer for the central technical power board of the Department of Works, Mines and Power of the Indian government in Simla. In 1949 he joined the staff of the Damodar Valley Corporation and was employed as engineer in charge of planning and design both in Calcutta and Bihar.

Mr. Mattson returned to his native Sweden in 1950 to assume the position of director of the Paul Anderson Construction Company in Vasteras, a position he held until his death.

Mr. Mattson joined the Engineering Institute in 1934 as an Associate Member, transferring to Member in 1940.

John James Gray, M.E.I.C., chief inspector of the Boiler Inspection Branch of the Provincial government at Halifax, N.S., died suddenly in Halifax on March 19, 1955.

Mr. Gray was born in Westville, N.S., and received his secondary education at Port Hood Academy. He completed I.C.S. courses in machine shop practice and mechanical engineering and passed examinations for stationary engineer, receiving the Nova Scotia Government certificate.

He began his engineering career in the shops of the Inverness Railway and Coal Company at Inverness, N.S., in 1908, spending four years as an apprentice machinist and one year as assistant foreman. In 1913 Mr. Gray joined the Maritime Coal and Railway Company as locomotive foreman and later as master mechanic.

During World War I he served with the 85th Battalion and later was active in the Cumberland Highlanders (Militia) where he attained the rank of major. At the end of the war he returned to the Maritime Coal and Railway Company, where he remained until 1923 when he was appointed mechanical engineering inspector with the Boiler and Inspection Company of Canada with headquarters in Amherst, N.S. For the next eighteen years Mr. Gray travelled over the Maritime provinces in this capacity and in 1940 he moved to Halifax and set up the Boiler Inspection Branch of the Provincial government, a position he held until his death.

During World War II Mr. Gray commanded the Bedford Detachment of the Halifax Rifles Reserve Battalion.

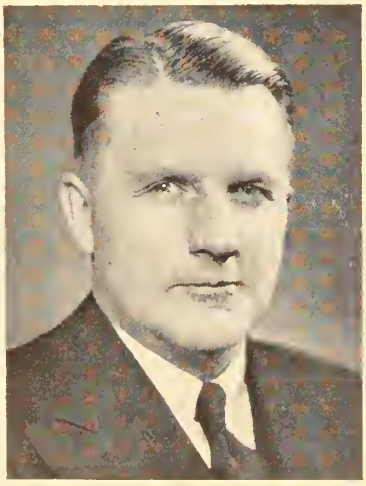
He was a Member of the Association of Professional Engineers of Nova Scotia. Mr. Gray joined the Engineering Institute in 1940 as a Member.

Personals

News of the Personal Activities of Members of the Institute

N. R. Crump, M.E.I.C., has been elected president of the Canadian Pacific Railway Company. He will succeed **W. A. Mather,** HON. M.E.I.C., who will be chairman of the company.

Mr. Crump joined the C.P.R. in 1920 and has risen successfully through the ranks to his present position. He took a leave of absence and attended Purdue University, graduating in 1929 with a B.Sc. degree in mechanical engineering. Through positions of machinist, locomotive foreman, master mechanic and chief draughtsman, Mr. Crump rose rapidly to become assistant superintendent of motive power on western lines, and was brought to eastern Canada for executive positions such as assistant to the vice-president, general superintendent at Toronto, and general manager and later vice-president of the eastern region. Mr. Crump was elected vice-president and member of the executive committee on May 4, 1949.



N. R. Crump, M.E.I.C.

He joined the Engineering Institute as a Student in 1928, transferring to Junior in 1931, Associate Member in 1938 and to Member in 1940.

Gilbert M. Young, M.E.I.C., has been appointed vice-president of Canadian Ingersoll-Rand Company Ltd. Mr. Young is also works manager of the company plant at Sherbrooke, Que.

Graduating from Sir George Williams in 1929, he had already served four years of his apprenticeship at Canadian Pacific Railways. He entered McGill University in 1929 and by returning to the Angus Shops during the summer months each year was able to complete his apprenticeship and receive his machinist papers in 1934.

Mr. Young graduated from McGill University in 1934 with a B.Eng. degree after winning the British Association Medal. Following graduation he spent one year with the C.P.R. as millwright and later as dynamometer car engineer, and then joined the Canadian Ingersoll-Rand Company as a sales engineer in the pump division in Montreal. During 1936 and 1937 he was manager of the contract service department. Mr. Young was appointed secretary of the company in 1937 and in 1941, became manager and also director of the Sherbrooke Pneumatic Tool Company, a wholly owned subsidiary engaged in the manufacture of shells for the government. Later in 1941, he was named a director of the parent company and the following year was named works manager of the plant at Sherbrooke, Que.

From 1938 to 1943 Mr. Young served as a captain with the Royal Canadian Electrical and Mechanical Engineers and at present, is an honorary lieutenant colonel of the R.C.E.M.E.

Gilbert M. Young, M.E.I.C.

Mr. Young is a member of the Canadian Institute of Mining and Metallurgy and of the Corporation of Professional Engineers of the Province.

H. A. Cooch, M.E.I.C.

Harold A. Cooch, M.E.I.C., retired in May from his position as board chairman of the Canadian Westinghouse Company.

Graduating from the University of Toronto with a B.A.Sc. degree in 1910 he remained at the university for two years on the teaching staff. While teaching he continued his apprenticeship courses with Westinghouse in Pittsburgh during the summer months and in 1911 he joined Canadian Westinghouse Company as a sales engineer in the Toronto office, thus beginning the outstanding engineering and executive career that covered 46 years.

Mr. Cooch enlisted in the Canadian Expeditionary Forces in 1915 and served in France with the 3rd division Canadian Engineers, returning in 1919 with the rank of Captain. He resumed sales work at the Toronto office of Canadian Westinghouse and in 1923 went to the head office in Hamilton. He became vice-president and sales manager in 1938, and was elected president in 1949. A year later Mr. Cooch became chairman of the board.

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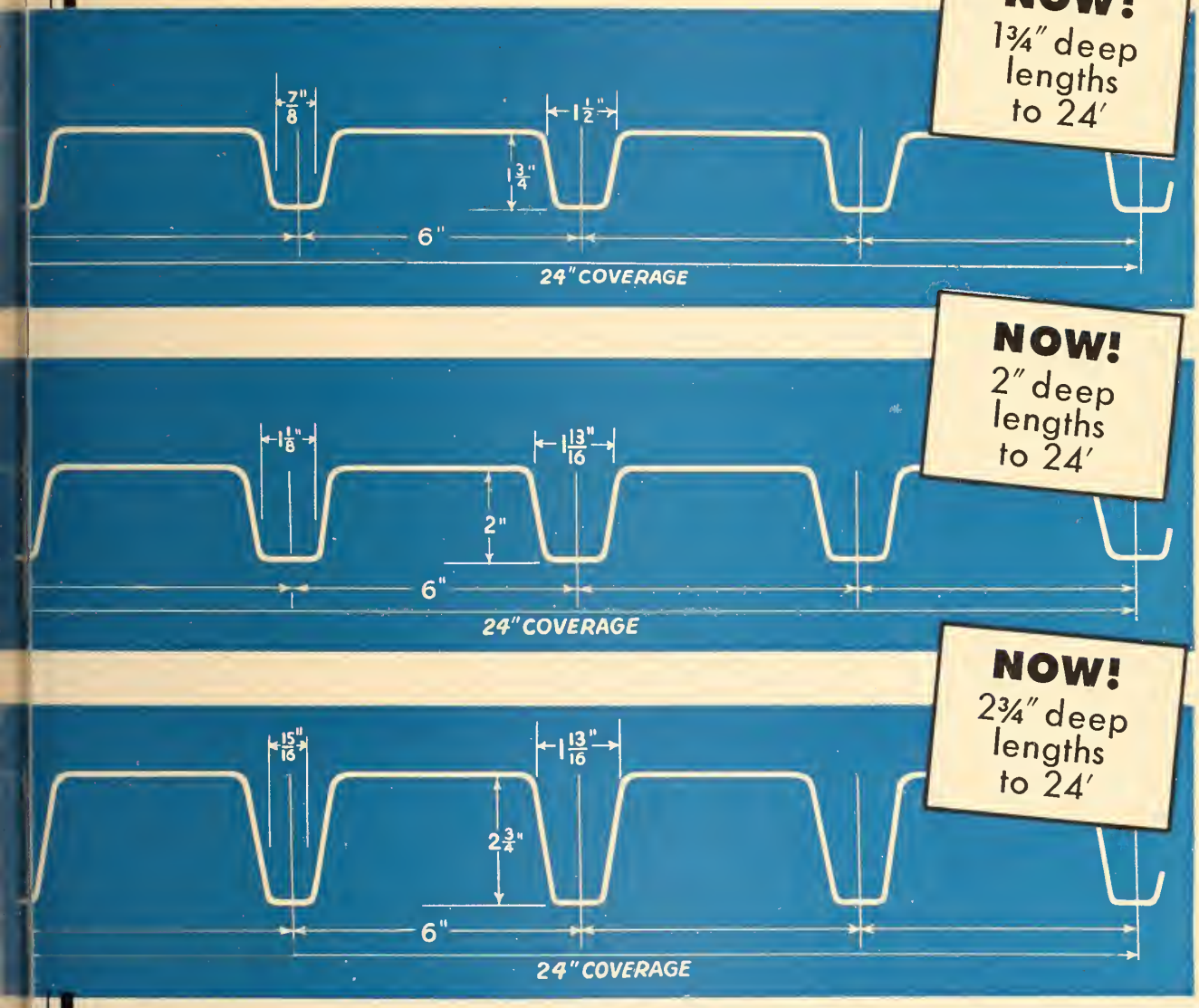

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During World War II Mr. Cooch was largely responsible for the development of Ignitron rectifiers which made possible the mass production of aluminum. The vital increase of aircraft production in this country was just one of the major benefits of this development.

Mr. Cooch is a past-president of the Canadian Electrical Manufacturers' Association, a member of the Canadian Electrical Association, a former councillor of the Association of Professional Engineers of Ontario and a member of the executive council of the Canadian Manufacturers' Association.

He became a Member of the Engineering Institute in 1939 and is a past-president of the Hamilton Branch.

Henri Gaudefroy, M.E.I.C., has been awarded an honorary doctorate of science by Laval University in Quebec City.

Mr. Gaudefroy received his B.A.Sc. degree from Ecole Polytechnique in 1933 and his B.S. degree from the Massachusetts Institute of Technology in 1934.

Mr. Gaudefroy is director of Ecole Polytechnique in Montreal.

After some time with the Bell Telephone Company as electrical engineer, Mr. Gaudefroy returned to Ecole Polytechnique as assistant to the dean and registrar in 1940. In 1943 he became secretary of the faculty and assistant to the dean. He was appointed dean in 1953.

Mr. Gaudefroy served as councillor of the Engineering Institute in 1954, and as chairman of the Montreal Branch in 1950.

Henri Gaudefroy, M.E.I.C.

G. Lorne Wiggs, M.E.I.C., has been elected president of the Corporation of Professional Engineers of Quebec. Mr. Wiggs is a partner in the firm Wiggs, Walford, Frost and Lindsay, consulting engineers, in Montreal.

Mr. Wiggs, following graduation from McGill University in 1921, worked for a number of leading industrial and commercial firms in Canada and the United States. Early in 1929 he entered private practice in Montreal as a consulting engineer, specializing in the design of the electrical and mechanical equipment of buildings. His practice has extended across Canada.

During the war he was retained by the Department of Munitions and Supply. At the end of the war Mr. Wiggs returned to the field of engineering of industrial plants and to the design of electrical and mechanical equipment for buildings of all kinds.

Mr. Wiggs has contributed a number of papers to different branches of the Institute and to other engineering societies in Canada and the United States.

F. W. W. Doane, Hon.M.E.I.C.

Lieut.-Col. Francis W. W. Doane, HON.M.E.I.C., has been honoured by the Nova Scotia Technical College. The de

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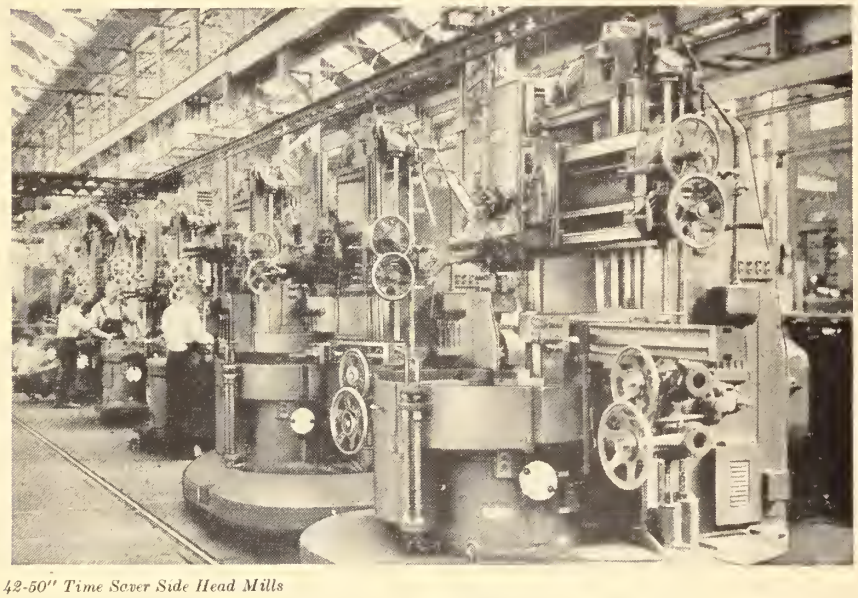

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gree of Doctor of Engineering honoris causa, was conferred upon Colonel Doane at the annual convocation held May 12.

Colonel Doane, Nova Scotia's oldest practising engineer, was born in Barrington, N.S. in 1863. He took up the practice of engineering in 1883 and for eight years was assistant to Dr Martin Murphy, provincial government engineer for Nova Scotia. In 1894, Colonel Doane was appointed city engineer for the City of Halifax and served in this capacity for thirty-three years until his retirement in 1924. On his retirement, he went into private practice and in 1931 became consulting engineer to Standard Paving Maritime Ltd. of which his son, **H. W. L. Doane,** M.E.I.C., was at that time superintendent, and later became manager.

At the outbreak of the first war in 1914, Colonel Doane who was at that time a member of the militia, was detailed for defence duty locally but volunteered for overseas service. Ultimately he served overseas with the Highland Brigade, and following his return to Canada continued with the militia. At the time of his retirement from the position of City Engineer he commanded the Sixty-Third Regiment, Halifax Rifles.

In the activities of the profession, Colonel Doane has always taken a prominent part, being one of the early members of the old Canadian Society of Civil Engineers, as well as the Union of Nova Scotia Municipalities. He is also a past-president and life member of the Nova Scotia Institute of Science. He has served as councillor of the Engineering Institute and was made an Honorary Member in 1952.

Ian F. McRae, M.E.I.C., has been appointed by the Canadian General Electric Company to head the company's engineering team assigned to design, engineer and construct Canada's first nuclear reactor for power purposes. Announcement of the nuclear power project was made recently in the House of Commons by C. D. Howe, Minister of Trade and Commerce.

Mr. McRae joined Canadian General Electric in 1925. From 1941 to 1950 he was manager of the company's largest plant at Peterborough, Ont. In 1952, following six months loan to the government as director of the gun division of the Department of Defence Production, Mr. McRae was appointed a vice-president of the company.

Ian F. McRae, M.E.I.C.

In 1950 Mr. McRae served on an advisory council for the Canadian Welding Bureau, a division of the Canadian Standards Association. He is also president of the Canadian Industrial Preparedness Association.

Philip N. Gross, M.E.I.C., has been appointed director and president of Gypsum, Lime & Alabastine Limited in Montreal and its senior executive.

Mr. Gross received his B.Sc. degree from McGill University in 1926. Upon graduation he joined Anglin-Norcross Limited. He has held various positions with the company, Toronto manager, vice-president and Montreal manager, and in 1946 he took over the presidency of the company and continued as president until a few months ago.

Mr. Gross served overseas with the Royal Canadian Engineers from 1940 to 1943, attaining the rank of captain.

He joined the Institute in 1932 as a Member.

George O. Saunders, M.E.I.C., has been elected a vice-president of Canadian Locomotive Company Ltd. at Kingston, Ont. Mr. Saunders was formerly works manager of the company.

A graduate of Queen's University in mechanical engineering, Mr. Saunders began with the company 13 years ago as assistant in the plant engineering department. He transferred to diesel engineering and subsequently became manager of locomotive sales, and then assistant to the works manager in charge of steam locomotive production.

Mr. Saunders is a member of the Association of Professional Engineers of Ontario.

John P. Stirling, M.E.I.C., has been named chief engineer of Defence Construction (1951) Limited in Ottawa. Mr. Stirling will replace **Donald H. McLaren,** M.E.I.C., who has been on loan to D.C.L. for the past year. Mr. McLaren is returning to the Foundation Company of Ontario of which he is a vice-president.

Mr. Stirling, who is an honour graduate of the University of Toronto in

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civil engineering, has had a varied background in the field of engineering, both in private industry and in government service.

He served overseas with the Canadian Army as an engineering officer, following which he was employed by the Hydro Electric Power Commission of Ontario as divisional engineer for the Aguasabon Power Development, and later as resident engineer during the construction of the power house and dam at Pine Portage, Ont.

Mr. Stirling left the Hydro Electric Power Commission in 1951 to accept an appointment with the Ontario Paper Company, where he was resident engineer in charge of the McCormick Dam Hydro project at Baie Comeau, Que.

For the past two years Mr. Stirling has been western manager for Provincial Engineering Ltd. at Edmonton, Alta.

James E. Neilson, M.E.I.C., has been named a director of Foster Wheeler Ltd. in St. Catharines, Ont.

Upon graduation from Queen's University in mechanical engineering, Mr. Neilson first joined Swift Canadian Company. Later the same year he became associated with Riley Engineering and Supply Company as a field engineer.

In 1934, when Foster Wheeler became Canadian representatives for the Riley Stoker Corporation, Mr. Neilson joined Foster Wheeler in the Montreal sales department. He has served the company as sales engineer, district engineer, assistant chief engineer, and as chief engineer. In 1950 he was elected vice-president in charge of engineering, and in 1952, executive vice-president.

Mr. Neilson is a past-president of the Niagara branch of the Queen's Alumni, and served for two years on the advisory council for engineering (mechanical branch) of Queen's University. He is a member of the American Society of Mechanical Engineers and of the Association of Professional Engineers of Ontario.

William C. R. Jones, M.E.I.C., mill manager of the Columbia Cellulose Company at Prince Rupert, B.C., has been appointed vice-president industrial and public relations, of Powell River Company Ltd. in Vancouver, B.C.

Mr. Jones has been previously associated with Howard Smith Paper Mills both as assistant mill manager at the Beauharnois, Que., plant and as project engineer with the Canada Paper division at Windsor Mills, Que. He has also spent some time in Australia, where he was assistant superintendent of construction with the Australian Paper Manufacturers in Melbourne.

James E. Neilson, M.E.I.C.

He became a Member of the Engineering Institute in 1953.

Louis Trudel, M..E.I.C., manager of the public relations and advertising department of Shawinigan Water and Power Company, has been elected president of the Canadian Public Relations Society at the organization's annual meeting.

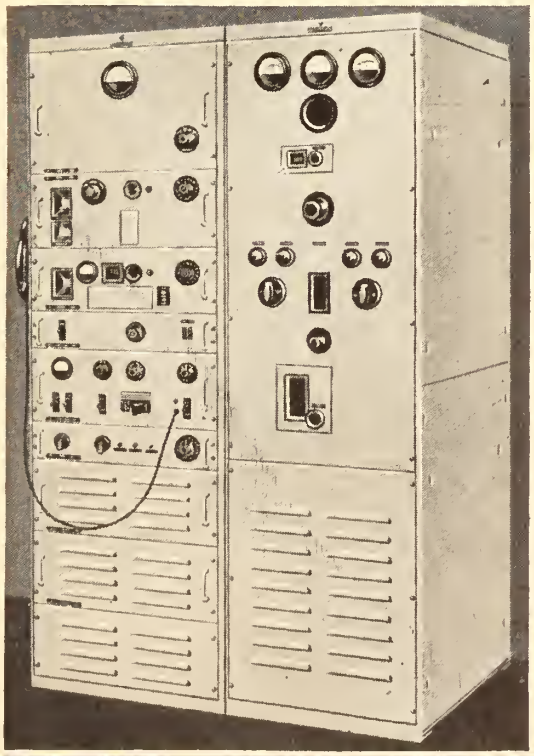
Mr. Trudel, who was assistant general secretary of the Engineering Institute for eight years, joined Shawinigan Water and Power Company in 1947. Before joining the Institute in 1939, he had been associated consecutively with the Provincial Electricity Board, the Southern Canada Power Company and Marine Industries Limited.

Mr. Trudel received his engineering degree from Ecole Polytechnique in 1936.

Louis Trudel, M.E.I.C.

B. G. Ballard, M..E.I.C., vice-president (scientific) of the National Research Council of Canada and director of its division of radio and electrical engineering, has been made a Fellow of the American Institute of Electrical Engineers. The citation reads, "for his contribution in applying electrical engineering technology to problems of national defence."

24-CHANNEL VHF FM RADIO SYSTEM FOR LONG LINKS



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Mr. Ballard won the Ross Medal of the Engineering Institute in 1949 for a publication called "Recent Canadian Radar", and was elected a Fellow of the Institute of Radio Engineers in 1954.

He is a past-chairman of the Ottawa Branch of the Institute and a member of its national council; a past chairman of the Ottawa Section of the American Institute of Electrical Engineers; a member of the board of directors of the Canadian Standards Association and chairman of their Approvals Administrative Board.

B. A. Monkman, M.E.I.C., managing director of Light Weight Aggregates of Canada Ltd., in Calgary, Alta., has been elected chairman of the Calgary Branch of the Engineering Institute.

Born in Medicine Hat, Alta., Mr. Monkman received his early education at Medicine Hat public and high school. He graduated from the University of Alberta in civil engineering in 1940. Upon graduation he joined Calgary Power Limited as construction engineer. After nine years with this company he moved to Newfoundland as operating superintendent with the Newfoundland Light and Power Company in St. John's. He later became assistant general manager of the company.

In 1953 Mr. Monkman returned to Calgary to assume his present position as managing director of Light Weight Aggregates of Canada Ltd.

B. G. Ballard, M.E.I.C.

He is a past chairman of the Newfoundland Branch of the Institute and a past-president of the Association of Professional Engineers of Newfoundland.

R. D. Livingstone, M.E.I.C., has been appointed assistant general manager of Lethbridge Collieries Ltd. in Lethbridge, Alta. Mr. Livingstone, who has been with the company since 1936, is the son of its first general manager.

B. A. Monkman, M.E.I.C.

A 1939 graduate in mining engineering from the University of Alberta, Mr. Livingstone served overseas during the war with the Royal Canadian Engineers. He was discharged in 1946 with the rank of captain and returned to Lethbridge Collieries Ltd.

Active in the engineering field, Mr. Livingstone is a member of the Canadian Institute of Mining and Metallurgy, the Institute of Mining Engineers of Great Britain, the American Institute

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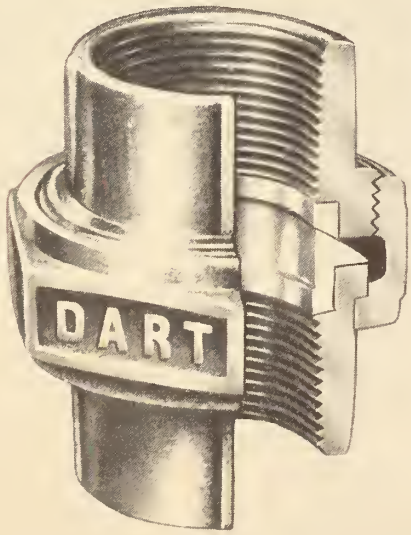

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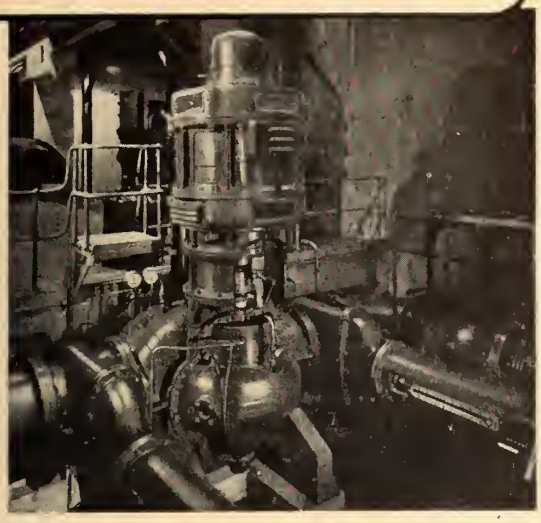

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of Mining Engineers and is a past coun cillor of the Association of Professiona Engineers of Alberta. He joined th Engineering Institute as a Member i 1946.

James J. Haffey, M.E.I.C.

James John Haffey, M.E.I.C., has bee appointed assistant plant manager o Canadian Schenley Ltd. in Valleyfield Que. Mr. Haffey will continue as chie engineer of the company.

A chemical engineering graduate fron the University of Toronto, Mr. Haffe joined Canadian Schenley Ltd. in 194 Early this year he was responsible fo the plans of the company's west coas subsidiary, Canadian Melrose Distille Ltd. at Vancouver, B.C.

Mr. Haffey is a former chairman c the Valleyfield-Beauharnois section c the Chemical Institute. He joined th Engineering Institute as a Member i 1949.

M. R. Campbell, M.E.I.C., assistant ger eral superintendent of Dominion Iro and Steel Limited in Sydney, N.S., ha been elected chairman of the Cap Breton Branch of the Engineering In stitute.

M. R. Campbell, M.E.I.C.

Mr. Campbell, who was born in Iris Cove, N.S., received his B.A. degr from St. Francois Xavier Universi and his M.Sc. degree in chemical eng

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55-14

R. M. Dingwall, M.E.I.C.

neering from the Massachusetts Institute of Technology in 1927.

While attending university he worked during the summer months at the steel plant in various capacities and early in 1927 he became a permanent employee of the Company. Later that year he was appointed assistant superintendent of the Open Hearth Department, becoming superintendent of that department in 1946. He was appointed assistant general superintendent in 1953.

Mr. Campbell has served on the executive of the Engineering Institute. He is a member of the Mining Society of Nova Scotia and the British Iron and Steel Institute, and has contributed a number of technical papers to some of these organizations.

R. M. Dingwall, M.E.I.C., has retired from active service as manager of Standard Iron & Engineering Works Ltd. in Edmonton, Alta. He will, however, continue to be associated with the company in a consulting capacity.

Mr. Dingwall, who graduated from the Royal Technical College in Glasgow, Scotland, in 1914, received his early training as a mechanical engineer and ship builder in that city.

During World War I he served with the Corps of Royal Engineers in France and on the British General Staff.

Shortly after the war Mr. Dingwall came to Canada and from 1920 to 1926 he was head of the engineering department at the Alberta Provincial Institute of Technology, after which he joined the Riverside Iron Works in Calgary, Alta., as sales manager.

In 1929 he founded Standard Iron & Engineering Works Ltd. in Edmonton. The company has grown under his leadership and during the past five years an extensive expansion program has been carried out.

Mr. Dingwall joined the Engineering Institute in 1923 as an Associate Member, transferring to Member in 1937. He has served as chairman of the Edmonton Branch of the Institute.

Arthur A. Scarlett, M.E.I.C., has retired after 38 years with the International Harvester Company of Canada. Mr. Scarlett was vice-president of the company, a position which he has held since 1944.

Mr. Scarlett, who graduated from Toronto University (S.P.S.) with a B.A.Sc. degree in 1913, joined International Harvester Company in 1919 as a designer. He was appointed assistant chief engineer in 1927 and chief engineer in 1935. In 1944 he was named vice-president in charge of engineering, having supervision over all engineering work carried on at Canadian plants of the company.

He joined the Engineering Institute as a Member in 1943.

Donald D. McLean, M.E.I.C., has been named manager of the sales department of the Canadian Westinghouse Company's electronics division at Hamilton, Ont.

An electrical engineering graduate from Queen's University, Mr. McLean saw wartime service with both the Royal Canadian Navy and the Royal Navy as a radar officer. He was later engaged in

(*Continued on page 842*)

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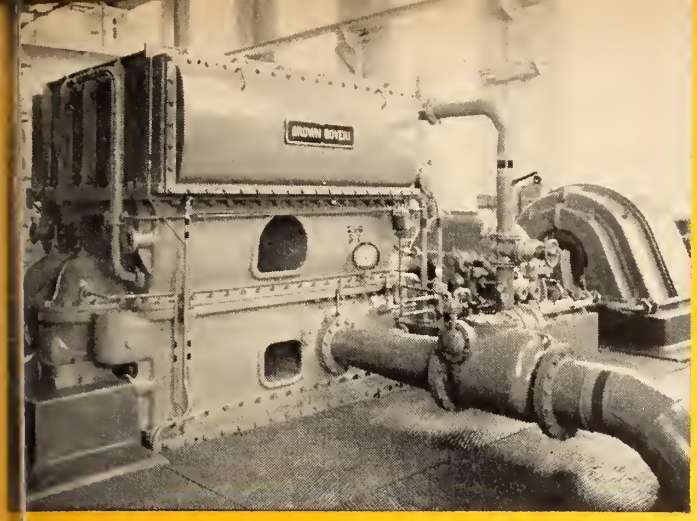

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C. W. WOOD
General Manager

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a CANADIAN company serving CANADIAN industry

Personals

(*Continued from page 838*)

electronics work with the National Research Council and with Trans-Canada Airlines before joining Westinghouse in 1951.

During the past four years Mr McLean has served as supervisor of the government contracts section of the company and as manager of telecommunications equipment sales. He was appointed manager of the defence contracts department in 1953.

Mr. McLean is a member of the Institute of Radio Engineers.

Professor Hugh Gordon Conn, M.E.I.C., has been appointed dean of the faculty of Applied Science at Queen's University. He succeeds **Dean D. S. Ellis,** M.E.I.C., who died on March 20.

Head of the department of mechanical engineering at Queen's and a member of the staff since 1937, Professor Conn holds the O.B.E.

After graduating from Queen's in mechanical engineering in 1931, Professor Conn spent five years with Proctor and Gamble in Hamilton, becoming plant engineer of the company.

He joined the Queen's engineering staff in 1937 as a lecturer. In 1939 he enlisted with the R.C.E.M.E., serving overseas for six years and rising to the rank of lieutenant-colonel.

The University of Michigan awarded him a M.S. degree in 1946, the same year he was appointed head of the department of mechanical engineering.

M. G. Taylor, M.E.I.C., has been named manager of the Nova Scotia Power Commission with headquarters in Halifax, N.S. Mr. Taylor has just returned from Venezuela, where he has been for many years. He was president and general manager of C.A. Energia Electrica de Venezuela at Maracaibo.

Mr. Taylor graduated from Nova Scotia Technical College in 1927 with a B.Sc. degree and received his M.Sc. degree from the Massachusetts Institute of Technology in 1931.

E. V. Macauley, M.E.I.C., executive vice-president and a director of the Bell Telephone Company of Canada, recently retired after 42 years with the company. Upon his retirement at a dinner held in Montreal, Mr. Macauley was presented with a certificate of life membership in the Telephone Pioneers of America.

During the first World War Mr Macauley served with the artillery and was awarded the Military Cross. He rejoined the company at the close of the war. In 1946 he was appointed vice president (engineering) and in 1948 became executive vice-president. Later the same year he was appointed a director of the company.

Mr. Macauley is a 1912 graduate from the University of Toronto.

Howard Johnson, M.E.I.C., has been named managing director of Burntisland Shipbuilding Company Ltd. in Burntisland, Scotland.

Mr. Johnson is also chairman of Hall Russell in Aberdeen and director of Alexander Hall & Company Ltd., shipbuilders, engineers and boilermakers, in Aberdeen.

Alexander R. Moffat, M.E.I.C., resident engineer with H. G. Acres & Company

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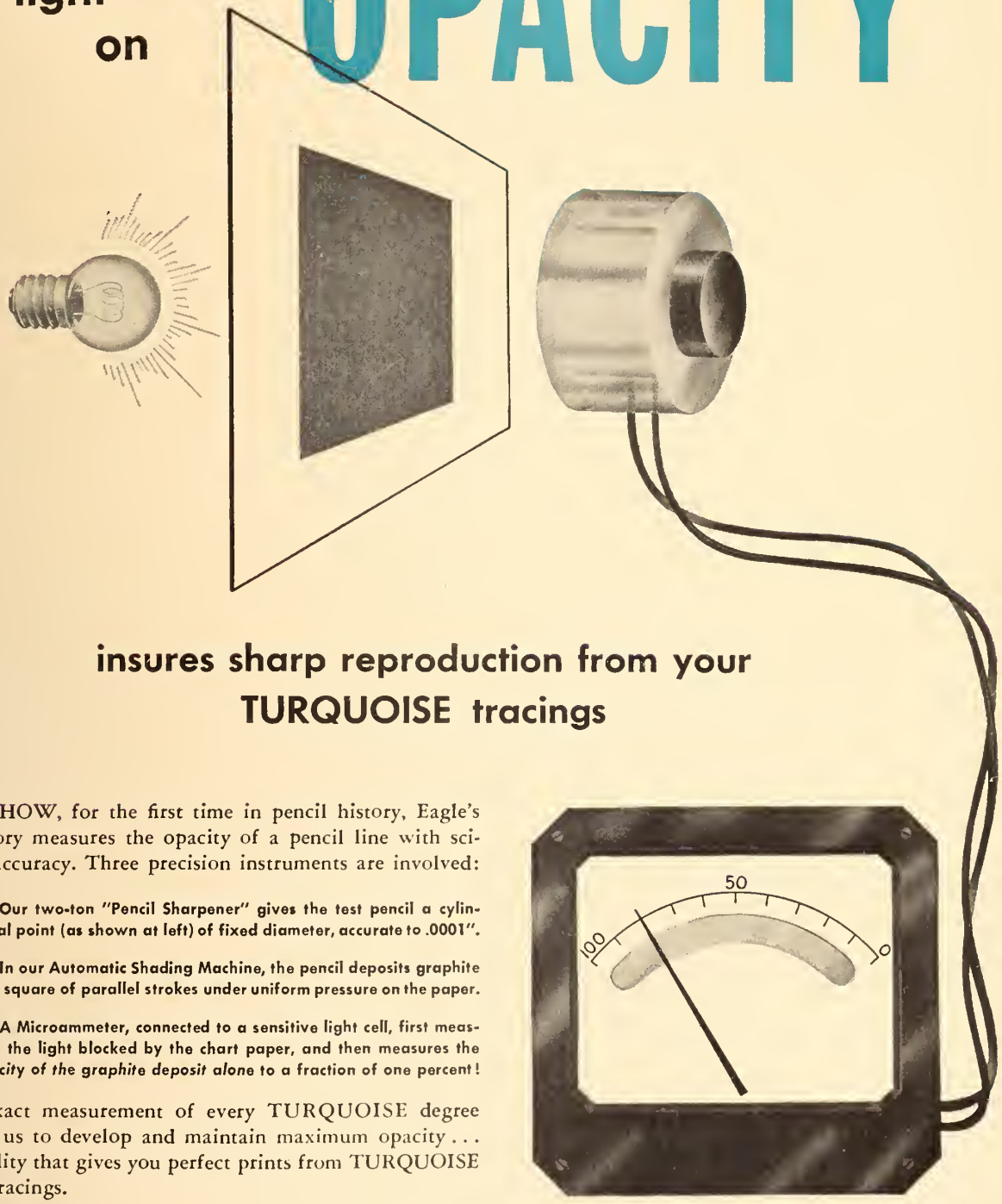

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Col. C. R. Boehm, M.E.I.C.

Ltd., has been transferred to the Ladore Generating Station project at Campbell River, B.C. for the B.C. Power Commission.

Since joining the company in 1947 Mr. Moffat has been engaged on many important power projects, among them, Marmion Lake Dam project at Atikokan, Ont., the Bersimis-Lac Cassé project in Quebec and the Beauharnois Power House No. 2 construction in Beauharnois, Que.

Previously, he had been connected with the Department of Mines and Resources at Ottawa and the Hydro-Electric Power Commission at Arnprior, Ont.

During the war he was with the works and buildings branch of the Naval Service in New Brunswick and with the Department of National Defence at Halifax, N.S.

Col. C. R. Boehm, M.B.E., C.D., M.E.I.C., has been posted from the Canadian Army Liaison Establishment in London, England, to the Canadian Armament Development and Experimental Establishment in Valcartier, Que., where he is serving as superintendent and commanding officer, succeeding Col. D. A. G. Waldock, M.E.I.C.

Col. Boehm, who attended the 1952-53 course at the National Defence College in Kingston, was previously director of electrical and mechanical engineering at Army headquarters in Ottawa.

A 1929 graduate of the University of Toronto, Col. Boehm was employed prior to the war as mining engineer in northern Ontario and Quebec.

Col. Boehm was commissioned in the R.C.O.C. at the beginning of the war and held the rank of major by April 1942, when he was attached to the British Forces in North Africa. Upon his return to the Canadian Army, he was promoted to lieutenant-colonel and served at the First Canadian Army headquarters in the United Kingdom, France, Belgium, Holland and Germany.

He served as deputy director of the Directorate of Mechanical Engineering until his appointment as director in October, 1948. In May, 1951, the Directorate was renamed the Directorate of Electrical and Mechanical Engineering and Col. Boehm continued as director until his departure in September, 1952.

John A. MacArthur, M.E.I.C., has recently established an office in Montreal in partnership with Alfred Malkin and James Daly, as consulting engineers and inspectors.

Born in Glasgow, Scotland, Mr. MacArthur came to Canada in 1929 and joined Abitibi Power and Paper Company Ltd. at Fort William, Ont. He has had varied experience with several chemical and engineering companies in Quebec, and between the years 1941 and 1944 he was associated with shipbuilding work.

After 1944 Mr. MacArthur was connected with Sherbrooke Machineries Ltd. in Sherbrooke, Que., with Longlac Pulp and Paper Company Ltd. in Toronto and with the Stadler, Hurter and Company in Montreal.

Mr. MacArthur graduated from the University of Glasgow in 1924.

A. Madryga, M.E.I.C., was recently transferred to the special contract department of the Bell Telephone Company of Canada in Montreal. His duties are now with multiplex type of communication.

Mr. Madryga has served with the Bell Telephone Company in London, Toronto and in Montreal. He is an electrical engineering graduate of the University of Toronto, class of 1944.

Kenneth Gilbert Cook, M.E.I.C., is now with Primco Limited in Ottawa as a development engineer.

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Mr. Cook, who graduated from McGill University with a B.Eng. degree in mechanical engineering in 1938, has previously been associated with R. D. Warner Company Inc. in Greenville, Pa.

During World War II he served with the R.C.A. Upon his discharge as a captain he joined the engineering department of Cresswell Rollforming Company Ltd. in Montreal. He became chief engineer of the company and chief engineer of Cresswell Pomeroy Ltd. In 1950 he became associated with the Kaiser Aluminum & Chemical Corporation in Spokane, Wash.

W. C. M. Luscombe, M.E.I.C., has joined the staff of Dominion Structural Steel Ltd. in Montreal.

Mr. Luscombe has been with Dominion Textile Company Ltd. for the past nine years both in Montreal and at Magog, Que. He has also been associated with the Aluminum Company of Canada in Montreal.

H. A. Marshall, M.E.I.C., has been transferred from Sydeny, N.S., to Halifax, as supervisor of domestic heating oil sales for Imperial Oil Limited. He was formerly industrial sales representative at Sydney for the company.

A mechanical engineering graduate from Nova Scotia Technical College, Mr. Marshall served as engineering officer with the Royal Canadian Navy during World War II. He was attached to the Directorate of Fuel, and served as port fuel officer at St. John's, Nfld.

In 1945 he joined Imperial Oil Limited, Maritime division, as industrial sales and service engineer. He has

C. N. McPherson, M.E.I.C.

worked in Halifax, Saint John and Sydney, advising industry on matters of lubrication.

Mr. Marshall is a past chairman of the Cape Breton Branch of the Institute which he joined in 1938 as a Student, transferring to Junior in 1943 and t Member in 1946.

D. Rhodes, M.E.I.C., has been transferre to Toronto as area chief engineer b the Bell Telephone Company fro Montreal where he was general plan extension engineer.

Mr. Rhodes, who graduated from Mc Gill University in 1928, has been wit the company in Sherbrooke, Que., an in Quebec City before coming to Mont real.

F. Petricek, M.E.I.C., has joined Parkin son Construction in Toronto, Ont. H was previously with the H. G. Acres Company in Niagara Falls, Ont. H has also been associated with the Gul Power Company at Clarke City, Que., a field engineer.

Mr. Petricek graduated from the Tech nical University of Prague in civil engi neering, class of 1938.

C. N. McPherson, M.E.I.C., has bee named manager of the new Branch offic at Edmonton, Alta., of Peacock Brother Limited. He was formerly with the com pany's head office in Montreal.

Mr. McPherson, who graduated fro McGill University in civil engineering in 1947, joined Peacock Brothers upo his graduation as a sales engineer. I 1949 he became associated with Spin Construction Ltd. in Montreal as jo engineer. Five years later he rejoine Peacock Brothers Limited in Montrea

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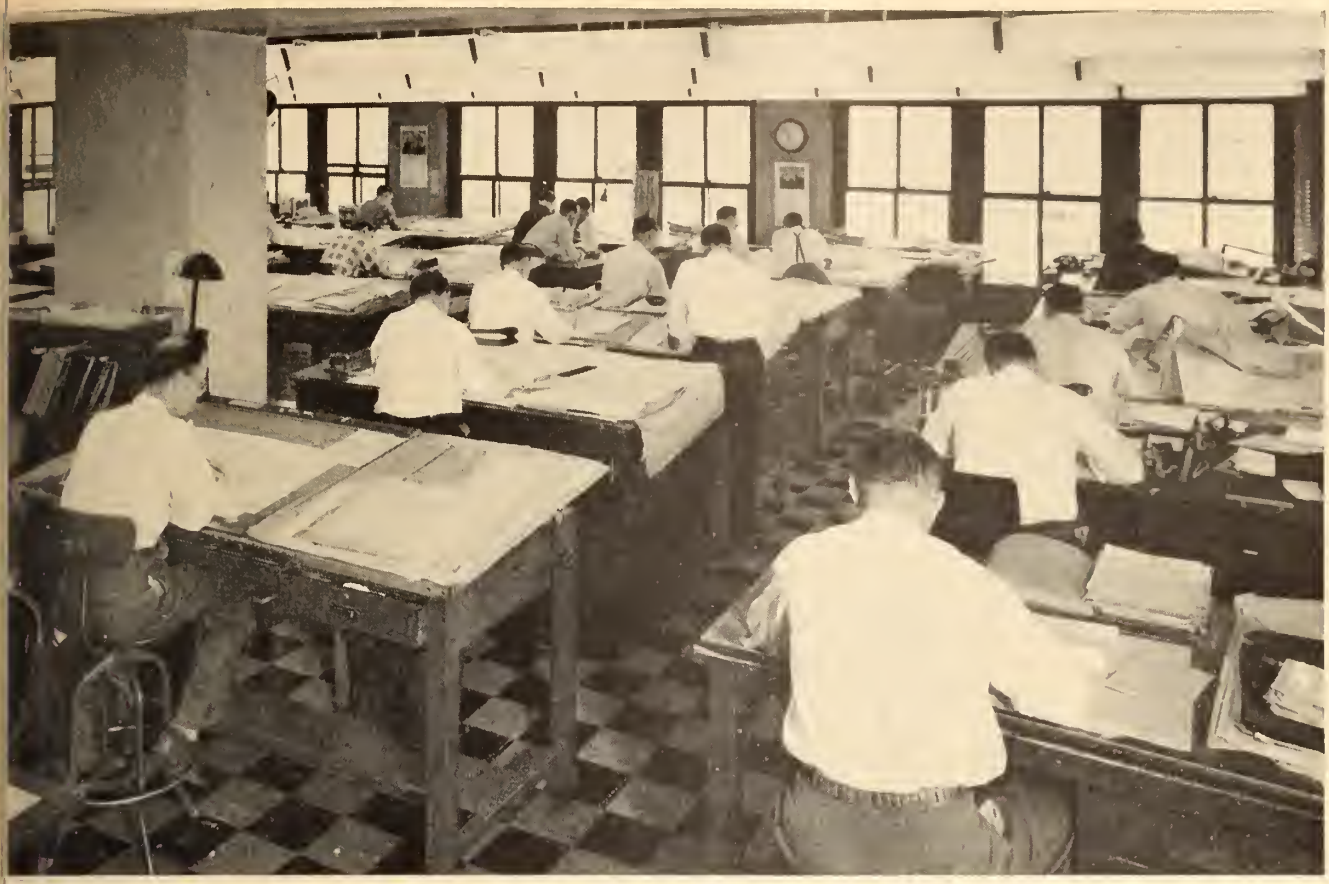

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serving in various engineering and sales capacities until his appointment as manager in Edmonton.

He is a member of the Corporation of Professional Engineers of Quebec.

D. Hadekel, M.E.I.C., has been appointed administrative engineer for Henry J. Kaiser Company (Canada) Ltd. in Montreal.

He has also been associated with Montebello Constructions Ltd. in Montreal as chief engineer, and with Central Mortgage & Housing Corporation in Montreal. Mr. Hadekel was with the World Commerce Corporation in New York and during the war was associated with Wartime Housing Ltd. in Montreal.

Peter J. Kunstler, M.E.I.C., formerly with Stadler, Hurter Company, consulting engineers, in Montreal has left for the United States and is now connected with Fellows Incorporated, industrial engineers, in Ohio, as a project engineer.

Mr. Kunstler, who graduated from Bodenbach Technical College in Czechoslovakia, has also been connected with Canadian Industries Ltd. in Montreal.

O. I. Logue, M.E.I.C., has joined the staff of Associated Designers and Inspectors in Fredericton, N.B.

A civil engineering graduate from the University of New Brunswick, Mr. Logue was formerly with the Caldwell Construction Company in Fredericton.

He is secretary-treasurer of the Fredericton Branch of the Engineering Institute.

F. G. Bird, M.E.I.C., has retired from Imperial Oil Limited where he was chief of lands and leases in Toronto.

Mr. Bird graduated from Queen's University in 1914 with a B.Sc. degree. Upon graduation he joined the army and from 1915 to 1919 he was in France with the Royal Canadian Engineers. He was discharged with the rank of major and joined Imperial Oil Limited at Calgary, Alta.

During World War II Mr. Bird was with National Defence Headquarters in Ottawa and was a lieutenant-colonel in the Royal Canadian Engineers. He was awarded the Military Cross and the O.B.E. He rejoined Imperial Oil Limited after the war ended.

He attained Life Membership in the Engineering Institute in 1955.

C. D. MacDougall, M.E.I.C., has been transferred to Toronto as supervisor of sales and service for the Ontario district by Canadian Westinghouse Company Ltd. from Moncton, N.B., where he was sales engineer with the company.

Mr. MacDougall graduated from the University of New Brunswick in electrical engineering in 1945.

K. Madsen, M.E.I.C., has joined the staff of H. G. Acres & Company Ltd. in Niagara Falls, Ont. He was previously town engineer in Grand Prairie, Alta.

Mr. Madsen, who was for a time in private practice in Calgary, Alta., as a structural engineer, graduated from the University of Alberta in civil engineering in 1950.

Charles W. Young, M.E.I.C., has joined the engineering department of Dominion Textile Company Ltd. in Montreal. He was previously in Sherbrooke, Que., as plant engineer with Domil Limited.

Mr. Young graduated from the University of Glasgow in electrical engineering in 1940.

K. H. Arnott, M.E.I.C., has joined H. A. Simons Ltd. in Vancouver, B.C., as a structural designer.

Mr. Arnott was formerly with Dominion Bridge Company Ltd. in Calgary, Alta., as structural designer.

C. J. Bradley, M.E.I.C., has been named division engineer in the marketing division of Imperial Oil Limited at Vancouver, B.C.

Mr. Bradley was previously assistant division engineer with the company in Regina, Sask.

During the last war he served with the Royal Canadian Electrical and Mechanical Engineers.

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Lloyd K. Hart, M.E.I.C., is now located in Hamilton, Ont., as manager of the agency and resale district apparatus division of Canadian Westinghouse Company Ltd.

Mr. Hart, who has been engaged in consulting work in Guelph, Ont., is an electrical engineering graduate from the University of Toronto, class of 1940.

A. S. Zakrzewski, M.E.I.C., has joined the staff of Taymouth Industries Ltd. in Toronto, Ont.

Mr. Zakrzewski, who is a mechanical engineering graduate from the University of Zurich, was previously associated with Selectra Industries Ltd. in Toronto.

A. J. Barker, Jr.E.I.C., is now with the Ford Motor Company of Canada Limited working in the maintenance department as construction design engineer in Windsor, Ont.

Mr. Barker, who has been connected with A. V. Roe (Canada) Ltd. in Toronto in the plant engineering department, was most recently assistant engineer with Etobicoke Township in Ontario.

He is a civil engineering graduate from the University of Edinburgh, class of 1948.

R. M. Heaton, Jr.E.I.C., has joined the staff of the Schlumberger Well Surveying Corporation in Regina, Sask.

Mr. Heaton was formerly assistant electrical engineer with H. G. Acres & Company in Great Falls, Man.

He is a graduate of the Institution of Electrical Engineers of Great Britain and has also been associated with Canadian Westinghouse Company Ltd. on field work.

Donald G. Demianiw, Jr.E.I.C., has been appointed assistant director of the plant research department of Shawinigan Chemicals Limited, in Shawinigan Falls, Que.

Mr. Demianiw joined the company in 1948 following his graduation from the University of Saskatchewan where he obtained his B.Eng. degree in chemical engineering.

He has served as secretary-treasurer of the St. Maurice Valley Branch of the Institute in 1951.

R. M. Sanderson, Jr.E.I.C., is now employed as a field engineer with Provincial Engineering Company Ltd. in Winnipeg, Man. He is engaged at present on the construction of a cement plant for the Canada Cement Company at Fort Whyte, Man.

Mr. Sanderson, who graduated from the University of Manitoba in civil engineering, has also been connected with the Department of Public Works at Fort William, Ont.

R. A. Pollard, Jr.E.I.C., has joined the Northern Construction Company in Edmonton, Alta.

He has been connected with the Pacific Oceanographic Group of the Fisheries Research Board of Canada at Nanaimo, B.C. Previously he had been with the Northern Construction Company at Bridal Falls, B.C.

Mr. Pollard graduated in civil engineering from the University of British Columbia in 1949.

G. R. Seviour, Jr.E.I.C., has moved to the United States and is now with the West Virginia Pulp and Paper Company in Charleston, N.C., as a mechanical engineer in the design and construction engineering department.

He was previously with Canadian Resins and Chemicals Ltd. at Shawinigan Falls, Que., and with Anglo-Newfoundland Development Co. in Grand Falls, Nfld.

Upon graduation in 1949 from the Nova Scotia Technical College he joined the engineering department of Canadian Industries Ltd. at Montreal.

Bruce G. Fraser, Jr.E.I.C., has been appointed production assistant of the film processing division of Canadian Kodak Co. Ltd. in Toronto.

Mr. Fraser has been associated with Canadian Kodak Co. Ltd. since his graduation from the University of Toronto in chemical engineering in 1949.

George S. Bowes, Jr.E.I.C., has joined Brantford Roofing Company Ltd., Thorold, Ont.

Mr. Bowes graduated from the University of Toronto in engineering and business, class of 1949. He was previously with Brantford Felt and Paper Company at Thorold, Ont.

W. J. McEachen, Jr.E.I.C., has joined Schell Industries Limited at Woodstock, Ont. He is employed as a sales engineer in the precast concrete division.

Mr. McEachen graduated from the University of Manitoba in civil engineering, class of 1949.

F. H. Bruce Chisholm, Jr.E.I.C., has been transferred to the Southern Kraft division of the International Paper Company at Mobile, Alabama. Prior to his new appointment Mr. Chisholm was with the Canadian International Paper Company at Temiskaming, Que.

Mr. Chisholm, who is a graduate of McGill University in mechanical engineering, class of 1950, has also been associated with the New Brunswick International Paper Company at Dalhousie, N.B.

Masao Saito, Jr.E.I.C., has joined the staff of the Water Rights Branch of the Province of British Columbia in Victoria, B.C.

Previous to accepting this appointment he was associated with the Canadian Hydrographic Service in Ottawa and Kemano, B.C.

Mr. Saito graduated in civil engineering from the University of Manitoba in 1950.

Gordon E. Smith, Jr.E.I.C., has joined the staff of Mathews Construction Company Ltd. in London, Ont. He was previously with the Ontario Department of Highways at Toronto and Bancroft, Ont.

Mr. Smith graduated from Queen's University in civil engineering, class of 1950.

Joseph Schneider, S.E.I.C., of McGill University was recently awarded the Hewitt Equipment Ltd. scholarship, which included a cash bursary and a desk pen, by W. J. Hewitt, vice-president. This new scholarship is given to encourage the efforts of a student of the Faculty of Engineering at McGill. Left to right: Joseph Schneider, S.E.I.C.; R. E. Jamieson, M.E.I.C., dean of the Faculty of Engineering; W. J. Hewitt, W. J. Carson, general sales manager, and A. Laporte, Jr.E.I.C., manager of the engine division.

J. C. Lachance, Jr.E.I.C., is now on the staff of the Rolland Paper Company at Mont Rolland, Que. Prior to his new position he was employed by Dominion Rubber Company at St. Jerome, Que., as an industrial engineer.

Mr. Lachance is a graduate in mechanical engineering from McGill University in 1950.

Alden J. L. Aube, Jr.E.I.C., has been appointed assistant electrical superintendent at the James Maclaren Company Ltd. at Buckingham, Que.

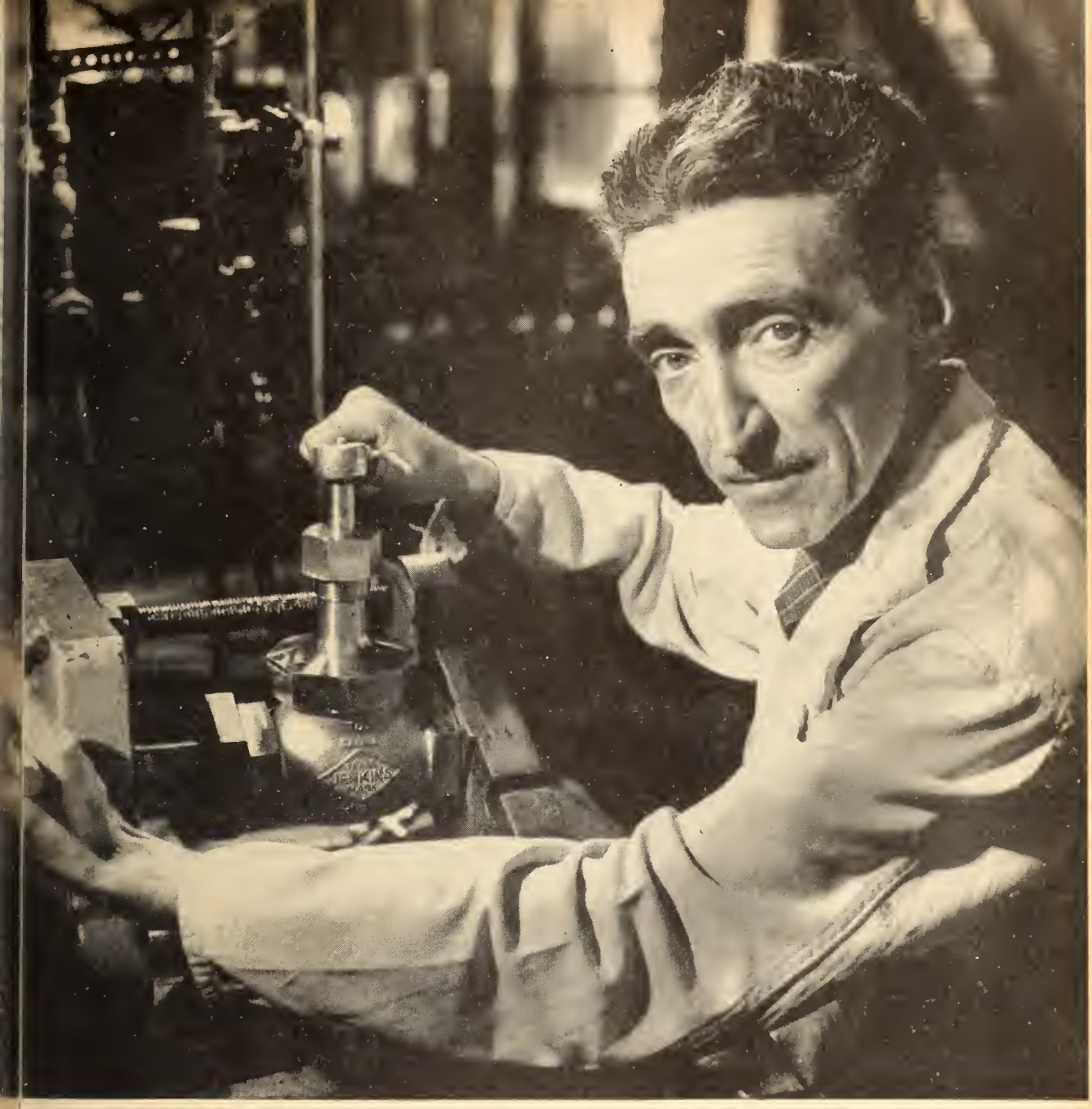
Mr. Aube graduated from the University of New Brunswick, class of 1950 with a degree in mechanical engineering.

D. W. Morash, Jr.E.I.C., has joined the Aluminum Company of Canada. He will be located in Shawinigan Falls, Que.

He is a graduate in mechanical engineering from the University of Toronto, class of 1950.

Leonard H. Harper, Jr.E.I.C., is now assistant construction engineer with Algom Uranium Mines Ltd. at Algoma Mills, Ont. He was previously with Gore & Storrie, in Toronto.

Mr. Harper graduated from Queen's University in civil engineering in 1951.



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Harald E. Sire, JR.E.I.C., is a designer on the staff of the plate and boiler department of Dominion Bridge Company Ltd. in Lachine, Que. He was formerly associated with Super Heater Incorporated in Montreal.

Mr. Siré is a mechanical engineering graudate from the University of Munich class of 1951.

Paul Amyot, JR.E.I.C., has been transferred by Defence Construction (1951) Ltd. from Camp Gagetown to St. Paul de Joliette, Que. He was previously associated with Fraser Brace Engineering Co. at Maitland, Ont., as resident engineer.

Mr. Amyot received his B.A.Sc. degree from Ecole Polytechnique in 1951.

S. A. Milner, JR.E.I.C., is now general field superintendent for the Inland Natural Gas Company Ltd. at Vancouver, B.C.

Mr. Milner is a graduate of the University of Alberta, class of 1951.

E. Van Walsum, JR.E.I.C., has joined the staff of Foundation of Canada Engineering Corporation Ltd. at Montreal.

Mr. Van Walsum graduated from the University of Delft in civil engineering in 1952.

Frank G. Oravec, JR.E.I.C., is now with Dominion Textile Company, Montreal Cottons Limited branch at Valleyfield, Que. He is employed as an industrial engineer in the standard department.

Mr. Oravec is a graduate of Queen's University, class of 1952, in mechanical engineering.

Douglas R. Cameron, JR.E.I.C., is now associated with the Department of Air Transport in Moncton, N.B., as an electrical engineer. He was formerly with Canadair Limited at Montreal and with Trenton Steel Works, Trenton, N.S.

Mr. Cameron graduated from Nova Scotia Technical College, class of 1951 in electrical engineering.

J. B. Palmer, JR.E.I.C., has been transferred by the Socony Vacuum Oil Company from Edmonton to Drayton Valley, Alta.

He graduated from the University of British Columbia in mechanical engineering in 1952.

M. B. Ferman, JR.E.I.C., is now with the Aluminum Company of Canada in Montreal. He is employed in the general engineering office with the structural squad.

Mr. Ferman, who is a civil engineering graduate of the University of Alberta, has previously been associated with Burns and Dutton Concrete and Construction Co. Ltd. in Calgary, Alta., and with Superior Masonry Products Ltd. of Lethbridge, Alta.

Gordon C. McCausland, JR.E.I.C., is field engineer with Nova Scotia Light and Power Company Ltd. in Halifax, N.S.

Mr. McCausland is a 1952 graduate in civil engineering from Nova Scotia Technical College.

John H. Chauvin, JR.E.I.C., has recently joined the staff of G. J. Hamilton Ltd. at Vancouver as machine shop manager and plant engineer. He was previously with the Corps of Engineers (U.S. Army) at Goose Bay, Labrador, as mechanical engineering inspector.

Mr. Chauvin graduated from McGill University in mechanical engineering, class of 1953.

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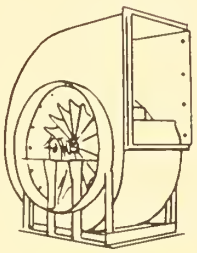

Regardless of the type of project, if it involves air handling, pumping or heating, "Canadian Buffalo" services can complement your services at all stages from original design, through construction to final installation and operation.

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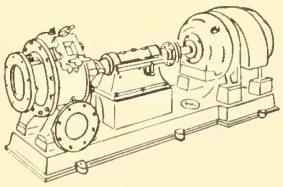
Reasonable price, service and ability to work well within deadlines is the co-operation "Canadian Buffalo" offers to contractors.



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D. K. Chapman, JR.E.I.C., has joined the staff of the Hamilton Gear and Machine Company Ltd. in Toronto. He graduated from the University of Manitoba, class of 1953, in mechanical engineering.

Jacques J. Paquin, JR.E.I.C., has joined the construction engineering department of Shell Oil of Canada Ltd. in Montreal East.

Mr. Paquin is a civil engineering graduate of McGill University, class of 1953.

Michael R. Thompson, JR.E.I.C., who was formerly associated with Price Brother and Company Ltd. at Kenogami is now with Dominion Structural Steel Ltd. in Montreal.

Mr. Thompson graduated from the University of Toronto with a degree in mechanical engineering in 1953.

W. E. Boresky, JR.E.I.C., is now employed as a structural draftsman with H. A. Simons Ltd., Consulting Engineer, Vancouver, B.C.

Mr. Boresky, who is a graduate in civil engineering from the University of British Columbia, class of 1953, was previously associated with Int. Pacific Salmon Fisheries at Vancouver.

Robert F. Wade, JR.E.I.C., who has been with Price Brothers & Company Ltd. in Riverbend, Que., has recently moved to the United States and is now associated with the John W. Rouse Construction Corp. in Gouverneur, N.Y., as project manager.

Mr. Wade graduated from Nova Scotia Technical College with a degree in civil engineering in 1949.

Edward J. Gilbert, JR.E.I.C., has joined the staff of the Royal Bank of Canada in Montreal, Que., as an electrical and mechanical engineer.

Mr. Gilbert was formerly connected with J. P. Keith & Associates in Montreal.

He is a 1950 graduate from McGill University in electrical engineering.

W. R. Tims, JR.E.I.C., is now employed as department chief in manufacturing methods of the wire and cable division of Northern Electric Company Ltd. in Lachine, Que.

A 1950 graduate from the University of British Columbia, Mr. Tims was formerly a power cable design engineer for the same company.

Joseph Clayton Anderson, JR.E.I.C., is now employed by A. D. Margison & Associates Ltd. in Toronto. Before his move to Toronto, Mr. Anderson was with Anglin Norcross Corporation Ltd. in Montreal, engaged in field engineering work.

A 1950 graduate of McGill University in civil engineering, Mr. Anderson has also been connected with R. E. Stewart Construction Corporation in Sherbrooke, Que.

J. N. Schilizzi, JR.E.I.C., has joined the staff of the Aluminum Company of Canada in Arvida, Que. He was previously with Shawinigan Chemicals Ltd. in Shawinigan Falls, Que.

Mr. Schilizzi graduated from Ecole Centre des Arts & Mfr. in Paris in 1950.

P. E. Desserud, JR.E.I.C., has joined Sprostons (Jamaica) Limited in Jamaica, B.W.I.

Mr. Desserud, who graduated from McGill University in civil engineering, class of 1952, was previously with the

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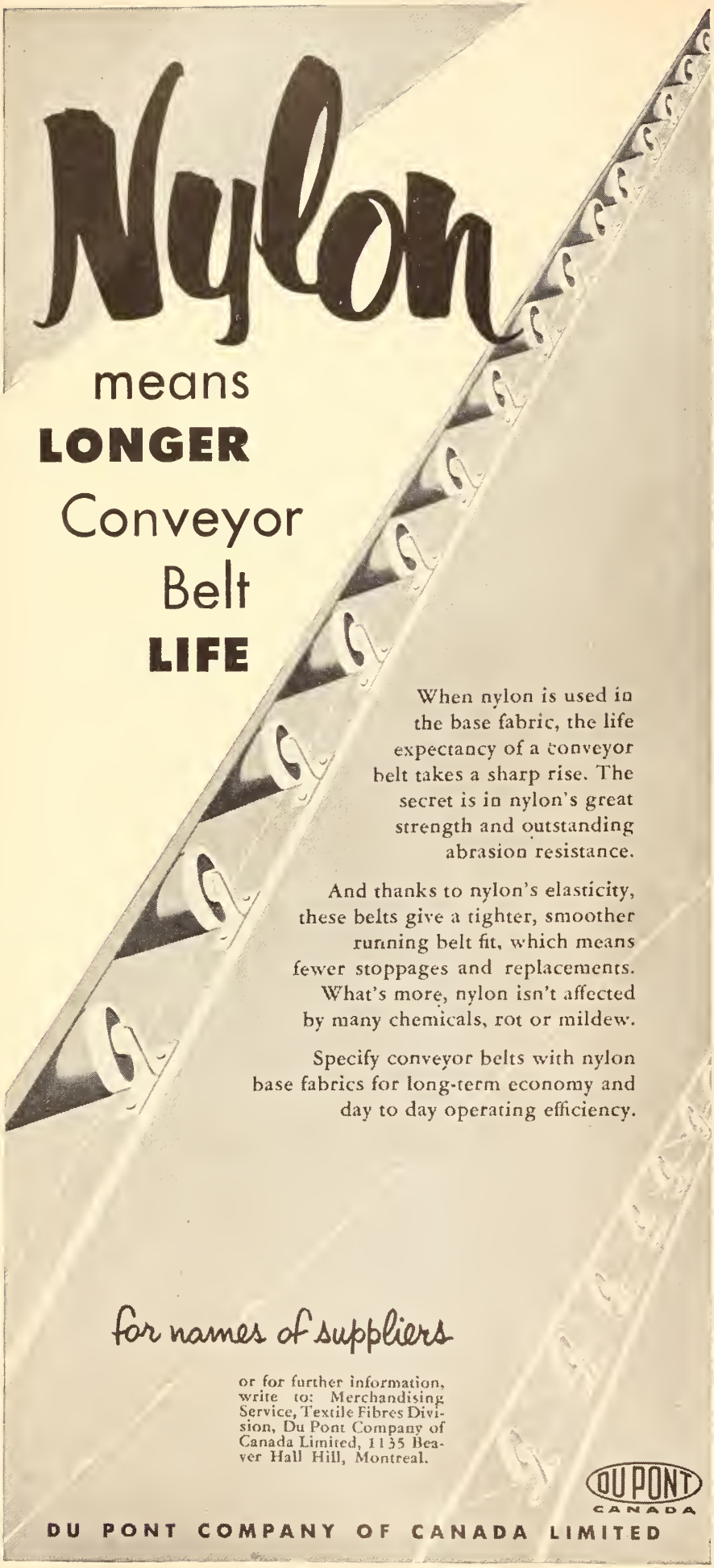

Aluminum Company at Arvida, Que., and Montreal.

Laurent B. Gendreau, JR.E.I.C., is now located in Ottawa as a mechanical engineer with the Naval Technical Services, Department of National Defence. He was previously with Sorel Industries Ltd. at Sorel, Que.

He graduated from Ecole Polytechnique in mechanical and electrical engineering in 1952.

Guy Gauthier, JR.E.I.C., is with the Dominion Steel & Coal Corporation in Montreal. He is employed as a combustion engineer in the coal sales department.

Mr. Gauthier graduated from Ecole Polytechnique in 1952 with a degree in chemical and metallurgical engineering.

A. P. Kilroy, JR.E.I.C., formerly with the Corps of Engineers of the United States Army in Goose Bay, Labrador, has joined the staff of Racey MacCallum & Associates in Montreal, Que.

Mr. Kilroy graduated from Trinity College, Dublin, in 1952. He has also been connected with the Department of Works, City of Toronto.

A. G. Morris, JR.E.I.C., has been named superintendent of manufacturing for the Canadian Westinghouse Company's lighting department at Granby, Que.

A chemical engineering graduate of McGill University, Mr. Morris joined Westinghouse in 1953 and following work in time study became a lighting method engineer last year. He has also been associated with Vulcan Iron & Engineering Ltd. in Winnipeg, Man., and with E. F. Drew & Company in Montreal.

R. W. Goldie, JR.E.I.C., has been appointed a director and chief engineer of Richard & B. A. Ryan Ltd. in Montreal. Mr. Goldie joined the company in 195 as assistant general superintendent.

He is a civil engineering graduat from McGill University, class of 195

Michael V. Spence, JR.E.I.C., is no junior engineer in the meter and rela section of the Hydro-Electric Powe Commission of Ontario, western regio at London, Ont. He was formerl located in Toronto with the company

Mr. Spence graduated from the Uni versity of Toronto in 1953 in electrica engineering.

Jean Blouin, S.E.I.C., was recently ap pointed to the Montreal office o Ferranti Electric Limited as assistan to Charles E. Begin, manager of sale for the Quebec district.

Mr. Blouin joined the company upo graduation from Ecole Polytechnique i mechanical and electrical engineering i 1954.

In 1953 he was awarded the Stude Prize of the Engineering Institute.

Gordon K. Yetman, S.E.I.C., has bee transferred to Toronto by the Contin ental Can Company of Canada fro Montreal. He is employed as an indu trial engineer with the company.

Mr. Yetman graduated from McGi University in mechanical engineering 1954.

Philip Ashbaugh, S.E.I.C., has joined th staff of the Atomic Energy Plant Deep River, Ont.

Mr. Ashbaugh graduated from Queen University, class of 1954, in chemic engineering.

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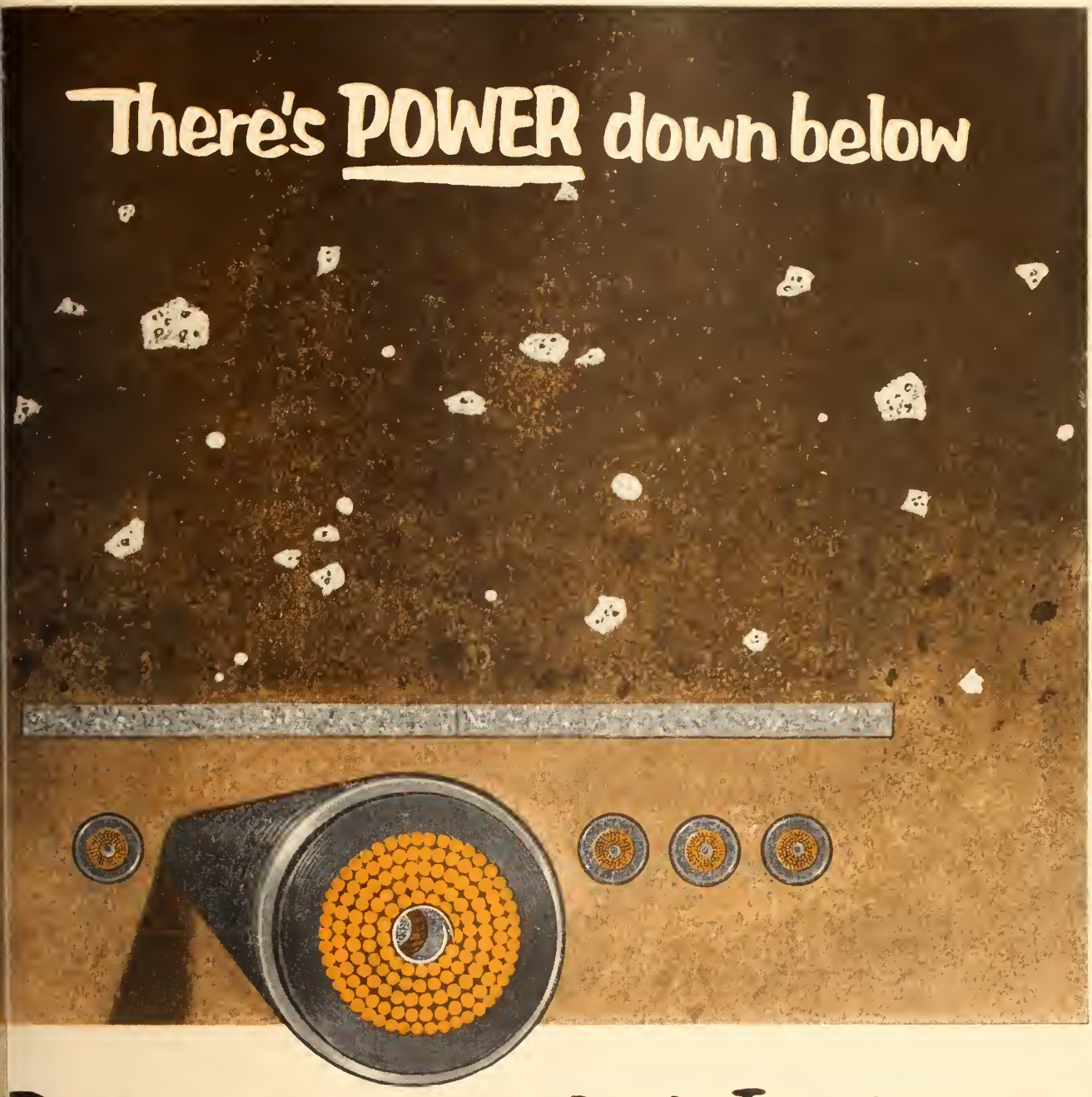

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Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS WANTED

MECHANICAL-ELECTRICAL ENGINEER, P. Eng. Jr.E.I.C., Polytechnique 1948, fluently bilingual, married with two children. 2½ years engineer draughtsman, equipment installation and plant services layout; 4 years plant engineering, supervising chemical plant electrical and process instrumentation design, construction and maintenance, equipment preventive maintenance program, pressure vessel work, safety and fire protection. Experience includes industrial electronics, hydro-electric sub-stations distribution and relay protection. Desires responsible position in Montreal area. File No. 1097-W.

INDUSTRIAL ENGINEER, Jr.E.I.C., B.A.Sc., Toronto 1950. Excellent background of Industrial Engineering experience having specialized in the installation and maintenance of various systems of wage incentive. Specifically occupied with time study, job evaluation, methods and cost reduction proposals. Particularly conversant with the Budgetary Control System. Qualified to move on to position of greater responsibility with progressive Southern Ontario or Quebec company, providing greater opportunity for advancement. Single, 32, car owner, willing to travel or re-locate. Fluently bilingual. Post-graduate courses. Available on one month's notice. Resume on request. File No. 1721-W.

GRADUATE ENGINEER, 1945, age 32, bilingual, diversified industrial experience combined with sales engineering in various fields such as pneumatic process instrumentation, chemicals, fuels. Excellent knowledge of all aspects of fuel utilization, combustion, heating, steam and power plant engineering. Seeks technical position with Canadian basic industry in sales, service or manufacturing. Montreal resident, but will locate anywhere. File No. 2554-W.

ELECTRICAL AND MECHANICAL ENGINEER, B.Sc., (Elect.) Alberta 1936, M.E.I.C., Canadian born, experience in Alberta and Quebec as follows: 4½ years oil refinery maintenance and construction and process instrument maintenance; 8 years public utility, of which 4 years high voltage substation design and operation and 4 years re operation and extension of town waterworks systems; 7 years electrometallurgical plant, of which 2 years as electrical engineer and 5 years as works engineer and purchasing agent re bulk material handling, conveying, elevating, drying, furnacing, crushing, screening, dust collecting. File No. 3028-W.

MECHANICAL ENGINEER, M.E.I.C., with 12 years experience in the design, construction, operation and management of a wide variety of process plants across Canada. Seeks interesting and challenging job preferably located in Montreal. Good organizer, age 34. File No. 3405-W.

GRADUATE ENGINEER, age 32, married, no children. Four years experience in heavy industry production control and planning last three as division production manager in a large Canadian firm. Desires employment of a similar nature with opportunities for advancement. File No. 3424-W.

MECHANICAL ENGINEER (M.E.I.C.), age 36 married. Experience 2 years designer draftsman, 3 years industrial engineering methods and production control. Trained in time and motion study and certificate as MTM practitioner. Desires responsible position in industrial engineering methods or plant management. File No. 3900-W.

CIVIL ENGINEER, Jr.E.I.C. (McGill) with 4 years experience on highway construction, surveys, soils and foundation engineering for bridges and heavy structures wishes employment with a small company undertaking construction of bridges, buildings and roads. File No. 3988-W.

CIVIL AND INDUSTRIAL ENGINEER, B.Sc., P.Eng., M.E.I.C., age 31, married. Experienced in planning of major industrial expansions and plant improvements, including reports, estimates, and design (civil and mechanical). During 5 years in pulp and paper industry, reaching supervisory capacity, have obtained broad office and field experience in diversified structural design, plant engineering and organization. Have done extensive studies in concrete mix designs and concrete structures. Seeks responsible position with industrial organization. Locate in any major city in Canada. File No. 4171-W.

GRADUATE ENGINEER, B.Sc. 1951, Jr.E.I.C., P.Eng. (Ont.) age 26, married. Two years experience with consultant on municipal projects and two years mechanical handling seeks position in mechanical handling, plant engineering or general industrial engineering. File No. 4207-W.

PROFESSIONAL ENGINEER, consulting, academic, food, beverage industries, 36, B.A.Sc. electrical, M.S. mechanical engineering, power field (3), University lecturing (3), consultative capacity preliminary survey, design, erection, supervision, refrigeration cold storage plants, breweries, air conditioning systems, processing, industrial in Canada, South America, Asia (5). Working knowledge French, Spanish, German. Willing to travel or relocate, no preference to location, domestic or foreign. File No. 4240-W.

EXPERIENCED MANAGER, A.M.I.Mech.E., M.E.I.C., A.M.I.prod.E. 16 years experience in England. Engineering and manufacturing telecommunications aircraft and domestic refrigeration. Full apprenticeship served. Tooling, methods and plant layout. Presently completed 12 months tour of U.S. plants, and wishes to return to Canada in position of responsibility. Minimum commencing salary $7,500. Detailed resume on request. File No. 4356-W.

CIVIL ENGINEER, 35, Veteran, married with two children, Jr.E.I.C., P.Eng., B.Sc., with 5 years varied experience—1 in design, 1 in supervising building construction and 3 in management seeks responsible position in Western Canada. Would prefer Junior partnership or associateship. File No. 4358-W.

INDUSTRIAL SALES ENGINEER, graduat mechanical engineer, senior, experience i diversified machinery and tools, good ap pearance and personality, bilingual, seek position only in the industrial sales fiel suitable to qualifications and possibilities, o salary and commission basis. File No. 4300-W

SALES ENGINEER four years experience i technical sales promotion, advertising, cata logue writing, marketing, and administratio Chemical engineer, P.Eng. (Que.), Jr.E.I.C University of Saskatchewan 1950. Age 2 married. Seeking interesting, responsible sale position. File No. 4516-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng B.A.Sc. honours degree, electrical engineerin University of Toronto 1950. One year e perience in municipal engineering, one yea with industrial electrical contractor as fiel engineer on construction. Three years e perience in paper and board industry, oper tion, maintenance, construction, hydroelectr plant operation. Seek position in heavy i dustry or manufacturing. Would locate in or month in Canada. File No. 4545-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng N.S.T.C. graduate 1951. Four years experienc in development and design. Available o reasonable notice. File No. 4559-W.

MECHANICAL ENGINEER age 33, marrie no children, University of Toronto 1943, ve eran. Ten years industrial experience, fou years design, engineering, manufacturin production and purchasing, six years appl cation, marketing, sales and service. Exper ence covers power plant equipment, pump feed water conditioning apparatus, boiler co trols, materials handling equipment, electr hydraulic and pneumatic control system petroleum products, mining machinery ar power transmission machinery. Presently em ployed but desire challenging work for a gressive firm with opportunity for admini trative and or management career in sale service or manufacturing. Would prefer O tario, Alberta or British Columbia. Partic lars willingly supplied to interested emplo ers. File No. 4604-W.

MECHANICAL ENGINEER, M.E.I.C., age married. 10 years experience in draftin piping layouts, estimating, inspection a plant maintenance in petroleum refinery. I sires position in industrial plant or refine Location Alberta or British Columbia interi Available on one month's notice. File N 4637-W.

CHEMICAL ENGINEER, P.Eng., M.E.I. graduated from the Polytechnic Institute Bucharest, Rumania 1949. 31 years old, ma ried, two children. Experience one year Professor Assistant at the University in R mania, one year as chemist in Greece wi textile company, one year with soap co pany in Canada, two years with a chemic company in Canada. Desires position in To cnto area. Available on one month's notic File No. 4692-W.

MECHANICAL AND METALLURGICAL ENG NEER, P.Eng., graduate 1946, age 36, vari

experience; mechanical design, materials and processes, heat treatment, casting, forging, welding, sales. Presently employed as executive responsible for technical and administrative problems. Seeks senior position with wide scope for initiative. File No. 4693-W.

ELECTRICAL ENGINEER, Jr.E.I.C., McGill 52, presently employed, experience includes utility and power project work, switchgear and control design, and contracts, industrial rectifier sales, and control work on D.C. drives. Interested in consulting or manufacturing in or around Montreal and would be available on one month's notice. File No. 4694-W.

ELECTRICAL ENGINEER, P.Eng., Jr.E.I.C., age 29, married. 3½ years sales experience, 2 years installation and maintenance electrical equipment in mines. Toronto area preferred. File No. 4698-W.

MANAGEMENT MEN. Can you use an electrical engineer, P.Eng., Jr.E.I.C. Assoc. Mem. A.I.E.E., B.Sc.E.E. 1949, who offers an excellent switchgear application background coupled with aggressive sales and administrative ability. Test course graduate. Age 28, married. Recently completed two years of evening discussion courses in Business Management. Currently employed in responsible supervisory sales capacity with large manufacturer. Capable of contacting and negotiating effectively at management and executive levels. All replies will be given careful consideration. Please reply to File No. 4699-W.

GEOPHYSICIST, graduate of engineering physics University of Toronto, Jr.E.I.C., age 27, married, one child, with three years experience in magnetic and electromagnetic surveys desires employment with future leading to position of responsibility not necessarily in geophysics. File No. 4703-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng., with 7 years' experience including manufacturer's test course, industrial control design, industrial apparatus application engineering, and engineering management, graduate Queen's, Canadian born, desires permanent position with opportunities for advancement in return for hard work and proven ability. File No. 4705-W.

CIVIL ENGINEER, Jr.E.I.C., M.Eng., McGill, age 34, 5 years diversified experience includes 2 years experience in laboratory testing soils, steel and concrete, and concrete design, 2 years R.C. and pile foundation design, reviews R.C. and steel structures, soil investigations and soil reports. Pressure vessel designs. Has aptitude for report writing and indeterminate structural problems. Seeks employment with consultant, growing firm or growing construction company where knowledge, ability and hard work will eventually lead to responsible position or partnership. File No. 4706-W.

MECHANICAL ENGINEER, 26, Canadian citizen, Canadian degree, varied experience in Canada, British heavy engineering training under Athlone Fellowship. At present in heavy Swiss engineering plant. Working knowledge of French and German, experienced traveller, single. Seeks to use experience to best advantage upon return to Canada in September. File No. 4709-W.

METALLURGICAL ENGINEER, Jr.E.I.C., B.A.Sc., 1952, R.C.A.F. veteran, married. Employed since graduation in materials department of large manufacturing firm; engaged chiefly in selection of materials and processes, enquiry into new materials and processes, collection of data, specification writing, etc.; small amount of shop and laboratory experience. Good background of industrial experience before graduation. Seeking employment in a metallurgical industry or closely related field. Opportunity to assume increasing responsibility with increased experience is an important consideration. File No. 4710-W.

CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.), Queen's 1949, desires supervisory position with contractor or consultants on engineering, highway or heavy building construction. Location Canada, Ontario preferred. Experience in construction, industrial engineering and technical sales. Able administrator. Age, 36, married, two children. File No. 4712-W.

MECHANICAL ENGINEER 1943, McGill, desires position of senior responsibility in design, project, development or plant maintenance. Past experience: 2 years engineering teaching; 10 years on plant layout, machinery foundation, design of process piping, plant services, steam plants, combustion work, industrial furnaces, structural design, building construction, field supervision. Also holder of B.A. degree, married, 2 children, and thoroughly bilingual. File No. 4713-W.

ELECTRICAL ENGINEER, B.Sc., P.Eng. (Ont.), Jr.E.I.C., age 40, 1951 graduate, plant engineering, instrumentation, and administrative experience, seeks position in engineering sales. File No. 4714-W.

CIVIL ENGINEER, Jr.E.I.C., P.Eng., graduate N.S.T.C. 1952, age 27, married. Three years experience with construction company mainly in field work and supervision of residential and heavy construction projects. One year in residential construction including housing, reinforced concrete, streets, water and sewer lines, sewage disposal plant, central heating. Two years experience in heavy construction on large mass concrete lock project including steel piling cofferdams, earth and rock excavation. Good references available. Desires responsible position with opportunity for advancement. File No. 4715-W.

CHEMICAL ENGINEER, B.Sc. Alberta, 1948, Jr.E.I.C., married. Seven years experience in development and production in metallurgical industry. At present in charge of development group working closely with production. Capable of carrying production problems to completion with a practical viewpoint. Have had recent experience in new plant start up in foreign country. Desires position leading to responsibility, in Western Canada or Ontario. Available August. File No. 4716-W.

GRADUATE ENGINEER, Civil, Jr.E.I.C., McGill 1950, with extensive experience in railroad maintenance and considerable experience in allied works desirous of obtaining employment anywhere. Would seriously consider municipal engineering. Available on reasonable notice to present employer. File No. 4718-W.

ENGINEERING PHYSICS, M.E.I.C., B.Sc. (Sask.) 1946, age 32, married, one child. Three years research and development; one year materials handling; 5 years chief engineer large Western municipality. Considerable top level experience on planning, design and construction of: roads, sewers, dykes and drainage, waterworks, town planning, budget preparation and control, purchasing, and personnel work. Locate anywhere in Canada in an interesting and challenging position. File No. 4719-W.

MECHANICAL ENGINEER, M.E.I.C. & P.Eng. Ontario. Age 46, married. Eleven years diversified experience in design and development engineering in oil refinery and chemical plants including power house and process piping design. Eleven years in plant engineering in the plastics and chemical industry. Accustomed to dealing with management and personnel (technical and otherwise). Capable of organizing and administering. Interested in a position where capabilities will be fully utilized, and opportunity for advancement is available. File No. 4720-W.

SALES ENGINEER, young graduate mechanical engineer having acquired three years of sales experience with international precision machine tool corporation. Interested in position as sales representative involving responsibility and challenge in specialized technical field. 29, single, Canadian citizen presently residing in U.S.A. File No. 4721-W.

MECHANICAL ENGINEER, Jr.E.I.C., graduate from University of Denmark 1950, 32 years old, married. Two years manual shop experience. Five years experience in mechanical and structural design, materials handling, plateworks, heavy machinery, maintenance and development. Three years in Canada. Desires position with responsibility and opportunities. Available on one month's notice to present employer. File No. 4723-W.

ELECTRICAL ENGINEER, B.A.Sc., 1945, P.Eng., M.E.I.C., age 31, married with family, C.G.E. test course, presently employed. Excellent technical and practical background combined with administrative experience including 7 years complete charge of electrical engineering, design, construction, operation, and maintenance of large papermill and hydro electric stations including water control, transmission, relaying, and distribution. Other experience includes substation, illumination design and sales. Desires position in Canada or elsewhere with heavy industrial, power or consulting company where experience will be an asset. File No. 4725-W.

METALLURGICAL ENGINEER, Jr.E.I.C., returning to Canada in December after two years in England on an Athlone Fellowship. B.Eng. McGill 1953, Diploma in graduate studies (industrial metallurgy) Birmingham, 1954. One year experience in a British steel plant, mostly in the melting shops (open hearth and electric furnaces). Undergraduate experience in nickel, copper and aluminum industries. Desires work in metal industry, preferably connected with production. Location open. File No. 4726-W.

CHEMICAL ENGINEER, Jr.E.I.C., M.A.Sc. U.B.C. (1953), Ph.D. (expected) Cambridge. Research experience in physical, radio, and radiation chemistry. Returning to Canada in October. Desires research or development work. Details furnished on request. File No. 4731-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng., 4 years experience in precision tool and machine design. 6 years engineering department supervision. Both since graduation, Queen's 1945. 7 years toolmaker's apprenticeship in automotive parts plant prior to entering university. Married, 2 children. Age 40, Canadian born. Desire permanent position in reliable firm or government agency. File No. 4732-W.

ELECTRICAL ENGINEER, P.Eng. Quebec, B.A.Sc. 1949 Laval University, test course, age 28. Four years experience in sales of electrical apparatus, motors, controls, switchgear, metallic rectifier specialist, some knowledge of water conditioning. Two years with electrical contractor and motor repair shop, layout, estimate, supervision of industrial electrical installations, technical and administrative responsibility for service shop. Seeks challenging position with advancement and incentive for consulting engineers or contractor. File No. 4733-W.

YOUNG CIVIL ENGINEER, A.M.I.C.E., Jr. E.I.C., married, one child. Three years highway and bridge design (England), three years R.C. and steel, bridge and structural design (Canada). Desires interesting and responsible position in British Columbia, will consider other Western provinces. File No. 4734-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. Toronto, graduate 1950, age 31, married, one child. R.C.A.F. aero engine mechanic 4 years. Wishes to offer training and experience in: pipe manufactures sales office ½ year, plant engineering 1½ years, test and development of combustion engines including design and liaison with all company departments involved in procurement and manufacturer of test models 3 years. Desires work in sales or a position in industry where initiative and the ability to get a job done will lead to an executive position. Prefer Niagara or Southern Ontario. File No. 4735-W.

CIVIL ENGINEER graduate of London University 1937, P.Eng., M.E.I.C., M.Jnr.Ins. Engineers, age 40 with the following experience: 10 years on design, estimating and construction, 2 years in supervisory capacity and 4 years in administrative post, requires post in Ottawa locality. File No. 4736-W.

CIVIL ENGINEER, Dipl.Ing., Jr.E.I.C., 37 and married, European University graduate, seeks permanent employment as design engineer with well established consulting firm. European experience: 4 years factory construction and hydraulic calculation in hydroelectric power field. Experience in Canada: 2 years engineering design of commercial and industrial buildings, involving design of foundations, R.C.—steel and wood structures. Excellent references. Presently in permanent position. Preferred location in Western Canada. Available one month after agreement is reached. File No. 4737-W.

MECHANICAL ENGINEER, Jr.E.I.C., Canadian University graduate, 25, with 2 years experience in heavy engineering design. Mother tongue English, reasonably fluent French, some German. Presently living abroad, desires employment in machine tool sales, service, or field engineering with Canadian Machine Tools. Training period in Canada, or on the continent considered. Available on reasonable notice to present employer. Reply File No. 4740-W.

MECHANICAL ELECTRICAL ENGINEER, P.Eng., Jr.E.I.C., B.A.Sc. (Hons.) Toronto 1951. Four years field engineering (Sales) with prominent electrical manufacturer. Promotion and representative duties. Electrical layout and estimating for application and usage of electrical distribution and motor control equipment. Administrative and associated duties. Desire position offering supervisory experience with scope for initiative. Further details upon request. Travel not objectionable. Would locate in one month. Prefer S.W. Ontario, Western Canada or U.S.A. File No. 4741-W.

CIVIL ENGINEER, M.E.I.C., University of New Brunswick 1933. Experience includes considerable travel in Maritime Provinces, Newfoundland and Ontario. Fully acquainted with many phases of construction and complete knowledge of concrete design and laboratory testing. Seeks opportunity where diversified experience could be best utilized. Not adverse to travel. File No. 4742-W.

ADMINISTRATIVE POSITION sought by young (29) bilingual, mechanical engineer, Jr.E.I.C., M.B.A., married. Retired naval engineering officer. Five years industrial experience in technical sales, industrial engineering and maintenance supervision. Willing to relocate anywhere in or outside Canada. Resume sent on request. File No. 4743-W.

MECHANICAL ENGINEER, Jr.E.I.C., B.Eng. (1948), M.Eng. (1950) Ph.D. (1953), McGill, single, age 28. Experience includes three years on a Canadian coal-burning gas turbine re-

"We, reposing especial Trust and Confidence in your Loyalty, Courage, and good Conduct..."

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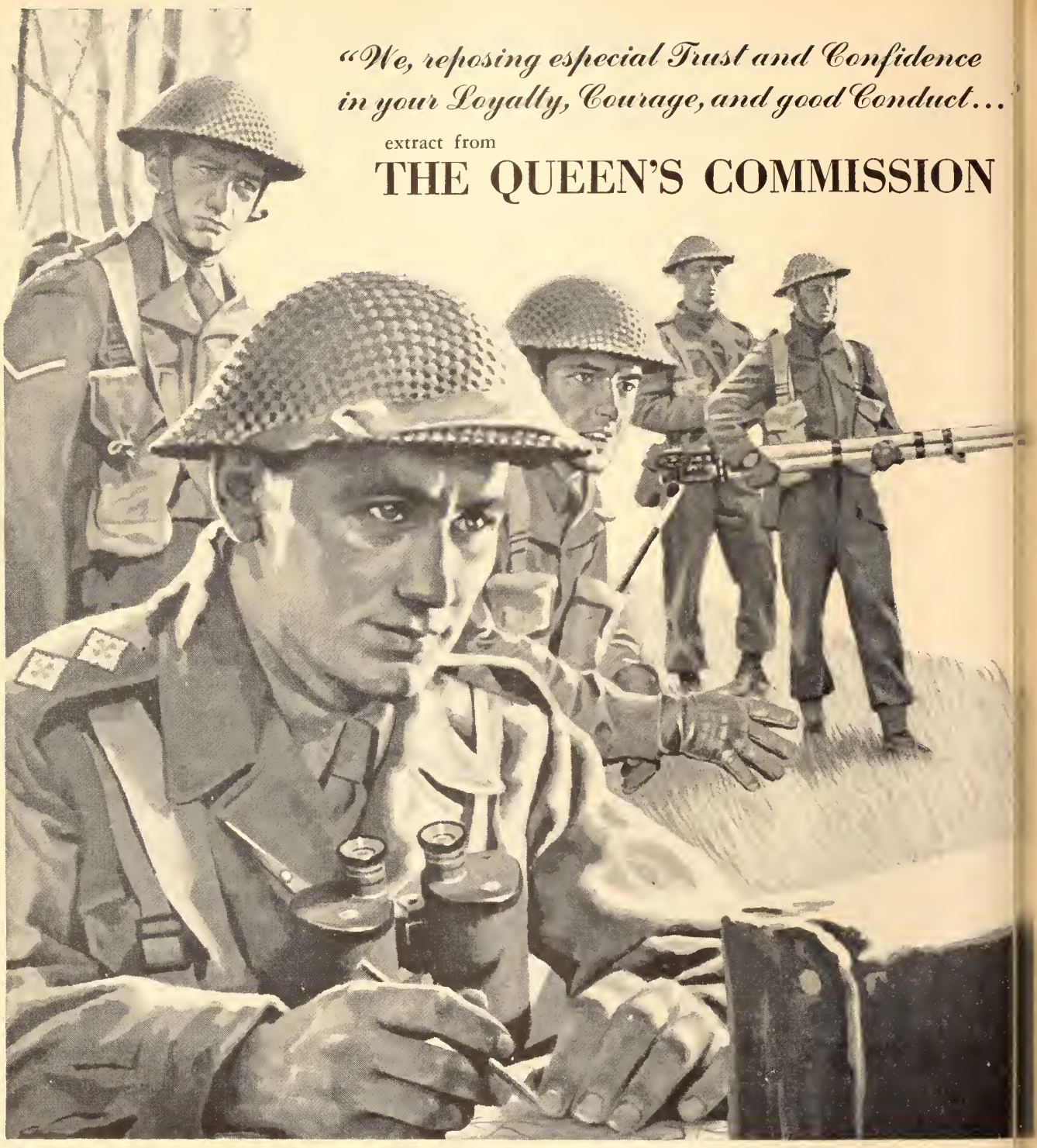
THE QUEEN'S COMMISSION



The Queen's Commission in the Regular Army opens a career of unusual importance, challenge and opportunities.

It offers many rewards. The financial returns, the pension plan, the opportunities for advancement match, and in some ways, exceed those of any civilian profession or career. However, no one can measure the many intangible rewards of a leadership career in the service of Queen and country.

The Army trains suitable young men for Commissions. It also provides facilities for further study and training for advancement. But the officers' personal abilities determine how high they will rise.

There are special opportunities and need for graduate engineers in The Royal Canadian Engineers, The Royal Canadian Corps of Signals, The Royal Canadian Electrical and Mechanical Engineers.

For full information on any aspect of an Army Commissioned Career, write, phone or visit the Army Recruiting Station nearest your home or write:

Directorate of Manning,
Army Headquarters, Ottawa, Ont.

search and development project, involving thermodynamic and heat transfer analysis, stress analysis and mechanical design. Has also spent one summer on a similar American project. Has done research in heat transfer and gas turbine combustion. At present teaching thermodynamics and machine design at an eastern Canadian college. Desires position in industry where qualifications may be utilized. Available on short notice. File No. 4744-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.) B.A.Sc. University of Toronto, 1949. Age 30, married with 2 children. 3 years experience as electrical/mechanical field engineer in steam and power plant responsible for operation and maintenance of associated equipment, supervision of new construction, liaison with consultants and contractors, etc. 2 years electrical design experience covering building power and lighting, design for new boiler installation, petrochemical plant electrical design, etc. 1 year experience in administration of large construction and building program. Seeks responsible, permanent position with good future and scope where experience can be utilized. File No. 4745-W.

SITUATIONS VACANT

CHEMICAL

PETRO CHEMICAL, CHEMICAL AND PETROLEUM ENGINEERS and constructors require engineers, designers and draftsmen with experience in the above fields, for their engineering design office in Southern Ontario. Please reply with brief details of experience, academic qualifications and salary. File No. 5140-V.

RESEARCH ENGINEER, required by Sask. department of Mineral Resources. Salary range $326-$397 per month. Requirements recent graduate in ceramics, chemical or geological engineering, to carry out lab and pilot scale experimental work, field exploration, and economic survey dealing with the non-metallic or industrial minerals of the Province. Good pension plan and conditions of employment. For further information and application forms contact P.S.C. Legislative Bldg., Regina. File No. 5154-V.

CHEMICAL ENGINEERS, young, with a few years practical industrial background in chemical or allied fields together with sales experience, required as technical representatives. World wide concern offers processes and equipment to a broad industrial market. Salary is open, car provided. Location Ontario and Quebec. File No. 5156-V.

CHEMICAL ENGINEER with 3 to 5 years experience, preferably in chemical plant process engineering and/or operations, for process engineering work, plant located 25 miles from Montreal. File No. 5161-V.

A CHEMICAL ENGINEER required for development work in latex and solvent adhesives. Experience in this field an asset but not essential. The field is expanding and offers good opportunities. Location Montreal. Replies will be treated in confidence. File No. 5173-V.

A CHEMICAL ENGINEER will be required to assist our salesman. He should preferably have some experience in the latex field. He should have some imaginative ability in order to recognize and be able to apply new uses to our growing list of products, as related to the construction industry. A period of training will be offered to a recent graduate in chemical engineering, or to someone with 2 or 3 years industrial experience. Offices in Montreal. File No. 5173-V.

CHEMICAL SALESMAN for Montreal area to represent an established manufacturer of fine chemicals, offering a wide range of products reinforced by intensive research and development policies. Primary responsibility will be industrial accounts. Preferred qualifications include technical degree, several years experience in field work, ability to plan and execute without close direction, age under thirty-five, own automobile. Liberal employee benefits, salary commensurate with qualifications. Replies will be held in confidence. Please submit full details of training and experience by letter only to File No. 5195-V.

TWO SALES ENGINEERS wanted with plant maintenance experience preferred, but not necessary, to sell corrosion resistant cements, coatings, pipes, tanks etc. We prefer chemical engineers and require one each for Quebec and Ontario. Salary and expenses plus profit sharing. File No. 5199-V.

ATOMIC ENERGY OF CANADA LIMITED has openings for chemical engineers for their expanding program on atomic power development. The work will be mainly the development of full preparation and processing methods, cost analysis and equipment development. Candidates must have a good academic background, preferably with some graduate training. Some industrial experience is essential. The responsibilities and salary depend on the qualifications of the candidate. State particulars including age, marital status, education and experience in first letter. File No. 5206-V.

CHEMICAL ENGINEER required by large beverage company located in Montreal. Laboratory is mobile and duties include considerable travel to plants in Quebec and Ontario testing quality control of the product which involves water analysis, product analysis, bacteria counts and the physical examination of the machinery and plant. Preferably single, man age 24-25 years. File No. 5223-V.

TWO GRADUATE CHEMICAL ENGINEERS or chemists required for a newsprint and specialty mill, located in Province of Quebec. Some experience in pulp and paper desired but not essential. Excellent opportunity for advancement. Salary dependent on experience and ability. Initial letter to include full resume of experience and references. File No. 5231-V.

CIVIL

CIVIL ENGINEER preferably recent graduate, for bridge section of large transportation company with headquarters in Montreal. Duties include design for steel and reinforced concrete structures preparation of reports and some travelling. File No. 5127-V.

CONSTRUCTION SUPERINTENDENT excellent opportunity for top flight man with a proven record of successful jobs completed in the chemical or petro chemical field. Ability to organize and administer large projects including cost control, lahour relations, stores, field supervision, together with a good technical and practical background. Applicant should have 10 years experience in construction field. Vacancy open with major petrochemical and petroleum engineers and constructors. Please reply with experience and salary expected to File No. 5139-V.

CIVIL ENGINEER. Canadian graduate preferably—minimum 3 years recent design experience in R/C bridge and highway required. Previous experience in industrial building design considered useful. Work in Windsor, Ontario. File No. 5155-V.

CIVIL ENGINEER, young Canadian graduate, 2 years maximum for academic design engineering related to steel and concrete support of equipment, pipes, etc. Work in Sarnia. File No. 5155-V.

TWO GRADUATE CIVIL ENGINEERS for consulting firm engaged in large scale development projects. One to three years experience in design and supervision of roads, sewerage systems, water distribution systems, etc. required. Please reply giving full details of academic training and professional experience, references and salary requirements. File No. 5163-V.

CIVIL ENGINEER required by general contractor to administer a group of contracts distant from the firm's head office which is in Quebec. Applicant must have experience in all phases of general contractors' operations and be not less than about 30 years of age. The administrator would be domiciled in Quebec or the Maritime Provinces. Applicants must state salary expected. File No. 5176-V.

CIVIL ENGINEER required by Provincial Government Department with headquarters in Toronto. To assist in the design and construction of small timber and concrete dams and maintenance and operation of locks and dams etc. throughout the Province of Ontario. Applicant should have experience in the construction of timber and concrete dams. Salary can be arranged to meet qualifications. Permanent position with illness, vacation and pension privilege if applicant proves satisfactory after a trial period. File No. 5180-V.

ARCHITECTURAL DESIGN, structural engineers and draughtsmen required for long range industrial program in an established consulting office. Must be experienced and capable of checking design drawings. Draftsmen experienced in structural steel detailing. Send complete resume of experience. Location Toledo, Ohio. File No. 5181-V.

ESTIMATOR QUANTITY SURVEYOR, required by construction company in Ottawa. State qualifications, age, marital status, experience, salary expected. Replies will be treated confidentially. File No. 5187-V.

CIVIL ENGINEER (Junior) required by established puhlic utility supervisory-consulting organization, 2-3 years experience, preferably in field on construction and or surveying, for work connection design and operation hydro systems also structural, foundations for steam and diesel plants. Location New York. Some travel field future. Reply stating age, education, experience, personal particulars, minimum salary expected. File No. 5193-V.

MUNICIPAL ENGINEER required by Montreal suburb. Graduate engineer with two or more years experience in layout and supervision of watermain and sewage extensions, street and sidewalk construction. Reply stating age, experience, education, salary expected and telephone number to File No. 5203-V.

ENGINEER, ARCHITECT OR ESTIMATOR wanted for young construction company doing sewers, roadwork and building. Apply stating age, experience, references and salary expected. File No. 5205-V.

CIVIL ENGINEER with a minimum of 4 years experience in supervision and design of heavy

SALES ENGINEER

We require a sales engineer to sell communications equipment in the Montreal area. Applicants must be bilingual and have an extensive electrical background. Above average remuneration on a base salary, plus commission arrangement. Car, company benefits and excellent future with expanding company.

Apply by letter to:

Mr. F. A. Callier

Rogers Majestic Electronics Limited,

11-19 Brentcliffe Road,

Leoside, Ontorio.

SPERRY GYROSCOPE COMPANY OF CANADA Ltd.

requires

ENGINEERS

For development in connection with telephony, magnetic amplifiers, radar, tronsistor circuits, fire control systems and other servo operated instruments far both military and commercial applicatians. The continuing expansion of work in our engineering department offers opportunities for both senior and intermediate engineers. Previous experience an fire control or electra-acousticol systems is desiroble, and supervisory obility wauld be an asset.

Pleose reply stoting age, salary, education and post experience to:

Personnel Monoger,

P.O. Box 710,

Montreal, Quebec.

All replies canfidential.

SENIOR PROCESS ENGINEER

A senior process engineer is required by large petrochemical, cellulase acetate and synthetic yarn plant near Edmontan. Minimum of five years' experience since graduatian is required. Experience in field af petra-chemicals is preferred. This is a permanent staff pasitian and the apening is immediate.

Write stating personal infarmatian, experience in full detail, salary required, the date available ta:

Persannel Department
Canadian Chemical Campany
Limited · P.O. Box 99
Edmantan, Alberta, Canada

engineering works. Duties would consist of supervising, during the coming summer, the construction of roads, sewage and water supply for community located in the Province of Quebec. During the winter would be located in Montreal office and work on design in the civil engineering field. File No. 5208-V.

GRADUATE CIVIL ENGINEER with at least three years experience. Man to be employed on the design, construction and maintenance of reinforced concrete, building structures and building services. He would also have other duties such as the maintenance of roads and lands, occasional instrument surveys and other civil engineering work. Location Province of Quebec with large chemical plant. File No. 5210-V.

QUALIFIED CIVIL ENGINEER for road work and excavating. Man required should have at least five years experience in the field. Duties would require him to be able to accurately estimate costs on this type of work and supervise the field work. Location Ontario. File No. 5222-V.

CIVIL ENGINEERS. Continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and developing communications systems involving uses of the latest types of microwave equipment, network TV transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known, it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary: commensurate with experience and ability. File No. 5227-V.

ELECTRICAL

ELECTRICAL ENGINEER required as junior or assistant distribution engineer. Graduate with at least 3 years field experience operating U.S. or Canadian Public utility. Permanent position with long established consulting organization New York. Some travel Latin America necessary in future. Knowledge of Spanish or Portuguese useful. Salary commensurate with experience. Reply giving age, education, experience and personal particulars. File No. 5042-V.

GRADUATE ELECTRICAL ENGINEERS, one senior—two juniors. Senior at least 10 years experience—junior 3-5 years experience in electrical design, operation and construction of steam, hydro plants and sub-stations. Permanent position with long established consulting organization for public utility operating companies located Latin America. Headquarters New York. Some travel necessary in future. Knowledge of Spanish or Portuguese useful not essential. Salary commensurate with qualifications. Good opportunity. Reply stating age, education, experience and personal particulars. File No. 5118-V.

GRADUATE ELECTRICAL engineer to assume responsibility for design and development of distribution and small power transformers with manufacturer established in Alberta. At least one year's design and/or manufacturing experience desirable. Applicants to give personal data (including recent photo), education, experience, references and minimum initial salary expected. File No. 5131-V.

SENIOR ELECTRONIC ENGINEERS and physicists are required by a leading Canadian firm to carry out design and development work in the fields of radar, microwave communications, telephony and AM and TV broadcast equipment. All replies are confidential and will be acknowledged. Location Toronto, Ontario. File No. 5135-V.

A LARGE PROGRESSIVE AND WELL established electrical engineering company in N.E. England offers opportunities to engineer designers and draftsmen who have served a recognized engineering apprenticeship, possess technical qualifications to Higher National Certificate standard in electrical and/or mechanical engineering and have had practical experience on the drawing board preferably in connection with the design of electrical switchgear. Engagement would be for a minimum period of 2 years with the opportunity of continuance thereafter on a pensionable basis. Minimum salaries £585 per annum at age 25 and £663 at age 30. Passage paid and housing assistance in approved cases. A few opportunities also occur on much similar terms for contract engineers with qualifications and experience adequate to handle all phases of tender and contract work met with in world wide electrical power supply equipment industry, particularly in respect to control and switchgear. File No. 5144-V.

PROJECT ENGINEER (electrical and Electronic) to design electrical and electronic installations in aircraft and to supervise a small section of electrical and mechanical draughtsmen. Applicants should have a degree in electrical engineering or mechanical engineering with electrical subjects as a strong secondary and preferably 5 years experience in design of electrical and electronic installations in aircraft. Experience in supervision of draughtsmen desirable. Salary commensurate with experience and qualifications. Reply stating age, education, experience, personal particulars and salary expected. File No. 5147-V.

ELECTRICAL ENGINEER, Canadian graduate with 4 to 6 years experience lighting and power distribution for industrial buildings. Work in Windsor or Sarnia. File No. 5155-V.

THE PUBLIC UTILITIES COMMISSION of the City of Kingston requires a graduate engineer with electrical distribution engineering experience to plan, design and supervise projects in connection with an electric utility. Position offers participation in commission's, hospitalization and pension plans. Salary commensurate with qualifications. Applicant should submit full details of education, experience, age and references. Replies will be kept confidential. File No. 5164-V.

GRADUATE ELECTRICAL ENGINEER interested in a career in Latin America with a Canadian owned electric light and power utility located in La Paz, Bolivia. Age limit 30 years and should have 4 to 5 years experience in electrical distribution. Prospects of promotion are excellent due to the company's continued growth and expansion. File No. 5170-V.

TWO COMPETENT GRADUATE ELECTRICAL engineers, age 30 to 40 with minimum 8 years experience design operation and maintenance of distribution facilities, required by rapidly growing utility, desirable location South America. Portuguese or Spanish useful, not essential to start. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5171-V.

ELECTRICAL ENGINEERS required to fill two vacancies in the teaching staff of the electrical engineering department at the University of New Brunswick. Good academic standing and either an advanced degree or at least two years of technical experience preferred. Should have an interest in teaching and initiative and energy to be effective in the growth of a rapidly expanding department. Reply stating age, education, experience, personal particulars, references and minimum salary expected. File No. 5172-V.

ELECTRICAL ENGINEER required as sales engineer, with a leading electronics firm. Good salary plus commission and excellent opportunity for future advancement. All applicants should state qualifications and salary expected. File No. 5177-V.

JUNIOR ELECTRICAL ENGINEER, required to act as an assistant to the distribution engineer. Please state education, experience, and salary expected. Replies will be held strictly confidential. Location Ottawa. File No. 5188-V.

ELECTRICAL ENGINEER 1954 or 1955 graduate to work in hydro department. Duties will be to work under one of our engineers on a power system. Starting salary $325.-$350. per month. Pension plan, group insurance, blue cross. File No. 5201-V.

ELECTRICAL ENGINEER university graduate of two or three years experience in electrical field and above average literary ability. Permanent employment in Ottawa with well-known industrial association, pension plan. File No. 5217-V.

ASSISTANT PROFESSOR electrical engineering duties: to instruct undergraduate studies and develop post-graduate work. Time and facilities for research. Qualifications university graduate, preferably some post graduate training, several years practical experience which may include industrial graduate engineer training course. Location Maritime Province. File No. 5220-V.

ELECTRIC AND ELECTRONIC ENGINEERS continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and developing communications systems involving uses of the latest types of microwave equipment, network T.V. transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known, it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary commensurate with experience and ability. File No. 5227-V.

A GRADUATE ELECTRICAL ENGINEER to assist in the laboratory and lecture work of the department of electrical engineering. The appointment will be made initially on the basis of sessional lecturer after which the appointment may be made permanent. Duties to commence September 1st, 1955. Apply to Dean of Engineering, University of Alberta, Edmonton. File No. 5233-V.

THE LARGEST CANADIAN OWNED electronics company has immediate openings in its engineering department. These are highly paid permanent and interesting positions with excellent opportunities for advancement. Successful applicants will be employed as project supervisors or senior design engineers in a field exclusive to this company in Canada. The applicants should possess a degree in electrical engineering from a Canadian, British or American University, or hold equivalent academic standing such as the Higher National Certificate and have 3 to 5 years industrial experience. Starting salaries are commensurate with proven ability and experience. Local interviews will be arranged. Pleasant working conditions in modern plant, 5 day week, full program of employee benefits. File No. 5240-V.

ELECTRICAL ENGINEERS required with experience in the design of power transformers. Full employee benefits. Large manufacturer in Ontario. File No. 5242-V.

ELECTRICAL ENGINEER Toronto manufacturer requires graduate electrical engineer with some mechanical design experience for product development work on transformers and substations. File No. 5247-V.

GRADUATE ELECTRICAL ENGINEER to inspect electrical work comprising unit substations, 6600 V distribution, and 550 volt wiring for motors and controls, at Dominion Wabana Ore Limited mine at Belle Island, Wabana, Newfoundland. This work will last until the end of September. File No. 5252-V.

GRADUATE ELECTRICAL ENGINEER to eventually superintendent maintenance and operation of electrical equipment underground and on surface at a mine in Newfoundland. Should be about 35 years of age and have mining experience. File No. 5252-V.

MECHANICAL

MECHANICAL MAINTENANCE ENGINEER with 5 years experience in oil refineries required as assistant maintenance superintendent in Southern Ontario. Please reply giving details of experience and salary expected. File No. 5141-V.

APPLICATIONS ARE invited for the position of instructor in Engineering at Mount Allison University. Duties to begin about Sept. 15th. Candidates must be university graduates in engineering, preferably in mechanical engineering. Salary range $2,500 to $3,000. Please apply to File No. 5150-V.

MECHANICAL ENGINEER, Canadian graduate 3 to 8 years experience process piping and equipment in refinery or chemical plant. Field experience valuable. Work in Sarnia. File No. 5155-V.

MECHANICAL ENGINEER with 3 to 5 years experience, preferably in connection with construction projects of various kinds, for work on plant engineering projects. Plant located 25 miles from Montreal. File No. 5161-V.

MECHANICAL ENGINEER OR graduate engineering physics required by leading manufacturer of heating, ventilating and air conditioning equipment for sales engineering work. Age 21 to 27 years. Prefer a gradua

of 1953, 1954 or 1955 classes. Previous experience in this work is not necessary, however, please state age and experience when replying. File No. 5168-V.

MECHANICAL ENGINEER required by automotive manufacturing company in Montreal. Applicant should be between the ages of 30-40 and preferably bilingual with experience in internal combustion engines. Duties will include the study of quality problems and production planning. File No. 5178-V.

PROGRESSIVE, MODERN TEXTILE COMPANY in Granby, Quebec, wishes to engage a mechanical or textile engineer as assistant superintendent. A man of 25 to 35 years of age who is primarily interested in production and plant engineering is desired. Previous manufacturing experience including staff supervision, is essential. All communications will be considered strictly confidential and interviews will be arranged in Montreal with applicants having suitable qualifications. Applicants should include day and evening telephone numbers, home addresses and details of qualifications. Please reply to File No. 5179-V.

MECHANICAL ENGINEER with 5 years or more experience in materials handling. Age 28-35. Must be Canadian citizen and must be registered professional engineer in Canada or qualified. Position headquarters in Minneapolis, Minnesota, with heavy travel in Canada. Prefer man with materials handling or packaging experience in food industry, but can consider others. Position offers good salary opportunity and permanence. Reply giving complete information regarding personal history, education, and experience. File No. 5184-V.

A RECENT GRADUATE MECHANICAL ENGINEER, bilingual is required by a large Western Ontario firm. This position involves travel and would be best filled by a young man who likes people and is interested in the sales and service of diesel engines. File No. 5186-V.

GRADUATE MECHANICAL ENGINEER with steam plant experience preferably in a central station utilizing pressures of 850 P.S.I. and temperatures of 900 degrees. Opportunities for advancement are excellent for right man interested in career in Latin America with a Canadian electric utility. Location Maracaibo, Venezuela. Housing provided. Salary open depending on experience and qualifications. File No. 5190-V.

MECHANICAL PLANT BETTERMENT ENGINEER, required by operating division of supervisory-consulting organization, for public utilities located eleven Latin American countries. Mechanical engineering graduate preferred with 5 to 10 years experience operation and betterment of steam electric plants. Diesel experience helpful. Some travel. Knowledge of Spanish desirable not necessary. Location N.Y. Reply giving age, education, experience, personal particulars, minimum salary expected. File No. 5192-V.

MECHANICAL DESIGN ENGINEER required in Bathurst, New Brunswick, who has graduated from a recognized Canadian University and who has had two years experience in the machine shop and steel fabricating industry. Duties will include development and design of earthmoving and industrial equipment. Reply with details of education, experience, and age together with salary range required. File No. 5196-V.

DESIGN ENGINEER required by a firm in Hamilton, Ontario, for development and product design of sheet metal working machinery such as presses, shears and roll farming machines. Applicant must have at least four years of machine design experience and preferably a graduate engineer. He must be able to design and develop such equipment with a minimum of supervision. Replies should outline qualifications, experience, age and salary expected. File No. 5200-V.

YOUNG MECHANICAL ENGINEER for week in connection with process plant. Previous experience in industry is not essential but it is possible that the successful applicant may be required to spend a short initial training period with our parent companies in England. Organization is part of a large world-wide engineering organization. File No. 5202-V.

MAINTENANCE ENGINEER required for new 12,000 BPD refinery at Winnipeg to be directly responsible to mechanical superintendent for all maintenance problems, materials, and scheduling and supervision of maintenance personnel and shop. Preferably mechanical engineer with five to ten years experience in general refinery engineering, maintenance and metals inspection, and with potential for future promotion. Remuneration will be negotiated. Send full details of previous experience and responsibility, and recent photograph to File No. 5204-V.

MECHANICAL ENGINEER for plant engineering work in the viscose rayon industry. Duties will include investigations, reports, design, and supervision of plant engineering activities, including maintenance, alterations, must be graduate engineer, age 26 to 35, with several years of practical experience in plant engineering work. Must have ability to take over leadership of a group and be prepared to make his own decisions and be responsible for them. Preferably should also have had full or partial trade apprenticeship training in industrial or plant. Position will be permanent, and offers excellent opportunity for advancement to the right man. Applications should contain all necessary personal data and full information about previous engineering experience. File No. 5207-V.

MECHANICAL ENGINEER as plant engineer for large plant manufacturing fibre conduit pipe at Cornwall, Ontario; three or four years mechanical engineering experience with some knowledge of machine design; starting salary $400-$450 per month. File No. 5212-V.

MECHANICAL ENGINEER required by plant engineering department in Montreal. Responsibilities will be to design processing equipment for plating, anodizing, cleaning, degreasing, etc. 5-7 years experience in plant engineering or process planning is a requirement. Please apply in writing giving full details of education experience, past earnings and personal history. File No. 5221-V.

MECHANICAL ENGINEER required by American chemical company establishing in P.Q. Applicant should have some experience in plant maintenance and general engineering. Position offers good opportunity and will include training in U.S. plant. File No. 5224-V.

MECHANICAL ENGINEERS. Continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and development communications systems involving uses of the latest types of microwave equipment, network TV transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary commensurate with experience and ability. File No. 5227-V.

A GRADUATE MECHANICAL ENGINEER to lecture in thermodynamics and/or machine design and assist in laboratory instruction. Appointment to be on sessional basis for the first year after which a permanent appointment as lecturer may be made. Duties to commence September 1, 1955. Apply to Dean of Engineering, University of Alberta, Edmonton. File No. 5233-V.

YOUNG MECHANICAL ENGINEER, preferably not over thirty years of age required for newly constructed plant in Montreal by large world wide manufacturer. To act as supervisor of building and mechanical maintenance departments. Experience not entirely necessary but useful. File No. 5234-V.

MECHANICAL ENGINEERS with or without paper mill experience required for large pulp and paper company in the Province of Quebec. Work available in either engineering or operating departments. Salary commensurate with experience and ability. Please reply to File No. 5235-V.

MECHANICAL OR METALLURGICAL ENGINEER interested in sales work required by progressive steel foundry to assume sales promotion responsibilities. Foundry experience an asset. Bilingualism a help. Location Montreal. Salary open. Car provided, pension plan and other benefits. Write outlining experience, qualifications and approximate salary required. File No. 5238-V.

MECHANICAL ENGINEER with executive ability required for manufacturing plant, located in Montreal, expanding operations. Please submit full details as to past experience, marital status etc. to File No. 5239-V.

GRADUATE ENGINEER required as plant engineer. Duties entail supervision of three draughtsmen in the engineering department, and estimating miscellaneous metal contracts for construction of buildings, shop drawings, mechanical design such as conveyors and platework. This position will be permanent and salary will be commensurate with experience and ability. Location Maritimes. File No. 5241-V.

MECHANICAL ENGINEER required with six to eight years experience on pressure vessel design, medium to heavy structural steel or plate design. Full employee benefits. Large reputable manufacturer in Ontario. File No. 5242-V.

MECHANICAL ENGINEER newly graduated or with two or three years experience to work in the development and research engineering department of large mechanical manufacturer located outside Montreal. File No. 5243-V.

TWO DESIGN ENGINEERS for commercial vehicle design. Good opportunity with a sound future for a graduate mechanical engineer, who has had practical experience in structural design. Location Ontario. File No. 5251-V.

MISCELLANEOUS

MAJOR OIL SERVICE COMPANY operating in several locations in the Western Provinces requires several graduate engineers immediately. The positions offered involve field work, travelling and irregular hours. The salary schedule and employee benefits are excellent, the work has variety and several opportunities for advancement are available. The company is the leader in its field and well established on a world wide scale. No previous experience is necessary, however an interest in fundamental electricity is desirable. Applicants must be 20 to 39 years of age and should supply a transcript of university marks with their reply. Please give age, education, experience and other qualifications. Minimum salary is $375.00. Complete job and company description available upon request. File No. 5146-V.

OPPORTUNITY FOR AN ENGINEER, if you have had ten or more years of experience in a pulp and paper mill, or in the sale of industrial equipment or some combination of the two, we have an opening in sales engineering that would be very interesting to you. We are a well established manufacturer of pulp and paper mill equipment. Living conditions in our centrally located city are considered very desirable. This is a senior position suitable for a serious and ambitious man who expects and warrants liberal remuneration. Our present staff have been advised of this advertisement. Your communication, outlining your background will be treated in confidence. File No. 5152-V.

LARGE ESTABLISHED paper company requires graduate mechanical, civil and electrical engineers with necessary experience to undertake investigations, preliminary designs and estimates for expansion of existing mills and new projects which may be contemplated. Good opportunity for qualified men with pulp and paper mill experience. Office located in Montreal. Replies should state age, qualifications, experience and salary expected. Interview will be arranged with prospective applicants. File No. 5153-V.

SALES ENGINEER, wanted with several years of sales experience preferably in petroleum chemical, steam power plant or pulp and paper industries. Required to handle all sales aspects relating to heat transfer equipment for major firm engaged in design of same. Would involve travel, principally in Eastern Canada. Location in Montreal. Salary and expenses. File No. 5157-V.

SENIOR PROJECT ENGINEER required by engineering-construction firm specializing in oil refineries and chemical plants. Applicants should have at least ten years experience in the design and installation of process equipment including pressure vessels, piping, pumps and compressors, buildings and structures. Plant operating or maintenance experience desirable. Location will be Montreal office. Please furnish personal data, detailed experience record and references. File No. 5158-V.

FOR LARGE INDUSTRIAL development in Middle East, several engineers are required. Salaries from $15,000 to $30,000, tax free. Expenses of family to and from destination included. Following are general qualifications: 1) Civil Engineer, in charge of general expansion and construction of all capital works. 2) Civil engineer familiar with water power development. 3) Electrical and mechanical engineer for industrial expansion and coordination of industries. 4) Agricultural engineer. 5) Transportation engineer for construction and extension of roads, railways, airports, docks, canals, etc. 6) Industrial engineers, to advise on processes, operations, maintenance, expansion. 7) Mining and metallurgical engineer to develop coal, iron ore, lead, tin, etc. Holiday allowance — 30 days per year. Two-year contract with possibility of extension. Salaries guaranteed by international organization. Age limit, generally from 45 to 60. File No. 5253-V.

RECENT GRADUATE IN MECHANICAL OR chemical engineering required for Montreal East Refinery. One or two years' basic experience required with plant utilities such as steam, air and water. Knowledge of plant electrical systems useful but not essential. Position provides excellent opportunity for professional experience and promotion. Duties after suitable training period, will include such matters as performance studies on steam boiler plant, steam engine and turbines, pumps, air compressors, condensers and similar mechanical equipment, economic studies on efficient usage of plant utilities; preparation of estimates and layouts for extensions to plant utility systems. Salary dependent on experience and qualifications. Applications will be treated confidentially and should be addressed in writing with full particulars to File No. 5159-V.

YOUNG TECHNICALLY TRAINED men for industrial engineering subdivision, which includes tool engineering, production engineering, work standards, and plant layout and material handling. Location Ontario. File No. 5162-V.

INDUSTRIAL ENGINEER with work standards experience in foundry, machine assembly type of operation. Assignments will include development and installation of major programs as well as development of procedures and personnel. We are seeking a man with a degree in engineering or applied science, between 28 and 35 years of age. Location Ontario. File No. 5162-V.

PLANT MANAGER PREFERABLY 25 to 35, required by an Alberta firm specializing in precast concrete. Applicants must be university graduates in civil engineering or mechanical engineering, with a minimum of three years experience, preferably in manufacturing or in reinforced concrete. Will be required to supervise and direct all activities of a branch plant, reporting directly to the general manager. Salary open, with advancement dependent largely upon administrative ability. Reply giving full personal particulars, education, interests and recent photograph. File No. 5166-V.

YOUNG SALES ENGINEER, preferably 1955 graduate required as sales engineer by manufacturer of complete line of heating and ventilating equipment and centrifugal pumps. Training period for experience in Canadian or U.S. offices. Head Office in Ontario. File No. 5169-V.

SALES ENGINEER required by well established and highly respected company in the field of scientific illumination. Duties after a specific training program, will involve the sale of prismatic lighting units and the discussion of lighting applications with architects, consulting engineers and electrical contractors, officials of industrial and commercial firms, municipal and hydro officers. Qualities of personality, diligence, and dependability along with a sincere desire for a permanent career in the lighting industry are of prime importance. File No. 5174-V.

DEPARTMENT OF NATIONAL DEFENCE, Ottawa, urgently requires inspecting officer. Under direction to be responsible for the direction of inspection of the manufacture and filling of artillery ammunition stores (shell); to lay down inspection requirements and proof conditions concerning the manufacture and filling of all shell stores; to set standards of workmanship and finish; to recommend acceptance or rejection of concessions or other departures from drawings and specifications. Graduation in engineering or applied science from a university of recognized standing, and/or qualifications that would permit membership in a Provincial Association or the Corporation of Professional Engineers. File No. 5175-V.

TECHNICAL WRITERS REQUIRED with a university degree in science or engineering. The ability to express technical information in clear concise English and to read wiring diagrams, schematics and mechanical drawings is essential. Positions offer varied experience, future security and an opportunity for advancement. Please reply stating age, experience, educational qualifications and salary expected. File No. 5177-V.

HYDRAULIC ENGINEERS, salary up to $7200. per annum, depending upon qualification for St. Lawrence River Joint Board—competition 55-1252. Northern affairs and National Resources, Ottawa, competition 55-1250. Quote competition number. File No. 5182-V.

NATIONAL RESEARCH COUNCIL division of Building Research, Ottawa, requires a physicist or engineering physicist, to assist with the Division's Fire research program. Qualifications: applicants must be graduates from a recognized university. Salary commensurate with qualifications. The program is intended to reduce the toll of life and the immense property loss which arise from fires in all kinds of buildings in Canada. A wide general scientific knowledge and originality and versatility in experimental work are more desirable than any advanced specialization; but an interest in measurement of thermal radiation and flame temperatures, in unsteady-state heat transfer and in statistics would be an advantage, and the capacity to write reports which are clear to the public is indispensable. File No. 5183-V.

AN EXPANDING CANADIAN company has openings for engineers of university graduate or equivalent status preferably with gas turbine experience in the following fields. Experience in gas dynamics problems desired and the ability to assume responsibility for organizing and executing detailed programs for the development of gas turbine combustors and related equipment. Vibration engineers with previous experience preferred in vibration problems on gas turbine blading and engine structures. The work will include direction of laboratory, test house and flight vibration tests in addition to analysis of test data. Location Ontario. File No. 5185-V.

A DIESEL LOCOMOTIVE manufacturer in Western Ontario requires recent graduates, electrical and mechanical department. This position will involve design, development and testing of the locomotive and its components. Experience not essential. File No. 5186-V.

ENGINEER WITH SOIL EXPERIENCE and soil mechanics training for interesting position in Montreal. Should be professional engineer or eligible for registration in Quebec. This position has good prospects for an intelligent engineer with initiative who has a reasonable amount of soil training with laboratory and field experience. The position involves some work in other fields where any type of engineering experience will be an asset. Please give details of education and experience and other relevant information to file No. 5194-V.

MECHANICAL OR ELECTRICAL ENGINEER recent graduate, required as project engineer for expanding progressive company of engineering contractors specializing in industrial combustion applications. After a brief training period he will make surveys, estimates, proposals and become responsible for design installation and operation. Location Montreal and vicinity. Salary commensurate with qualifications. Please reply stating experience or background. File No. 5197-V.

ELECTRICAL OR METALLURGICAL ENGINEER, recent graduate, required by machine tool house to train for service and sales of technical production machinery in the plastics, electronic and metallurgical field. Location Montreal. Territory Eastern Canada. File No. 5209-V.

MECHANICAL OR CIVIL ENGINEERS required by a large metallurgical company located in Southern Ontario as designing draftsman. Some experience required in either plant layout, reinforced concrete structural steel or materials handling. Please reply giving details of experience and salary required. File No. 5213-V.

ENGINEER REQUIRED with 5-10 years experience in Production control covering stores functions, physical inventory operations, and dispatch and/or scheduling functions. Engineering degree preferred but experience in production control probably more essential. Position requires supervision of staff of approximately 100. Salary range $6,000-$7,500 depending upon experience. Location Montreal. File No. 5214-V.

RELAY ENGINEER to undertake system studies and provide relay settings for all generation and transmission plant of young B.C. utility with headquarters in Victoria. Reply stating age, experience, education, salary expected. File No. 5215-V.

SALES ENGINEER LOCATED Northern Ontario, required by established manufacturers' representative. Selling to pulp and paper, mining, industrial and heating contractors. Applications are invited from graduate engineers with civil or mechanical background and an aptitude for sales work. Address full details of education and experience to File No. 5216-V.

ELECTRICAL OR MECHANICAL ENGINEER required for utility company in Eastern Ontario. Assistant to engineer. Company operations include distribution of electricity urban transportation, and rail switching operations. Company carries out all design, construction and maintenance. Some experience in utility work would be desirable and an interest in electric utility is essential. This is an addition to present staff required by growth and future retirement program. Salary commensurate with experience. Applicants should include resume of education, marital status, health, experience, and interest references, and a recent picture. All replies in confidence. File No. 5225-V.

SALES ENGINEER required for Province of Quebec with experience in automatic heating with gas etc. Applicant should be bilingual. Good opportunity. Salary plus commission. File No. 5226-V.

PERFORMANCE ENGINEER required, who, in addition to having a degree in engineering or science should possess a strong mathematical background. A knowledge of hydraulics and aero-dynamics essential and experience in servo-mechanisms most desirable. By manufacturer of aircraft engine fuel systems located in Toronto. Apply with full details as to experience, age, education, etc., and state approximate starting salary required. File No. 5228-V.

ENGINEER BETWEEN 30 and 40 years of age with sound knowledge of mechanical engineering to take up responsible position as sales engineer with a St. John's, Newfoundland, company. Applicants should write stating education, training and experience. Knowledge of selling desirable but not essential. Field of sales would cover a wide line of heavy engineering items. An applicant should be prepared to travel fairly frequently within the Province. All applications will be strictly confidential and salary etc. can be discussed when application is received and suitability of applicant determined. Reply in own handwriting to File No. 5229-V.

ENGINEERS WITH 2 or more years experience required for rapidly expanding chemical company. Civil, electrical, mechanical. Good opportunity and permanent position with central engineering office in downtown Toronto. Top salary for right men. Applications will be confidential. File No. 5230-V.

YOUNG ENGINEER required by a Montreal construction company. Applicant must be bilingual and have experience in construction. State age, education and business experience in first letter to File No. 5232-V.

MECHANICAL OR CHEMICAL engineers with 2 to 4 years experience, required for positions in the engineering division of textile industry located in Cornwall, Ontario. Duties will include investigations, reports, design and other affiliated duties connected with the engineering division. The successful applicant must have the ability to assume leadership of a group and to take full responsibility for their work and the decisions made. This position offers an excellent opportunity to the right man for future advancement to an executive position. File No. 5236-V.

ENGINEER REQUIRED to develop sales for continuous vacuum filtration equipment. This equipment manufactured in the United States by a leading firm and consisting of drum filters, disc filters, precoat filters, pressure filters, etc. The sales engineer would reside in Toronto and make calls, from time to time, throughout the Dominion of Canada. Previous sales experience would be an advantage but not a necessity. Full details supplied during interview. Reply giving age, education, marital status and previous experience. File No. 5237-V.

YOUNG GRADUATE ENGINEERS required who would like to begin their career in the electrical and mechanical phases of power transformer design. Full employee benefits. Large reputable manufacturer located in Ontario. File No. 5242-V.

SALES AND SERVICE ENGINEER required by water treatment engineering firms to work in the Quebec City area. Require man who is completely bilingual and preferably with an engineering degree. File No. 5248-V.

MECHANICAL OR CIVIL ENGINEER, graduate of this year or one with a few years of experience. The duties will consist of layout and design work in a paper mill engineering office. Salary $375.00 per month. Location Province of Quebec. File No. 5249-V.

AMERICAN ELECTRONIC CONCERN seeks a top-notch microwave engineer to head up a newly formed division. The corporation which is located in Boston, Massachusetts desires a person thoroughly capable of designing highly precision microwave components to operate in the "C", "K", "S", and "X" band regions. The initial objective of the candidate would be to develop a line of microwave components which could be catalogued and sold to the United States electronic industry in general. In addition to moving expenses; salary, commensurate with ability to produce; the successful candidate would be given an opportunity of voting stock participation at division level. Every opportunity for further advancement and financial interest in the parent corporation would be encouraged. Write full details of marital status, education, accomplishments and experience. File No. 5250-V.

is is the Otis Electronic Zone of Detection (Illustrated in phantom) This ne extends in front of the leading edges of both hoistway and elevator r doors from floor to shoulder height. When a passenger enters this ne of detection the electrical effect of the passenger's body energizes o series of electronic tubes. The tubes in turn permit the passage of current to operate the relays that control door operation. The result? The doors politely and obediently reverse before they can touch the passenger. This zone travels with the car and provides double-door protection at each floor.

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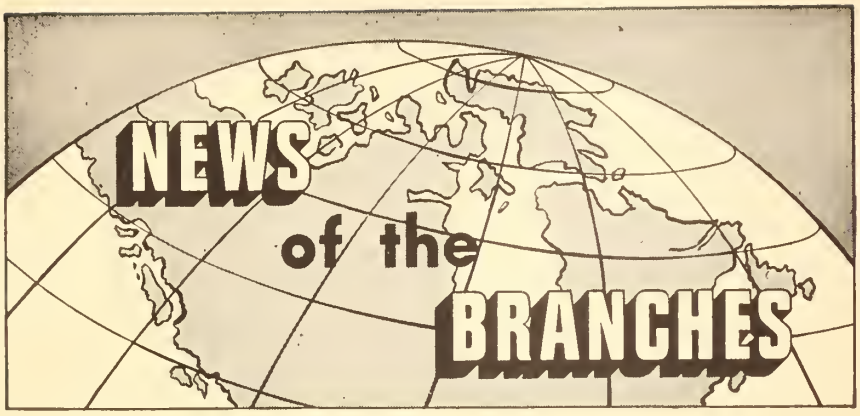

Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Belleville

J. A. Grant, M.E.I.C.,
Secretary-Treasurer

The Belleville Branch of the Engineering Institute of Canada held its eighth meeting of the 1954-1955 season on May 16 at the Masonic Temple with approximately 20 members and guests present.

B. C. Robson spoke on "Mineral Resources of Hastings County". His address was illustrated by means of samples of minerals found in the district and by the demonstration of modern prospecting equipment including a geiger counter and black light source. The speaker was introduced by A. O. Drysdale.

This meeting was the last of the current season and activities of the Belleville Branch will be suspended until the October meeting.

Brockville

M. H. D. Broadbent, M.E.I.C.,
Secretary-Treasurer

G. M. Woods, M.E.I.C.,
Branch News Editor

Coal Burning Turbine

R. W. Foster-Pegg, graduate of McGill University, addressed 40 members of the Engineering Institute of Canada, Brockville Branch, and the Institute of Power Engineers, at the Daniels Hotel in Prescott, Tuesday evening, April 19, on the subject of "The Experimental Coal-Burning Turbine".

John Preston, introducing Mr. Foster-Pegg, said the speaker had many years in the development of reciprocal and turbine engines at the Rolls Royce plant in England. He is well known to the graduates of McGill University for his work on coal-fired turbines and pulverized coal-fired locomotives carried out under the direction of Prof. D. L. Mordell.

Project engineer with McGill University attached to the mechanical engineering department, Mr. Foster-Pegg told the group of the experimental tests conducted by Prof. D. L. Mordell, in conjunction with Mr. Chant and himself on November 27, 1953, when two runs were made on exhaust-heated gas turbines on oil and coal.

The runs were the first ever made using powdered coal. "The possibility of producing an economical unit of one to five thousand horsepower suitable for use on the Canadian prairies and also offering an approach to competition with diesel locomotives brought the attention of the Department of Mines and Technical Surveys of the Dominion Government to the project," said Mr. Foster-Pegg.

Africa, he said, would stand to gain from this development where coal costs $1 to $3 a ton and water is scarce.

Convert Aircraft Engine

In explaining in detail the development of this engine, Mr. Foster-Pegg used a number of slides. They first obtained an obsolete aircraft engine, a Rolls Royce "Dart" turbo-propeller job, and then designed heat exchangers, furnace and ducting necessary to convert the engine to run on coal, and to lay out the plant for experimental convenience.

Tom Scott thanked Mr. Foster-Pegg for his very informative talk and expressed the appreciation of the members. He said it was not generally understood by the public that such important pioneering work in mechanical development was going on in our universities.

President F. F. Walsh informed the members of a ladies night planned on or about May 17 when the subject of "Colour in Home Decoration" would be discussed by Mr. Sinclair of the C-I-L Paint and Varnish Division.

In June, General Motors has tentatively arranged to provide a speaker to talk on the subject of "The Car of Tomorrow".

Central British Columbia

H. D. DeBeck, Jr.E.I.C.,
Secretary-Treasurer

A meeting of the executive was held at the Golf Club in Kamloops on April 15, 1955.

The meeting convened at 8.10 p.m. with Mr. Ker in the chair. Executive members present were Messrs. Joplin, Mulcaster, Dimock, Zirul, Wade, Harris and DeBeck.

After the minutes of the last executive meeting held in Vernon on February 11 were read and adopted the secretary was instructed to ask the Student Guidance chairman to follow up his inquiry to Headquarters concerning the film, Leonardo Da Vinci, and to ask for directions as to its use for the information of the next meeting.

Letters from the Kootenay Branch regarding the annual meeting in Toronto and their resolution favouring the admittance of scientists to membership in the Institute were read and discussed. The secretary was instructed to write the Kootenay Branch saying "That the executive of the Central B.C. Branch agrees with the resolution of the Kootenay Branch regarding the admission of scientists to membership in the Institute provided that the individuals admitted should meet the requirements of the Institute for membership or affiliate membership".

It was decided that the E.I.C. executive report that in discussion with the executive of the B.C.E.S., they have ascertained that there is a movement afoot for a confederation embodying the E.I.C. and B.C.E.S. and that a report will be issued this year from our parent bodies concerning confederation; and in the meantime, it is recommended that nominating committees of both bodies nominate the same persons for comparative positions.

The possibility of a joint meeting this year at Trail with the Kootenay Branch was discussed.

Fredericton

Otis Logue, M.E.I.C.,
Secretary-Treasurer

Noreen E. Donahoe, S.E.I.C.,
Branch News Editor

Annual Meeting

The Fredericton Branch of the Engineering Institute of Canada held its annual meeting on Wednesday evening, April 20, at Colwells Inn with 22 members present.

After the dinner the election for the executive in the forthcoming year was held. R. Tweeddale, this year's president was chairman of the nominating committee and Mr. Hargreaves was a member.

New Executive

Howard MacFarlane was elected president for 1955-56, Ira M. Beattie, vice president; Otis Logue, secretary; and Robert McLaughlin, treasurer.

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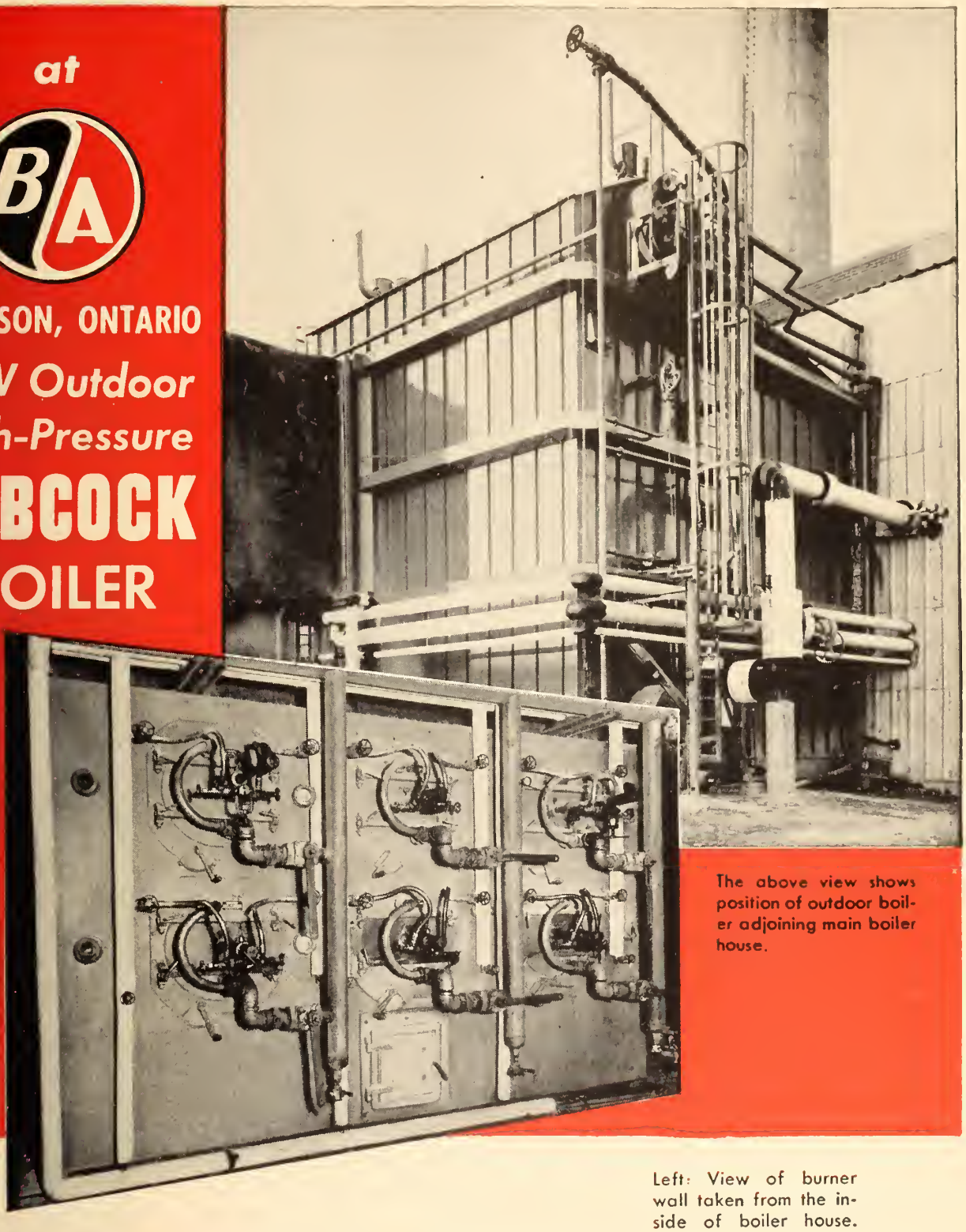

The above view shows position of outdoor boiler adjoining main boiler house.

Left: View of burner wall taken from the inside of boiler house.

The recently installed Babcock Type F "INTEGRAL-FURNACE" Boiler, at the British American Oil Co. Ltd., Clarkson, Ontario, has a capacity of 120,000 lbs. of steam per hour and is designed for 875 psi. pressure.

The boiler is fitted with six Babcock Oil and Gas Burners.

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Colonel W. Akerley, G. Young and D. Ganong were elected members of the executive.

It was pointed out that in the past year two members of the E.I.C. were appointed to the City Council and the Revisions to the Engineering Act were passed in the New Brunswick Legislature.

After the meeting, films on lead and zinc mining were shown.

On May 9, 1955, the engineering students graduating this year from the University of New Brunswick were entertained at Colwells. This followed the annual Iron Ring Ceremony.

Edmonton

R. B. KERR, JR.E.I.C.,
Secretary-Treasurer

P. H. BUCKLAND, M.E.I.C.,
Branch News Editor

Annual Branch Meeting

The annual meeting of the Edmonton Branch was held on Wednesday evening, April 20, 1955. The meeting was conducted under the direction of the outgoing branch chairman, E. K. Cumming.

Reports from the various branch committees were presented in the annual report distributed to all members before the meeting.

The "Report of Program Committee" which summarized the clubs activities from April 28, 1954 to April 6, 1955, was submitted by H. L. Roblin, chairman of the Program Committee. Mr. Roblin thanked Stan Hampton of the committee for his able assistance through the year.

The "Report of Young Engineers' Committee" was submitted by P. M Butler, chairman of that committee. Mr. Butler gave thanks to Professor L. Gads and Colonel Cormack of the University of Alberta for their co-operation in making the public speaking classes conducted by Mr. Butler's committee a success.

The "Report of the Membership Committee" was submitted by R. N McManus, the committee chairman.

The "Report of Committee for Non-Resident Members" was submitted by its chairman, J. A. Brownlee. Mr. Brownlee proposed the abolition of this committee in future branch executives.

Secretary-Treasurer's Report

The "Secretary-Treasurer's Report on Membership" which noted a steady increase in the rise of both M.E.I.C. and Jr.E.I.C. members, was submitted by R. B. Kerr, the secretary-treasurer.

The "Secretary-Treasurer's Financial Report" was submitted by R. B. Kerr. Mr. Kerr noted a 1954-55 net income of $278.87 from an income of $1,589.01 and disbursements of $1,310.14.

The "Report on Hawkes Fund" was submitted by R. B. Kerr. Donations of $1,971.90 were passed on to the widow of a deceased member Mr. Hawkes. Thanks were made to C. Garnet and A. E. McDonald for their work promoting the fund.

The "Councillor's Report" was submitted by Councillors N. J. Allison and E. L. Smith.

The "Report of By-Laws Committee" was submitted by its chairman, E. K. Cumming. The committee recommended four major amendments to existing Edmonton Branch by-laws. All amendments are to be sent to Council of the Institute for approval before being sent to the branch membership for approval.

Officers and Executive

The "Nominating Committee Report" was submitted by N. J. Allison, E. K. Cumming and R. B. Kerr. The committee recommended the following as officers and executive members of the Edmonton Branch for the year 1955-56: chairman, H. L. Roblin; vice-chairman, R. N. McManus; Executives for one-year term, J. A. Brownlee. S. J. Hampton, A. W. Peterson, and D. E. A. Mackay; (these members are completing the second year of a two-year term); executives for two-year term, T. M. Carscadden, B. Y. Lynn, T. H. Newton, and W. D. Stothert; secretary-treasurer, R. B. Kerr; auditors, E. E. Moore and K. Provost.

All of the above reports and recommendations were adopted by the required majority vote of the branch membership.

Halifax

W. D. PIPPY, M.E.I.C.,
Secretary-Treasurer

FRED H. TREMAIN, M.E.I.C.,
Branch News Editor

Technical Meeting, March 3

A technical meeting of the Branch was held on Thursday, March 3, 1955, at 8.00 p.m. in the Assembly Room of the MacDonald Building, Nova Scotia Technical College. This meeting was of particular interest to engineers in the electrical field. There were two speakers for this meeting. D. G. Brown, of the Nova Scotia Light & Power Co. Ltd., spoke on "Pilot Wire Relaying in the Halifax System". This was a very interesting talk and was illustrated with slides. R. W. Wilson, of the Maritime Telegraph and Telephone Co. Ltd., spoke on "The Use of Radio in Telephone Communications". This talk was illustrated by drawings and dealt chiefly with the use of micro wave in the Maritimes and particularly between Halifax and Saint John, N.B. A discussion period was held before the meeting was adjourned. Approximately 70 members were in attendance.

Buffet Supper, March 31

A general meeting in the form of a buffet supper was held in the Bedford Room of the Nova Scotian Hotel on Thursday, March 31, at 5.30 p.m. This meeting had an attendance of over 125 members.

The speakers for this meeting were Dr. P. L. Pratley, and his son, Hugh Pratley.

Their subject was in connection with the new Angus L. Macdonald Bridge. Dr. Pratley designed this structure and spoke at length on the various problems of design. Hugh Pratley, who was the engineer in charge of construction, outlined in detail the various stages of construction. The bridge was officially opened for traffic on April 2 with appropriate ceremonies and Mrs. Angus L. Macdonald, widow of the late Premier of Nova Scotia, cut the ribbon.

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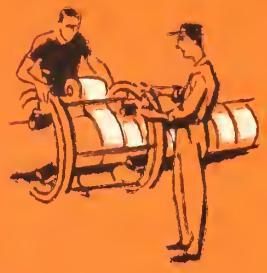

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Joint Meeting, April 14

The second annual joint meeting o the Military Engineers Association o Canada and the Halifax Branch of th Engineering Institute of Canada wa held in the Robie Street Armouries o Thursday, April 14, at 8.30 p.m. wit approximately 135 in attendance. Th speaker was Lt. Col. E. Churchill Deputy Director of Works (Eng.) Army Headquarters, Ottawa. His subject wa "Camp Gagetown and its Develop ment".

Camp Gagetown

Camp Gagetown is one of the majo construction projects undertaken in the Maritimes in recent years and is slated for completion and in full operation by the end of next year.

It is located approximately 14 miles from Fredericton and was chosen for the reason that the terrain was suitable for all types of army training, includ ing field training in heavy artillery jungle fighting and mountain warfare It covers an area of approximately 427 square miles. It is proposed to construct 100 buildings of concrete, steelframe or stucco construction; and there will be a 115-125 bed hospital, an 800 seat theatre, stores, etc.; and an independent telephone exchange.

The camp will use two million gallons of water a day and will have a central heating plant nine storeys high It will be the largest building in the area.

Over 2,000 people were displaced and more than 1,000 legal transactions were involved in purchasing and expropriating the site.

After a discussion and question period George A. Cunningham, vice-chairman of the Halifax Branch, moved a vote of thanks to Lt. Col. Churchill for his excellent talk.

Hamilton

A. F. Barnard, Jr.E.I.C.,
Secretary-Treasurer

Ross R. Packer, Jr.E.I.C.,
Branch News Editor

Annual Joint Meeting with A.I.E.E.

The Hamilton and Toronto sections of the A.I.E.E. were our hosts at a joint meeting on April 15, at the Westinghouse Auditorium in Hamilton. J. W. Kerr welcomed us on behalf of Canadian Westinghouse.

H. Tovee introduced the speaker Graham L. Moses, who first worked for Westinghouse Electric in the railway division, then with the railway engineering department, before entering 12 years ago the insulation development section which he has headed for the past five years.

Graham L. Moses, Guest Speaker

Graham L. Moses discussed new insulation and new process techniques. Motors were first insulated using natural substance such as mica splittings, which still has many advantages but has recently been greatly supplemented by insulation and binders developed by modern chemistry.

Insulations must have many properties to withstand such stresses as thermal aging, conducting contaminates, thermal expansion, mechanical damage, high voltage, and looseness due to expansion.

(*Continued on page 878 (86)*

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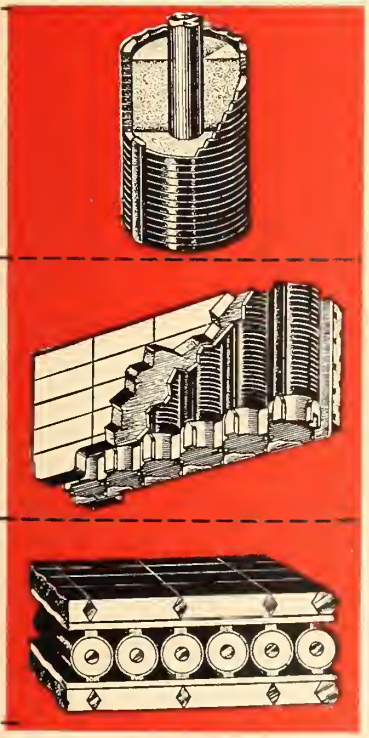

...g through centre of each ...r Tube" is an alloy core which is ...ss with the heavy tap cross bar. These ...rm the sturdy, nan-buckling grid. Bath ...ar ...nd top bar are made of Exide's ...w ...arrasian-resistant Silvium, an ...llo... of silver, lead and ather com-...n...s, which adds greatly ta plate's ...ng...fe.

...ew ...polyethylene insulating tube ...ea ... of acidproaf, nan-carroding ...pla... fits snugly inta battam af ...Po... Tubes" eliminating lass of ...ac... material fram the bottam ...of ...e plate, thus Ironclad's high ...ap...ty is sustained far langer ...wor...g life.

...ot ...much greater expasure af ...ac... material to electrolyte as ...om...red with that af usual flat ...pas...e plate. This makes passible ...the ...gh pawer ability and unifarm ...rat...e characteristics af the Iron-...ad Negative plates are extra ...ea ... to balance increased capacity ...of t... "Power Tube" pasitives.

FOR PEAK PERFORMANCE OVER A LONGER LIFE

Ironclad's exclusive power tube positive plates ore the most effective power retoiners ever demonstroted in motive power service.

These tubulor, polyethylene retoiners contain hundreds of fine slots which permit the electrolyte to flow freely to the octive moteriol which is packed around a centre core of heavy corrosion-resistant Silvium olloy.

Eoch tube is end-seoled. At the top by the heovy, Silvium olloy, current-corrying bor . . . ot the bottom by o polyethylene seoler.

This simple construction permits the lowest known internal resistonce, eliminates plate buckling, minimizes grid-structure stresses due to exponsion or controction in o working bottery, ond holds the shedding of octive moteriol to o minimum.

These ore the things to remember when buying o motive power bottery . . . the things that meon higher power obility, longer working life, lower depreciotion cost and less operotionol expense.

An Exide-Ironclod bottery will give you snappy truck perform-once right to the end of the working doy . . . and last years longer.

Exide IRONCLAD

...XIDE BATTERIES OF CANADA LIMITED

MONTREAL **TORONTO** VANCOUVER

Western Engineers Hold Meetings

Prince Rupert. Left to right, J. G. Lewis, L. Evans, L
Orr, Wentworth Brown, R. O. Evans, Mr. Kristmanson
M. Wayman, R. Cunliffe, V. T. B. Williams, J. P. Jopp
R. M. Sanford, D. J. Doswell, Colonel Grant, T. G
Spangler, R. McBride, W. C. R. Jones.

Prince Rupert. V. T. B. Williams, Colonel Grant, J
Cummings, R. McBride.

Prince George. H. P. Burden, W. J. MacKenzie and Co
Grant.

Kitimat. Seated, R. A. H. Ruddell, P. M. Hopkins, J.
Fortier, P. E. Radley, J. G. Campbell, Col. Grant, P. W
Douglas-Turner. Standing, A. C. Turney, H. C. Jer
kinson, R. C. Hermann, R. W. Kraft, J. L. Connolly, F. T
Boutillier, L. A. Kirkpatrick, H. D. McLellan, F.
Hauser, G. T. Trudeau, W. H. Sparks, J. T. Madill, K. I
Sommer, S. Butte.

The field secretary, Lt.-Col. L. F. Grant visited the West in February and March. These are some of the groups of engineers who held meetings for the occasion.

Flin Flon. Front row, left to right, J. Stirling, K. McMillan, B. Gordon, L. Guglielmin, G. Feldman, R. Comstock. Back row, A. Harder, J. Siryj, Col. Grant, W. Kasperski, D. Treilhard, F. Pearson, M. Kostiuk.

Beecan Falls. S. W. Forstrom, J. M. Heaps, J. Graham.

Brandon. A distinguished friend at the Brandon meeting was W. H. Shillinglaw, who became a Student member of the Institute in 1887. He makes his home in Brandon, where he practised for many years as a municipal engineer and in private practice.

Brandon. From left to right, around the table, Geo. Durnin, K. Maitland, G. Miller, Col. Grant, J. Hoogstraten, L. Stevenson, C. Smelts, E. Hayward, E. Locke, C. Landon, W. Taciuk, L. Blackman, G. Beech, E. Kaarsberg, R. Sharpe, G. B. Williams, J. Harrison, J. Peacock.

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Branch News

Hamilton

(*Continued from page 874* (*84*))

New Material, New Procedure

Thermal insulation is a radical departure which employs not only a new material but also a new procedure. The material used is a tape of mica splittings with impregnating polyester. The soluble is dissolved in the resin used and a catalyst is contained which aids the reaction with the bond in mica tape without producing any liquids or gases. The change takes place directly from liquid to solid and is irreversible.

The chemical components are built in place to fill the voids between the large molecules of mica. As a result of the process it takes one thousand times as long to destroy the mica walls. It even has restorative properties and is chemically inert.

During the reaction any moisture present is driven out. The thermal conductivity is high, thus lets more heat escape resulting in longer life.

Thermalastic Insulation

With thermalastic insulation, electrical machinery coils now can be made with size control and dimensional stability. The technique is to subject the coils taped with the special tape consisting of mica splittings and a binder to a high vacuum, then to spray the coils with the solvent in a pressure chamber. The coils cure in moulds to ensure dimensional control. The thermalastic insulation has one quarter the thickness expanse of asbestos insulation.

Slides were shown of a core model used to test insulation. A graph of time versus voltage to cause failure showed an increase in voltage for any time but a much greater increase (1000:1) in the time for a specific voltage.

The first thermalastic insulated coils were used with steam turbine generators, later with water wheel generators. In 1951 some low voltage machines were insulated, however in 1954 it became standard for all a-c. motors. We were informed that now Westinghouse insulate with thermalastic all d-c. motors and generators.

The thermalastic insulated motors stand up well under service operating conditions such as in rubber plants where carbon black is a problem, or in moisture laden atmospheres. The resistance to ground of motors while being sprayed for 275 hours dropped greatly with both asbestos and thermalastic insulation, but the motor with thermalastic insulation returned to high megohm reading very rapidly while drying while standing over a pool of water.

D-c Test

Mr. Moses commented on the d-c. test used to test coils. A study of the coils which failed during the d-c. test disclosed that they should have failed, and not one stator has failed since receiving and passing the d-c. test. For the last five years all preliminary tests at Westinghouse are d-c. before the final a-c. test.

Any attempt to forecast failure has been made by increasing the d-c. voltage slowly to the required value.

New coils designed for cooling will necessitate new insulation, said Mr.

PHOTO ANALYSIS
AND INTERPRETATION

THE PROOF OF THE PUDDING..

Mapped 4000 miles away—but when the survey party arrived at the spot the peat sampler brought up the proof—here was buried trouble exposed in time to save expensive changes in plans and location.

DAM SITES—RAILROADS
ROADS—PIPELINES—AIRFIELDS

LOCATION Before you plan construction, know the ground conditions thoroughly and avoid trouble. Our soil surveys give you this information *on time* and *in time* for maximum use. Our experts will help you avoid the problems of peat and muck deposits, unstable soils, rock excavation, landslides and seepage.

MATERIALS SURVEYS Our Materials Survey Division located 32.5 million cubic yards of gravel and 50 million cubic yards of clay and special borrow in 1954. Our rapid and accurate surveys locate undeveloped sources of concrete aggregates, filter sands, clays and special borrow for engineers, contractors and ready-mix plants.

INDUSTRIAL SITES Our reports on area studies are the most authoritative available, drawing on the full experience of modern geology, engineering, agriculture and transportation. They include such factors as foundation conditions, ground water resources, climate, related housing, transportation, fill and construction materials.

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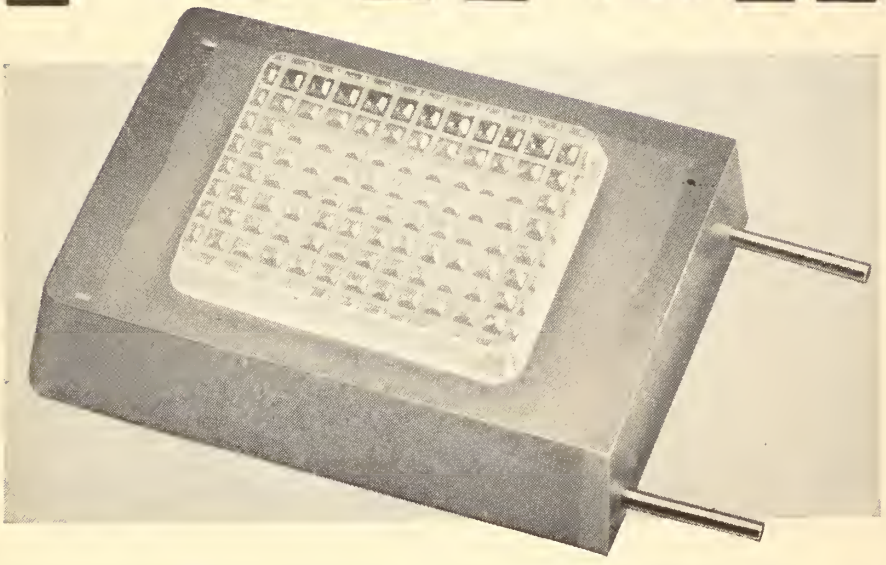
POWER



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The superiority of Canadian Marconi Photoconductive Cells is shown in this review of its characteristics.

Dissipation	0.3 watts max.
Voltage	1.5 to 120 max. volts (a.c. or d.c.)
Current	20 ma max.
Temperature	−70°C. to 75°C. ambient
Spectral Response approximates that of the eye.	
Wavelength at max. response	5100 angstroms
Dark resistance	10 to 1000 megohms
*Sensitivity at 1 ft. candle (100 volts)	0.15 to 0.4 amp/lumen
Capacitance	20-30 mmfd
Rise-time at 50 ft. candles	5 m. sec
Decay-time at 50 ft. candles	10 m. sec

*Measured with a 2854°K colour temperature tungsten lamp.

NOW AVAILABLE

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CANADIAN MARCONI COMPANY

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Moses, but he felt sure that new and better insulation will be developed.

After a question period, the members and guests enjoyed a light lunch.

Nipissing and Upper Ottawa

E. A. Watson, M.E.I.C.,
Secretary-Treasurer

A. T. McKerrall, M.E.I.C.,
Branch News Editor

R. R. Prescott Elected Chairman

R. R. Prescott of Temiskaming was elected chairman of the Nipissing and Upper Ottawa Branch of the Engineering Institute of Canada at the annual meeting of the Branch held on April 27, 1955, at the Manor Hotel.

Following dinner J. W. Millar, the outgoing chairman, presided over the election of officers and a business session. E. A. Watson presented the secretary-treasurer's report, G. L. Hood, the Membership Committee's Report, F. R. Marshall, the Entertainment Committee's report, H. R. D. Graham, the Papers Committee's report and R. R. Prescott, the report by the committee studying the Smith report on amalgamation.

Those elected to the executive of the branch were: R. R. Prescott, chairman; T. C. MacNabb, vice-chairman; F. R. Marshall, Committee, North Bay; and R. A. Booy, Committee, Temiskaming.

Mr. Millar outlined the highlights of the past year and turned the chair over to Mr. Prescott. The meeting adjourned following a few remarks by the incoming chairman.

Northern New Brunswick

G. J. Melanson, Jr.E.I.C.,
Secretary-Treasurer

J. O. Flower, Jr.E.I.C.,
Branch News Editor

General Meeting, April 29

A general meeting of the Northern New Brunswick Branch of the Engineering Institute of Canada was held April 29 at the Bathurst High School. Chairman G. A. Kirner presided, and there were 30 members present.

Nominations were received for the executive for 1955-56, and C. R. Whalen and T. W. Creaghan of Dalhousie were appointed auditors.

Leonardo da Vinci Film

After the business meeting a documentary film on the lifework of Leonardo da Vinci was shown. This was one of the first screenings of this film in Canada. It illustrated beyond any doubt, that Leonardo da Vinci was the pioneer supreme of all engineers, and that his theories, written down centuries ago, are the cultural base of the engineering profession today.

Saint John

J. W. G. Scott, M.E.I.C.,
Secretary-Treasurer

G. E. Graham, M.E.I.C.,
Branch News Editor

"Operation Budworm"

The regular monthly meeting of the Engineering Institute of Canada, Saint John Branch, was held in the Admiral Beatty Hotel on Tuesday, May 10, 1955. In the absence of the chairman, T. C.

"How do you know they'll meet?"

A bridge begins its life long before the first member is hoisted into position.

It starts on the drawing board, where loads and stresses are translated into the necessary girders, beams and rivets. When fabrication begins the plans are precise—there can be no margin for error. This demands a combination of science and practical knowledge to a high degree.

As designers and builders of successful bridges across Canada, Bridge & Tank offers you this combination. Whether your problem is one of bridges, storage tanks, buildings, pressure vessels, towers or machined parts, the Bridge & Tank team of steel companies is equipped, in facilities and experience, to answer it.

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The electrolytic corrosion resulting from a junction of copper tubing with a steel header is entirely absent where "Steeline" is used . . . the liners being arc-welded to the headers to form an all-ferrous construction.

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Higginson, J. Frank Dody presided. Mr Dody introduced the speaker for the evening, B. W. Fleiger, who is manager of the Forest Protection Department of Campbellton, N.B.

Mr. Fleiger spoke under the title "Operation Budworm". He said that in the fall of 1951 an extremely bad situation had developed in the forests in the north of the province where an epidemic of spruce budworm was in full swing.

Aerial Spraying

It was decided to attempt an aerial spraying program to control the budworm. Pulp and paper companies and the provincial government decided that some action should be taken to preserve valuable timber and a forest spraying program was decided on in the fall of 1951.

Since float aircraft could not be used, it was necessary to provide air fields inside the spraying area. In November, 1951, the first field was started and was completed in January, 1952. This field was 250 feet wide and ½ mile long. All material had to be moved to the site in the winter before a heavy spring break-up.

A new insecticide had to be developed which could be stored under winter conditions. There was great difficulty in procuring spraying aircraft and they were obtained from the United States, mostly from west of the Mississippi.

Biological control of the operation was handled by the Federal Department of Agriculture. They specified when the application of spray should be made and per cent kill of the insects.

One Hundred Per Cent Kill

First results indicated one hundred per cent kill of insect population. The first year the area covered was about ten per cent of the infested area, about 300 sq. miles. By the end of July this area had been heavily reinfested from outside and it was decided that spraying should be greatly extended in the next year.

The Province of New Brunswick, four pulp and paper companies, and the federal government share cost of spray.

In 1953 a new method was used to cover a wider area with less spray and 1,800,000 acres were treated. In 1954 the reinfestation was not as serious as in 1953.

In 1953 five additional airfields were built and in 1954, two more.

The spraying operation has grown from 300 sq. miles in 1951 to 4,000 sq. miles in 1955. The same insecticide has been used throughout.

Pine Forest Susceptible

Efficiency has been gained through the use of one type of aircraft and one type of engine. About eighty aircraft will be used in 1955 with ten inspection aircraft flying from six locations in New Brunswick and four in Quebec. Control of this insect is of vital importance to the province. The pulp and paper industry is based on a pine forest which is very susceptible to budworm attack.

The present object of the spraying operation is to keep the forest alive until natural conditions develop to stop the epidemic.

At the conclusion of the talk pictures showing part of the operation were shown by H. B. Lingley. Mr. Fleiger was thanked for his interesting talk by John Flood.

The PROOF of a building's age is behind these doors!

Five seconds behind these doors, and you *know* your building's age!

Notice the plumbing fixtures. If they are off-the-floor . . . your building is new forever. If not . . . it is obsolete when the doors first open.

Off-the-floor fixtures installed today will never give away the age of your buildings. Year after year, they will continue to contribute to the desireability—and marketability—of your investment. They add graciousness. They free washrooms of litter-traps and breeding grounds for bacteria. They do away with obstacles to easy cleaning and hospital-like sanitation.

In today's major buildings, more than 800,000 such fixtures are supported on the ZURN SYSTEM®. You should look into the reasons why. You will find, among other things, that Zurn-engineered, patented features simplify installation and alignment. The entire stress is on the Zurn fitting—not on the wall. And ZURN SYSTEMS never interfere with future alterations, but often make them easier.

Buildings age fast enough. Do not give yours a running start by designing washrooms that are obsolete when the doors first open.

Before planning your next building, be sure to write for the helpful new booklet, "Behind Closed Doors." It is your guide to modern, sanitary washroom decor. 110-1

The ZURN ZERO ZONE® is created by mounting off-the-floor plumbing fixtures on behind-the-wall ZURN SYSTEMS. This permits the highest degree of restroom sanitation to be attained and maintained. All major plumbing manufacturers make fixtures to fit the ZURN SYSTEM.

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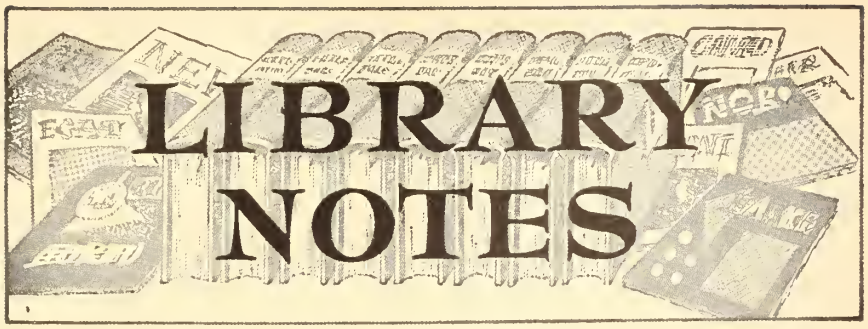

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

A history of mechanical inventions, rev. ed. A. P. Usher. Cambridge, Harvard University press, Toronto, Saunders, 1954. 450 pp., illus., $11.75.

During the years since 1929, when the first edition of this work appeared, it has become recognized as a masterpiece of thought and presentation in the field of mechanical invention. In this completely revised edition the author's theories on his subject have been further developed in the four additional introductory chapters. In the main these theories are based on Gestalt psychology and on the concept of a continuous social evolution. Emphasis is placed on the importance of economic forces in the development of technology. The author, however, is not dogmatic in this analysis of historical invention and does not present his theories as proof of the school of thought which they represent.

Following these preliminary chapters an account is given of various specific mechanisms and of general developments and trends. This section is not as detailed as the account found in the new five-volume "History of Technology", edited by Charles Singer, E. J. Holmyard and A. R. Hall, but the method of presentation is logical and fascinating.

Two chapters are devoted to the early history of mechanical sciences and to the equipment of pre-Christian antiquity, a history which demonstrates some surprisingly advanced thinking. Next comes a discussion of water wheels, windmills, water clocks and mechanical clocks during primitive times.

Of special interest to our readers will be the story of Leonardo da Vinci, the engineer and inventor, for many have seen, or will soon have the opportunity to see, the film of his work which was recently purchased by the Engineering Institute of Canada.

The development of printing is included as well as textile machinery, and precision instruments which were evolved from clocks and watches. The last section is devoted to the production and distribution of power in general and to a number of operative mechanisms in particular.

This revised edition will interest many classes of readers, from scientists and technicians to those concerned with the history of science and invention and with economic and social history. M.R.

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BOOK NOTES

Prepared by the Library
The Engineering Institute of Canada

*Review provided through the courtesy of the Engineering Societies Library in New York.

Prepared by the Library
The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Angewandte Nomographie, Teil 1. Fritz Kiessler. Essen, Girardet, 1952. 135 pp., illus., 18 DM.

The first volume of this book on applied nomography is divided into five general sections, beginning with a theoretical introduction to this method of graphically solving equations.

Equations with two and three variables are covered within such subjects as parallel scale nomographs. A great number of equations and graphs are naturally included and it should prove a useful book to any of our readers who are at home in the German language.

Basic electronics. Van Valkenburgh Nooger & Neville, Inc. New York Rider, 1955. 5 vols., figs., $2.00 (U.S.) per vol., $9.00 (U.S.) per set.

A companion series to "Basic electricity" this set is the second half of the U.S. Navy's electricity and electronics training program. It is a very simplified approach to the subject and makes extensive use of illustrations. The course covers diodes, power supplies amplifiers, oscillators, transmitters and receivers. Each section is followed by review pages which assist in home studying.

Basic vacuum tubes and their uses J. F. Rider and Henry Jacobowitz New York, Rider, 1955. 204 pp. diagrs., $3.00 (U.S.).

This is a scientific explanation, on an elementary level, of the theory and operation of the basic types of vacuum tubes. Included is material on electron and electron emission, diodes, triodes and multielectrode tubes.

Baumaschinen-Wartung. Heinrich Ilsemann. Berlin, Ernst, 1955. 86 pp. illus., 9.80 DM.

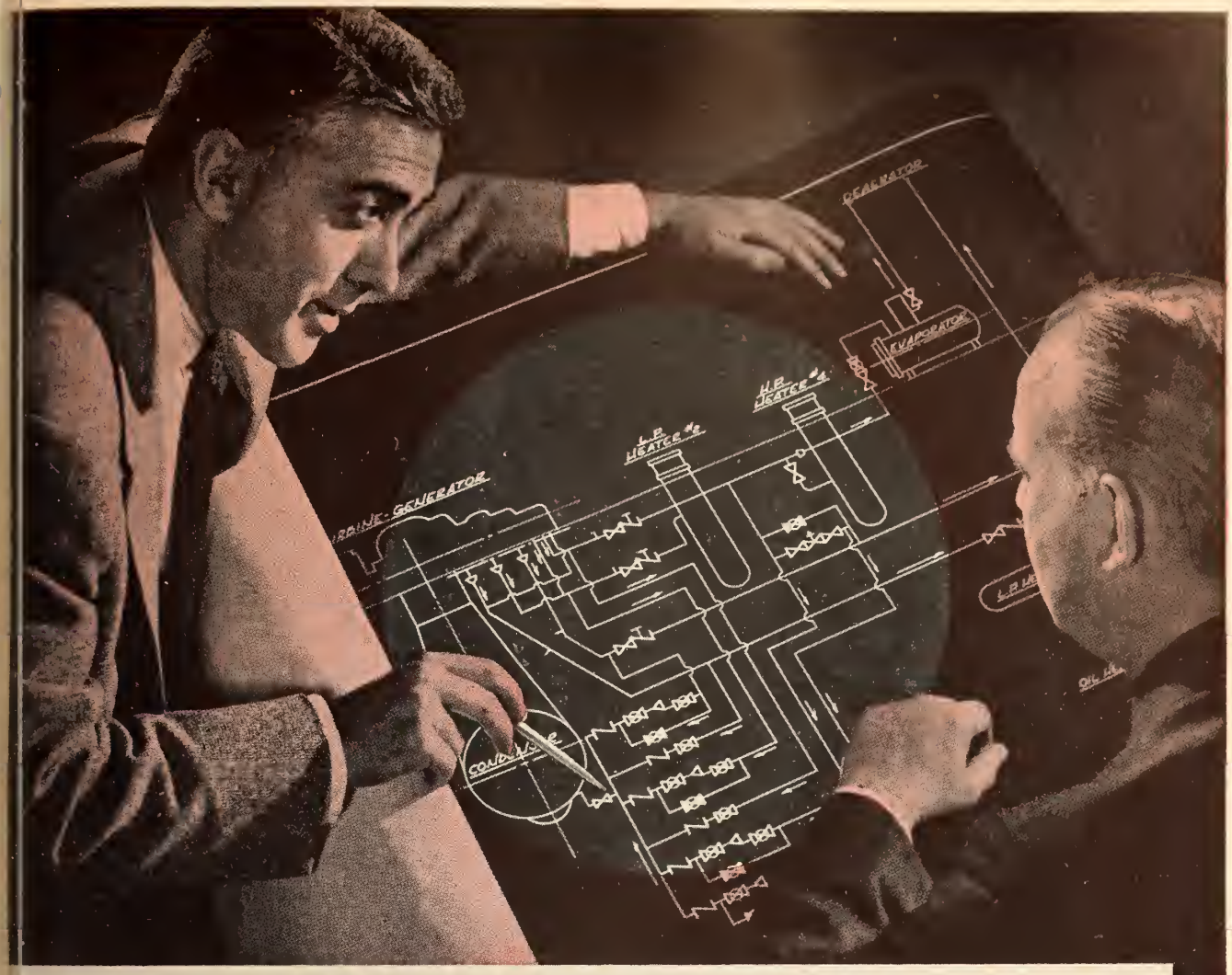
In this construction guide for overseers, foremen and engineers we find a well-illustrated description of tools and equipment used in the building industry.

Methods of site preparation and the provision of such necessary supplies as water, grease, and lubrication are the subject of the first section of the book.

The second main section discusses various types of equipment. These include machines for lifting and transporting materials; earth moving equipment cranes; and diesel engines.

***Behavior of metals under impulsive loads.** J. S. Rinehart and J. Pearson Cleveland, American society for metals, 1954. 256 pp., ilus., $5.5 (U.S.).

Using a broad and general approach in order to furnish the physicist and engineer with a background for further studies, this book discusses the characte



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of impulsive loading, conditions under which such loading develops, and the main phenomena involved when materials are subjected to rapidly applied loads of short duration. The book includes treatment of loads and forces generated by impacts and explosions, and of fundamental aspects of failure under impulsive loads.

***Big dam foolishness; the problem of modern flood control and water storage.** E. T. Peterson. New York, Devin-Adair, 1954. 224 pp., illus., $3.75 (U.S.).

The author, a journalist who has traveled and read widely in his study of the problem of modern flood control and water storage, strongly advocates conservation practices such as upstream small dams and ponds, terracing, breaking-up of the plow pan, and the growing of cover crops. Highly critical of the big dam program, he discusses a number of water and flood control projects of both kinds, with comparisons of situations, costs, and overall effectiveness. Statements are quoted, but no bibliography is given.

Canadian who's who, v. 6, 1952-1954. Toronto, Trans-Canada Press, 1954. 1175 pp., $27.00.

The latest edition of this reference book contains over 8,000 biographies of Canadian men and women It is intended to keep the volume up-to-date with semi-annual service booklets which will include new listings, appointments, retirements, deaths and other corrections.

Inclusion in this directory is decided by the editors, and does not entail payment of any kind. Although the criteria for selection are not given, an attempt seems to have been made to include a wide selection of people, and there is a useful directory in which the biographies are arranged by profession.

This valuable work is essential in any Canadian library.

***Control-system dynamics.** W. R. Evans. Toronto, McGraw-Hill, 1954. 282 pp., figs., $7.00.

The analysis of the dynamic response of linear systems is the main theme of this book. Problems of design, typical components, and physical and mathematical concepts involved in control systems are treated, and the La Place transform, frequency-response, root-locus, and other methods of analysis are discussed and applied to a variety of problems. The root-locus method, developed by the author is applied in separate chapters to the solution of multiple loop systems and circuit analysis. The final chapter discusses graphical analysis of non-linear systems. A brief bibliography is included.

Cours d'électrotechnique; 3ième partie, Centrales, réseaux, applications diverses. Edgar Gillon. Paris, Dunod, Montréal, Fomac, 1954. 568 pp., illus. $16.20.

The subject of this volume is a broad one and the author states that only fundamental principles relating to the electrotechnics of power stations, networks and other applications have been included.

The first part deals with the production of electrical power in power stations, including the subjects of protection against overvoltage and of materials used in power stations.

The transportation and distribution of electrical power forms the subject matter of the second section while the third deals with such matters as electric lighting, electrothermics and electrical traction in connection with tramways and trolleybuses.

Cours de résistance des matériaux. J. Courbon. Paris, Dunod, Montreal, Fomac, 1955. 782 pp., illus., $29.60.

We have here an extensive treatise on the subject of the strength of materials written by a well-known member of the French School of Bridges and Roads. His book contains both the theory and the practical problems connected with strength of materials as a factor in construction.

The first few of the thirty chapters discuss such matters as the theory of elasticity and the mechanical properties of materials. There follows a section on beams with a description of the stresses and deformation affecting them. The mathematical methods of calculating strength of materials are dealt with as well as methods used in determining the strength of such components as arches and plates.

***Design of machine elements,** 3rd ed. V. M. Faires. Toronto, Macmillan. 1955. 550 pp., illus., $7.50.

Basic theories of strength of materials, and other pertinent theories are applied in this book to the actual design of the most common machine elements; links, gears, shafts, springs, bearings, belts, etc. The new edition is featured by expanded treatment of variable stresses and fatigue, more detailed coverage of mechanical properties of materials, and new design information for most of the elements. Originally written as a textbook, an effort has been made to make this edition useful also to practicing engineers.

***Deterioration of materials; causes and preventive techniques.** G. A. Greathouse and C. J. Wessel, eds. New York, Reinhold, 1954. 835 pp., illus., $12.00 (U.S.)

Basic principles involved in the preservation of materials are discussed and the most effective practical preventive measures are summarized. The first section covers causes of deterioration and the nature of deterioration processes. The next two sections discuss prevention for broad classes of specific materials—metals, wood, paper, textiles, plastics, paints, etc.—and for assembled units—electrical, electronic, and photographic equipment, and optical instruments. References are cited after each chapter.

***Development of the guided missile,** 2nd ed. K. W. Gatland. London, published for "Flight" by Iliffe, 1954. 292 pp., illus., 15/-.

A survey of the evolution of guided missiles up to the present time and a description of their possible future development. Methods of propulsion of rockets and ram-jets, current methods of research and both military and peaceful applications of various types of missiles are discussed, with consideration given to rockets for high altitude research, space satellites, and interplanetary flight. Appendixes give comparative data on 140 rockets from 8 countries and scale photographs of over 40 notable rockets.

Élasticité et anélasticité des métaux, C. Zener. Paris, Dunod, Montreal, Fomac, 1955. 174pp., figs., $10.25.

First published by the University of Chicago in 1948, this monograph discusses the elastic and anelastic properties of metals. The latter term was devised to designate non-permanent deformation under conditions of stress.

The first section contains four chapters on the subject of the elasticity of metals. The first of these covers the mathematical relationship between stress and deformation. The remaining chapters cover the influences of temperature on the elastic qualities of metals and discuss microelasticity.

In the section on the anelasticity of metals the physical interpretation of this phenomenon is given and other theories relating to the subject are outlined.

The English edition of the book is also in the library.

***Electric power stations,** volume 1, 4th ed., rev. & enl. R. H. Carr. Toronto, British Book Service, 1954. 605p., illus., $12.00.

This book deals with general principles governing design, construction, and operation of power stations. The major topics discussed are fundamentals of station design; sites and buildings; circulating water systems; cooling towers; coal-handling plant; ash-handling plant; boiler plant; pipework; and turbines. There are chapter bibliographies.

The elements of probability theory, and some of its applications. Harald Cramér. New York, Wiley, 1955. 281pp., $7.00.

While this is a fairly elementary treatise on the theories of probability and statistics the reader must have an understanding of analytic geometry, calculus, and algebra, including determinants. Graded exercises and problems are designed to aid the reader's understanding.

An historical introduction to the probability theory is followed by the fundamental theorems underlying mathematical probability. In the second section the emphasis is on random variables and probability distributions. These include the binominal and related distributions, normal distribution and variables and distributions in two dimensions.

Part III discusses the applications of the probability theory e.g. sampling distributions and methods of estimation. The last chapter contains some observations on the theory of errors, analysis of variance and statistical quality control.

How to install TV antennas. S. L. Marshall. New York, Rider, 1955. 124pp., illus., $2.50 (U.S.).

This book deals with every aspect of the installation of both VHF and UHF television antennas, and includes chapters on fundamentals, transmission lines and installation methods and materials. It is intended for the practical man.

***Industrial dust; hygienic significance, measurement and control.** 2nd ed. P. Drinker and T Hatch. Toronto, McGraw-Hill, 1954. 401p., illus., $12.50.

A critical discussion, written from the engineer's standpoint, with considerable space devoted to medical aspects which influence the design and operation of dust-control equipment. It covers physical and chemical properties of dusts,

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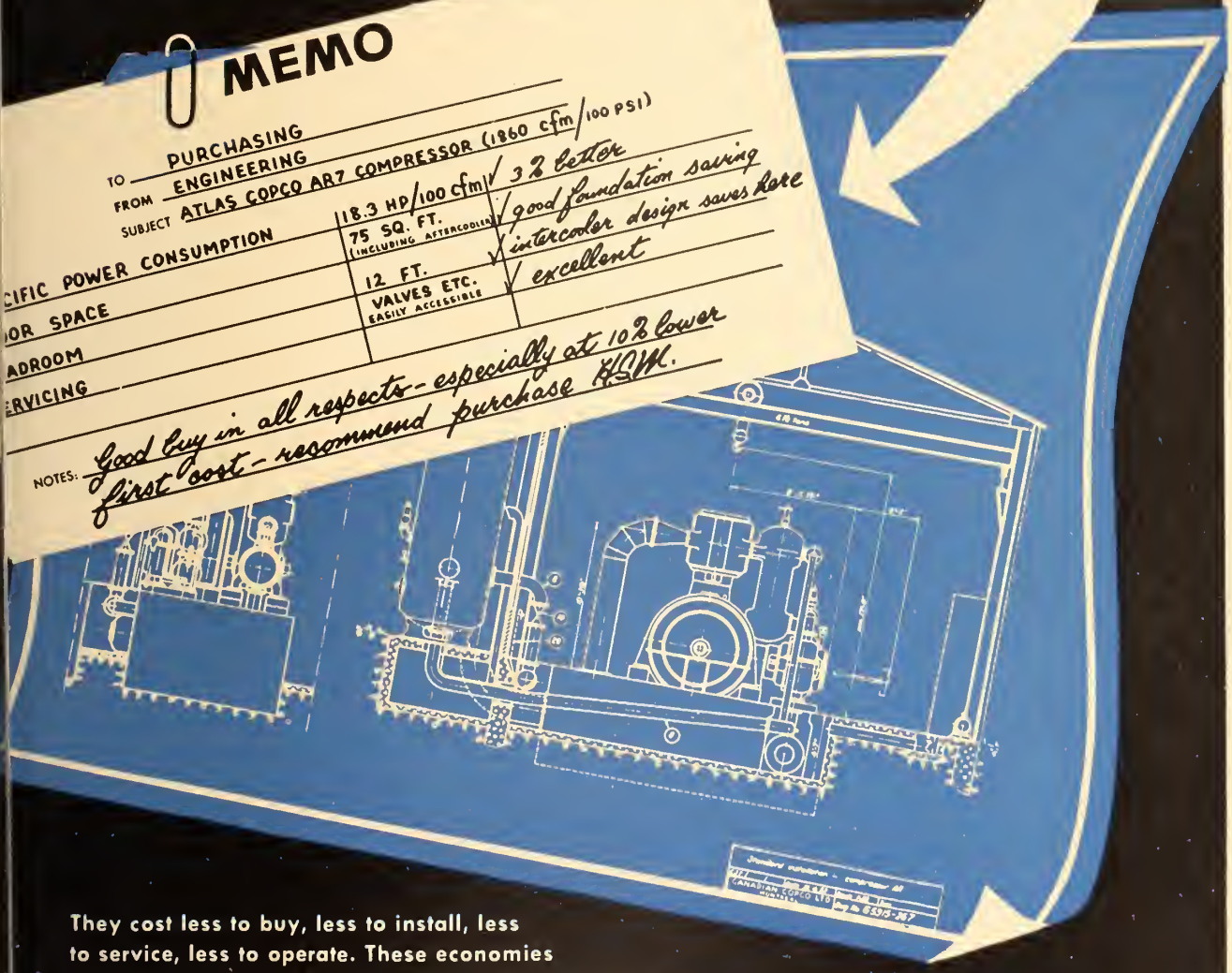

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fumes, and mists, and their effect on man; analysis, measurement, and microscopy of dusts; and methods for the control of dusts. Material is included on design of exhaust systems, filtering, electrical precipitation, and respirators, and there is a bibliography of 458 references.

Materials of construction; their manufacture and properties, 6th ed. A. P. Mills, H. W. Hayward and L. F. Rader. New York, Wiley, 1955. 650pp., illus., $7.50.

The materials covered in the sixth edition of this popular textbook include metals, stone, cement and concrete, brick, timber and plastics.

Much of the text has been revised by Professor Rader for this edition, and several new chapters included. The section on the service requirements of metals has been revised, as have those on the developments in steel, alloy steels and light weight non-ferrous alloys, and on organic protective coatings and organic plastics. The chapter on laminates and adhesives is new.

The book covers the manufacture, properties, and uses of materials of engineering construction, and should prove useful to both students and those needing a fairly concise survey of the subject.

Métallurgie strueturale théorique. A. H. Cottrell. Paris, Dunod, Montreal, Fomac, 1955. 330pp., figs., $11.00.

In the introduction to this book by a well known author the subject matter is summed up as covering the general laws of physics, the atomic structure of metals and the make-up of the metallic atom itself. The book was written for the practising metallurgist who may find in it ideas for future research, and also for students of metallurgy and engineering.

The chapter headings show in detail what is included: the structure of the atom and interatomic forces; the crystal structure of metals; the electronic theory of metals; thermal behaviour of metals; alloy phases.

The presentation of material is clear and well organized and the translation from English was done by a specialist in the subject.

Pathologie et thérapeutique du béton armé, 2e. d. Henry Lossier, Paris, Dunod. Montreal, Fomac, 1955. 156pp. illus., $4.00.

In reviewing the failures which have occurred, or may take place, in reinforced concrete structures the author attributes them to three causes: the planning of the project; the forms and arches; and the quality and use of materials.

While upholding the use of reinforced concrete the author cites various mistakes in reasonning which have caused accidents, and explains how they can be avoided.

Picture book of TV troubles, v.2. J. F. Rider laboratories staff. New York, Rider, 1955. 91pp., illus., $1.80 (U.S.).

This volume is devoted to vertical sweep and deflection circuits, and outlines the troubles which may be caused in receivers through defects in these. The book is illustrated, and later volumes in the series will deal with other sections of the TV receiver.

Professional engineering registration laws; a compendium. A. L. McCawley, comp. Washington, National society of professional engineers, 1955. 614pp., $8.75 (U.S.).

While this compendium of registration laws for professional engineers in the United States, Alaska, Hawaii and Puerto Rico will be of prime interest to American engineers it will also be useful to those Canadians contemplating a move to our neighbouring country.

There will be general interest as well in comparing the legal requirements necessary for professional practice. These include educational requirements, experience, examinations, public works projects, fees and bonds, certificate applications and temporary permits.

The book is arranged alphabetically by state with the year given when the registration laws were first enacted. It is planned to revise this volume at intervals of ten years or less and to issue supplements between these revisions. This edition covers the years from 1907 to 1954.

A professional look at the engineer in industry. Engineer-in-industry committee. Washington, National society of professional engineers, 1955. 124pp., $3.00 (U.S.).

While the drive for unionism of engineers in Canada may not have been as forceful as has been the case in the United States there will, nevertheless, be great interest taken in this publication. The case for and against unions is thoroughly explored and suggestions are made for a series of remedial actions by management and individual engineers in the fields of professional status, employment conditions and economic status. Forty-six specific areas for improving engineer-management relationships are discussed by the committee.

The book analyzes the policy of the National Society of Professional Engineers that professionalism and unionism are incompatible concepts and recounts specific engineering union attitudes to strikes, etc. The non-bargaining "sounding board" organizations of engineers, a middle-of-the-road approach, is also explored.

Charts and tables in connection with the economic review are included.

Profitable small plant management. M. H. Gotterer. New York, Conover-Mast, 1954. 318pp., illus., $5.50 (U.S.).

The author, a management consultant, has written this book for the owners and managers of small plants. He has had three groups of people in mind: those planning a cost reduction or management development programme; those supervising the work of management specialists; and those who want to acquire some knowledge of scientific plant management.

Every aspect of the subject is covered concisely: organization, plant layout, production, incentives, manpower and cost control.

A Dun and Bradstreet report is quoted in which it is shown that almost ninety per cent of the business failures in the United States in 1953 were traceable to some fault in management. The author hopes that this book will point the way to more efficient management and to improved small plant operation.

Steel designers' manual. C. S. Gray and others. London, Crosby Lockwood, 1955. 909pp., figs., tables, 50/-

This is a practical manual, not a textbook dealing with the theory of structures, and is intended to include all the necessary information for the design of steel framed buildings and other steel construction. Some material, e.g. in relation to the analysis and design of rigid frames, has not been published before. The examples are based on the British standard covering the use of structural steel in building.

The subjects discussed include the theory, design and deflection of all kinds of beams; forces and deflections in framed structures; modern methods of structural analysis; theory and deflection of rigid frames; bunkers and hoppers; beams in torsion; and welded work.

An interesting section is a complete design for a 2-bay, single-storey engineering workshop while other chapters deal with tension and compression members; foundations, brackets, and plate girders.

A committee representing the British Steel Producers Conference and the British Constructional Steelwork Association cooperated closely with the authors in the production of this important work.

The TVA; an approach to the development of a region. G. R. Clapp. Chicago, University Press, Toronto, University Press, 1955. 206pp., map, $3.50.

A former chairman of the board of directors, the author writes with authority about the aims and activities of the Tennessee Valley Authority.

First Mr. Clapp outlines the history of the Authority, the dams and power plants built, and the way in which the river has been changed. He then discusses the effect the development has had on the people and states in the area.

This story of a relatively new approach to the conservation and development of an area will be of interest to many of our members.

Tape recorder manual, volume 1. Rider laboratory staff. New York, Rider, 1955. 286pp., illus., $4.50 (U.S.).

The official service and adjustment information on the products of 13 tape recorder manufacturers are covered in this volume. Included among these manufacturers are RCA, Revere, Webster-Chicago, and Bell & Howell.

The electronic details consist of the schematics, tube layout, operating voltages, photographic views of the location of the components on the chassis, parts list, etc. Complete mechanical details are also given. The products covered were manufactured between 1950 and 1955.

Théorie et pratique du séchage industriel, 6e éd. Paul Razous. Paris, Dunod, Montreal, Fomac, 1955. 322pp., illus., $11.00.

This work is a comprehensive discussion of the industrial removal of a greater or less part of the associated water from raw materials and manufactured goods during various stages of production. This drying involves

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thermo-mechanical processes which must conform to feasible limits of speed and temperatures of operation.

The book is divided into two parts, the first dealing with various types of dryers, their functions and the calculations necessary prior to their installation. The second discusses the dryers for different raw materials and manufactured products.

The author has drawn on earlier texts for this work, and also on the proceedings of the 1952 International Industrial Heating Congress, and has included a bibliography of French and German books.

Time-saver standards, 3rd ed. Architectural records. New York, Dodge, 1954. 888pp., illus., $12.50 (U.S.).

This is not a book of standards in the usual sense of the term but is rather a collection of tables, diagrams and blueprints relating to architectural design, engineering methods and building practices. Many of these originally appeared in such magazines as the Architectural Record as early as 1938.

Information is given on structural design, site preparation, uses of materials, designs of electrical installations, etc.

The present edition is divided into six major sections: office practice; standard design and construction methods, elements of residential and non-residential design; recreation, site planning and landscaping; building materials and equipment.

Both design principles and their applications are presented in these standards which will be of use to architects, engineers, designers and contractors.

***Titanium in iron and steel.** G. F. Comstock. New York, published for the Engineering Foundation, by Wiley, 1955. 294p., illus., $6.00.

The third monograph in the new series of authoritative, comprehensive summaries of available data, prepared for the practical metallurgist, engineer, steel worker, and foundryman. General information on titanium and its ores, on the preparation of the metal, and on preparation, properties and uses of alloys is given in the introductory chapter. Later chapters cover titanium as a deoxidizer in rimmed and killed wrought steels; effects of the metal on nitrogen and sulphur in steel; titanium in cast iron and steel; and titanium as the sole alloying element in pearlitic and low alloy steels. Two chapters are devoted to carbide stabilization by titanium, and the final chapter deals with precipitation-hardening steels and complex heat-resisting alloys. The bibliography includes 282 items.

***Vibration problems in engineering,** 3rd ed. S. Timoshenko. Toronto, Van Nostrand, 1955. 468p., diagrs., $9.50.

This standard work on fundamentals and applications of vibration theory has been thoroughly revised to incorporate important new developments. The first chapter, on systems having one degree of freedom, has been thoroughly recast; the chapter on non-linear vibrations has been expanded to include new methods of treatment; and the chapter covering elastic bodies has been completely revised. In the latter, new topics, such as combined bending and torsional vibrations of beams, are discussed. The appendix, dealing with measuring instruments, has been omitted from this edition.

NEW BOOKS RECIVED

The accident. Dexter Masters. Toronto, McClelland & Stewart, 1955. 406pp., $4.50.

Aciers inoxydables; aciers réfractaires. L. Colombier et J. Hochmann. Paris, Dunod, 1955. 526pp., illus., $20.90.

Aeronautical engineering catalog, 1955, 11th ed. New York, Institute of the aeronautical sciences, 1955. 346pp., illus., $7.50 (U.S.).

Aide-mémoire Dunod; méeanique-physique générale, 5e. éd. Maurice Denis-Pepin. Paris, Dunod, 1955. 216 pp., $2.25.

The amplification and distribution of sound, 3rd ed. rev. A. E. Greenlees. Toronto, British Book Service, 1955. 300pp., diagrs., $6.00.

Analog methods in computation and simulation. W. W. Soroka, Toronto, McGraw-Hill, 1954. 390pp., figs.

Annual report on the progress of rubber technology, v. 18, 1954. T. J. Drakeley, ed. London, Institute of the rubber industry, 1954. 186pp., £1.1.0.

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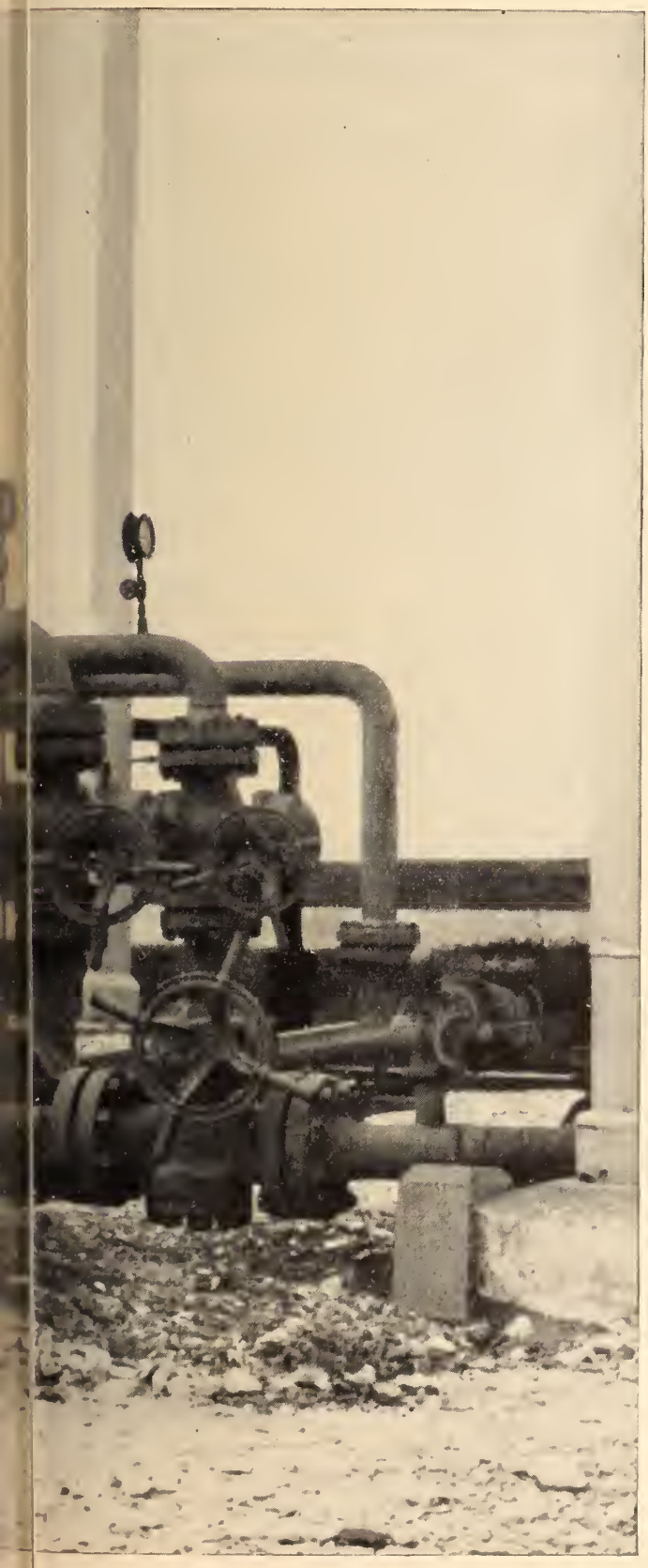

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Automatic control bibliography. W. F. Wade and E. N. Kemler. Spring Park, Minn., Summary Reports, 1955. 331pp., $15.00 (U.S.).

Beton-Kalender, 1955. Berlin, Ernst, 1955. 2 vols., 16 DM per set.

Dust is dangerous. C. N. Davies. Toronto, British Book Service, 1954. 116pp., illus., $3.60.

Fluid dynamics of jets. Shih-I Pai. Toronto, Van Nostrand. 1954. 227pp., $5.50.

Le frottement et l'usure des métaux: les anti-frictions. R. Cazaud. Paris, Dunod, 1955. 221pp., illus., $10.00.

Geology in engineering. J. R. Schultz and A. B. Cleaves. New York, Wiley, 1955. 592pp., illus., $8.75.

Glass reinforced plastics. Phillip Morgan, ed. London, Iliffe, 1954. 248pp., illus., 35/-.

A history of technology, v.1: From early times to fall of ancient empires. Charles Singer, E. J. Holmyard and A. R. Hall, eds. Toronto, Oxford University press, 1954. 827pp., illus., $22.50.

Industrial waste disposal charges in cities over 5,000 population. Chicago. American public works association, 1955. 81 pp., charts, mimeog., $3.00 (U.S.) (Special report 18-S.).

The influence of plant size on industrial relations. Princeton, University, Industrial relations section, 1955. 65pp., $2.00 (U.S.).

L'instabilité en mécanique automobiles, avions, ponts suspendus. Y. Rocard. Paris, Masson, 1954. 239pp., illus., 1200 fr.

An introduction to carrier current communications. J. N. Petrie and H. E. Clapham. Toronto, Automatic electric, 1949. 136 pp., diagrs., $3.50.

Introduction to nuclear engineering. R. L. Murray. New York, Prentice-Hall, 1954. 418pp., illus., $9.35 (U.S.).

Irrigation and hydraulic design, v.1: General principles of hydraulic design. Serge Lehavsky. Toronto, British Book Service, 1955. 492pp., illus., $21.50.

The joint and several responsibility of architects, engineers, and builders. W. S. Johnson. Montreal, Wilson et Lafleur, 1955. 215pp., $8.50.

Minerals for atomic energy. R. D. Nininger. Toronto, Van Nostrand, 1954. 367pp., illus., $8.75.

An outline of atomic physics, 3rd ed. O. H. Blackwood, T. H. Osgood and A. E. Ruark. New York, Wiley, 1955. 501pp., illus., $7.50.

A programme of nuclear power. London, H.M.S.O., Ottawa, U.K.I.O., 1955. 22pp., 25c (Cmd. 9389).

Refuse collection and disposal, a bibliography 1941-1950. Supplement 1951-1953. Washington, U.S. Public health service, 1951, 1953. (Bibliography series nos. 4 and Suppl. A.)

Servomechanisms and regulating system design, v. 2. Harold Chestnut and R. W. Mayer, New York, Wiley, 1955. 384pp., figs., $8.50.

Some fundamentals of petroleum geology. G. D. Hobson. Toronto, Oxford University press, 1954. 139pp., diagrs., $2.75.

Technique du bâti soudé. F. Koenigsberger. Paris, Dunod, 1955. 119pp., diagrs., $4.50.

TV repair questions and answers on front ends. Sidney Platt. New York, Rider, 1955. 122pp., diagrs., $2.10 (U.S.).

The testing of high speed internal combustion engines, 4th ed. rev. A. W. Judge. Toronto, British Book Service, 1955. 494pp., illus., $12.75.

Titanium in industry. Stanley Abkowitz, J. J. Burke, and R. H. Hiltz. Toronto, Van Nostrand, 1955. 224pp., illus., $5.50.

Wave diagrams for nonsteady flow in ducts. George Rudinger. Toronto, Van Nostrand, 1955. 278pp., figs., $6.50

Who's who in world aviation, v.1. Washington, American Aviation Publications, 1955. 345pp., $10.00 (U.S.).

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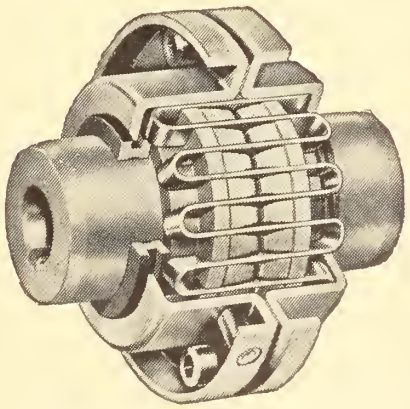

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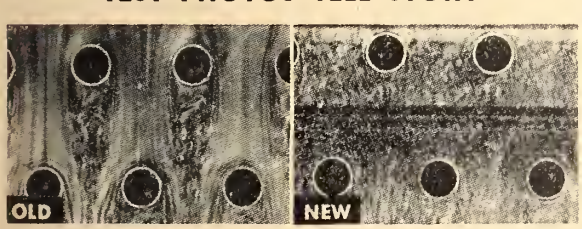

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The Williston Basin. E. N. Kemler and W. D. Lacabanne. Spring Park, Minn., Summary Reports, 1954. 272 pp., illus., maps. $12.00 (U.S.).

The world's great bridges. H. S. Smith. New York, Harper, Toronto, Musson, 1953. 180pp., illus., $4.25.

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Acta polytechnica:

No. 150—Effects of underwater explosions on elastic structures in water, by Erik Enhamre. No. 158—A theoretical investigation of the ionospheric electron density variation during a solar eclipse, by Olof Rydbeck and Hans Wilhemsson. No. 159—Wind effect on shallow bodies of water with special reference to Lake Okeechobee, by H. R. Kivisild. No. 160—Lateral stability of bridge arches braced with transverse bars, by Lars Ostlund. No. 161—Calculation of the magnetic field in the ferromagnetic layer of a magnetic drum, by Olle Karlqvist. No. 162—Simple calculation of deformation and stress in the shell of thin-walled cylindrical vessels, by K. I. Karlsson.

Alberta. Bureau of statistics:

Facts and figures, 1954 ed.

American road builders' association:

The highway construction industry in a ten year national highway program.

American society for testing materials:

Directory of commercial and college testing laboratories. Fatigue of aluminum, by R. L. Templin. Interpretation of engineering data: some observations, by H. F. Dodge. Symposium on lateral load tests on piles (STP No. 154) Supplement to symposium on lateral load tests on piles (STP No. 154-A).

American welding society:

A6.1—55T—Recommended safe practices for inert-gas metal-arc welding (tentative) 50c.

Atomic Energy of Canada Limited. Publications:

No. 165—Economic aspects of nuclear power, by W. B. Lewis.

Canada. National research council. Radio and electrical engineering division:

Progress report for October-December 1954 (ERA-279).

Canadian construction association:

Statement of policy and resolutions January, 1955. Submission to the federal government following the 37th annual general meeting of the Canadian construction association.

Canadian General Electric Company, Limited:

Power paces our prosperity (release No. 4631).

Canadian standards association. Approvals laboratories:

List of approved equipment, 5th ed., September, 1954.

Institution of engineers (India):

Thirty-third annual report 1953-54 and papers to be read at the thirty-third annual session.

Institution of mechanical engineers:

Bending stresses in spur gear teeth: proposed new design factors based on a photo-elastic investigation, by M. A. Jacobson. The hydraulic transport of solid material in pipes, by R. C. Worster and D. F. Denny. The promotion of fluid lubrication in wire drawing, by D. G. Christopherson and H. Naylor, and investigation of the mechanics of wire drawing, by J. G. Wistreich. Heay-duty truck development in the United States of America, by Rober Cass (Automobile division).

The National Boiler & General Insurance Co. Ltd.:

Failure of a large welded oil storage tank.

Ontario. Gold mining committee:

Interim report March, 1955.

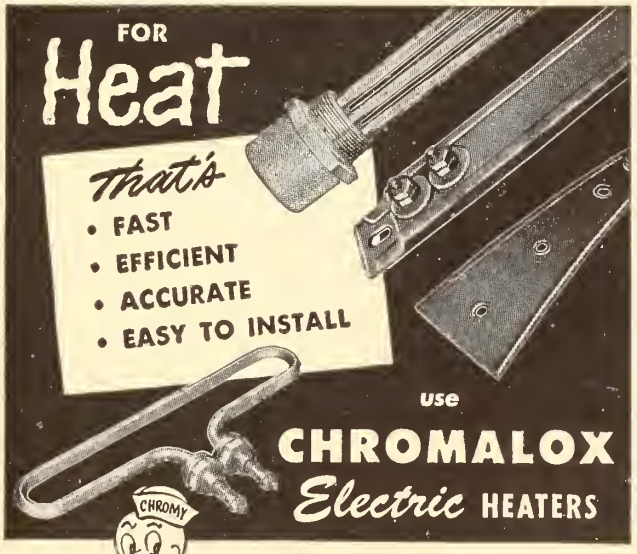
Quebec:

Statistical year book, 1954.

United States. Bureau of reclamation. Technical memoranda:

No. 649—Impervious soils used in rolled earth dams, by E. E. Esmiol.

United States. National bureau o



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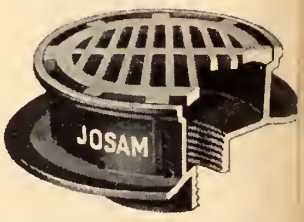

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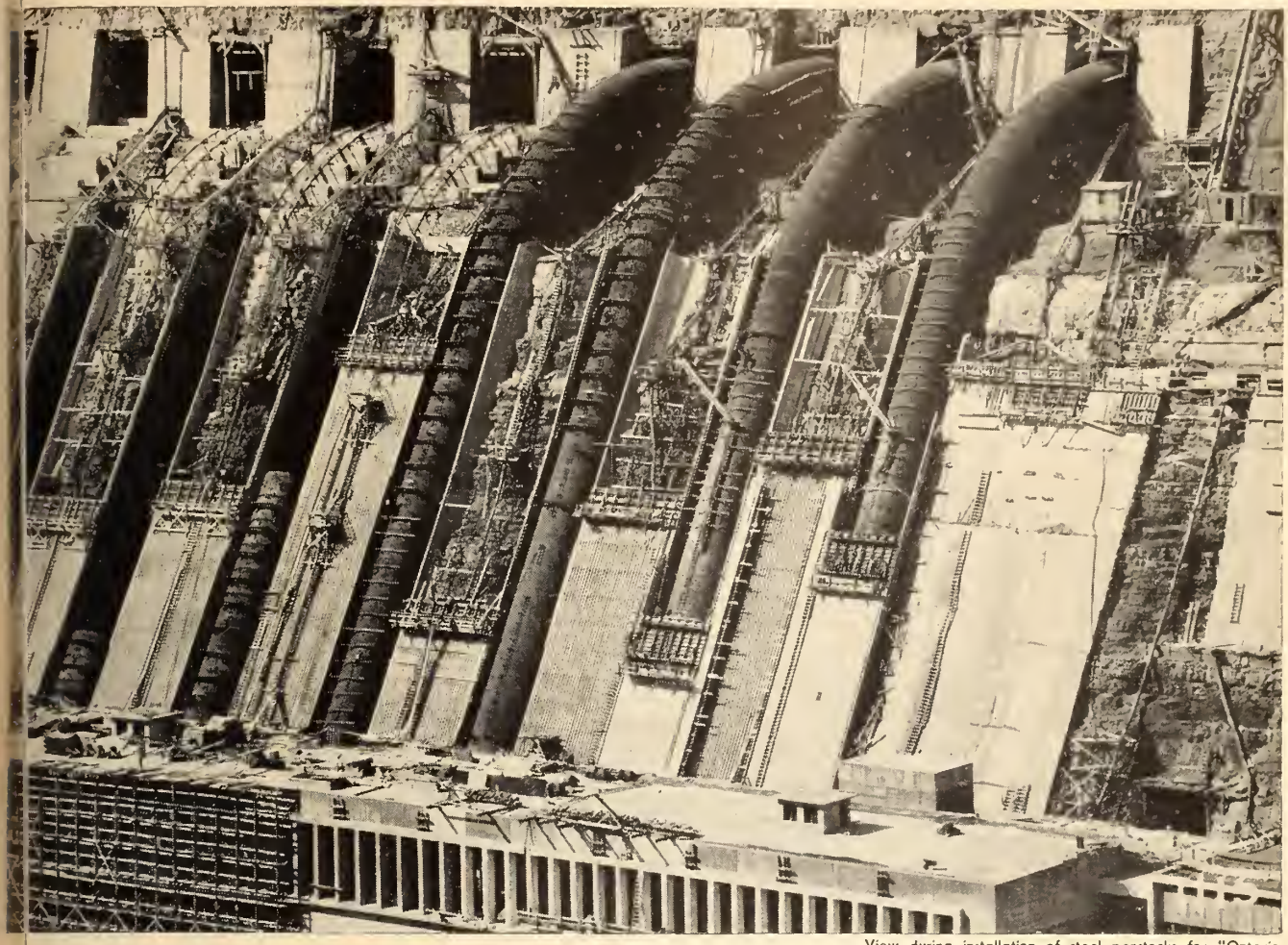

View during installation of steel penstocks for "Ontario Hydro".

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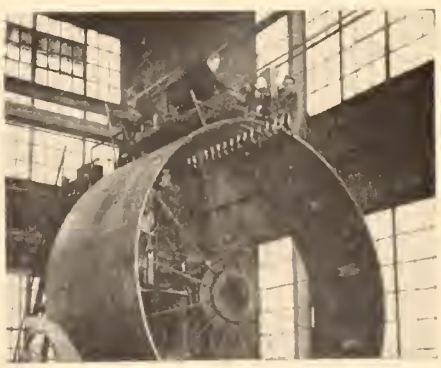

Seams on each steel penstock ring are welded in the shop. The spider ring is removed after the section is installed and embedded in concrete.

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standards. Building materials and structures. Reports:

No. 144—Sound insulation of wall and floor constructions.

STANDARDS REVIEWED

A.S.T.M. standards, American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.T.M. 1954 supplement to book of A.S.T.M. standards, including tentatives. 7 parts. $3.50 per part; $24.50 per set.

Some 415 specifications, tests and definitions appear in these supplements, either issued for the first time in 1954 or revised since their first publication. As in the original standards the supplements cover ferrous metals; non-ferrous metals; cement and concrete, etc.; paint and polishes, etc.; fuels; rubber and plastics; textiles, paper, etc. Each part contains some particularly important new specifications or tentatives and as a whole they are necessary to make the Standards complete.

A.S.T.M. standards on petroleum products, 1954.

The greater part of this standard is not new as its purpose is to bring together in convenient form the various A.S.T.M. standard and tentative methods of test and specifications relating to petroleum products and lubricants. Five proposed test methods are also included for readers' comments.

Among the standards are those pertaining to butadiene, motor and aviation fuels, petroleum solvents and naphthas, industrial aromatic hydrocarbons, diesel fuels, lubricating oils and greases, petrolatums and paraffin waxes, plant spray oils and petroleum sulfonates and bituminous materials.

British standards, British standards institution, 2 Park Street, London, W. 1. British standards are available from the Canadian standards association, National research building, Ottawa, Canada.

B.S. 1131—Plain bearings (metal)

Part 1. Dimensions of non-ferrous solid bushes and thrust washers. 4/-.

The first part of this standard specifies the dimensions and tolerances for plain and flanged bushes, including those with a machining allowance in the bore and those which are pre-finished, and for thrust washers, and for journals of ¼ in. to 5 in. nominal diameter. It also notes methods of identifying the bushes and thrust washers and of marking the bushes.

Part 2. Dimensions of wrapped bushes and thrust washers. 4/-.

The dimensions and tolerances for wrapped bushes are here specified and those for thrust washers, for journals of ⅜ in. to 3 in. nominal diameter (10 mm. to 58 mm. nominal diameter).

Part 3. Dimensions of medium-walled & thick-walled bearing half-liners. 4/-.

The bearing half-liners covered in this part are for journals of 2 in. to 12 in. nominal diameter. There are two ranges of wall thicknesses and the half-liners may be in non-ferrous metal, unlined; in non-ferrous metal, lined with anti-friction metal; or in ferrous metal, lined with anti-friction metal.

Part 4. Dimensions of thin-walled bearing half-liners and thrust half-washers. 7/6.

This part specifies the dimensions, tolerances and running clearances for three groups; steel-backed, thin-walled, grooved bearing half-liners for nominal journal diameters from 1 in. to 6 in.; steel-backed, thin-walled, ungrooved bearing half-liners for nominal journal diameters from ⅝ in. to 6 in.; steel-backed, thin-walled thrust half-washers for nominal journal diameters from 1 in. to 6 in.

Part 5. Bronze oil-retaining bushes and thrust washers. 4/-.

The specifications here are for plain and flanged oil-retaining bushes and thrust washers, charged with lubricating oil and having a normal oil content of from 25 to 30 per cent by volume within the size range from 3/16 in. to 2½ in. normal bore.

B.S. 2493:1954—½ per cent molybdenum steel electrodes (covered) for metal-arc welding. 4/-.

This standard refers to the type of electrode commonly used for the welding of molybdenum and chromium-molybdenum steels, which operate at elevated temperatures. Basically the specification is the same as B.S. 639, except that the deposited metal is required to contain 0.5 per cent molybdenum.

B.S. 2549:1954—Covered electrodes for the metal-arc welding of medium-high tensile structural steel. 4/-.

This standard deals with electrodes for the welding of steel having a tensile strength of up to 43 tons/sq. in., e.g. the type of steel covered by B.S. 968 'High tensile (fusion welding quality) structural steel for bridges, etc. and general building construction'. The absence of such a specification in the past has meant that most specifications for the design of structures in high tensile steel have had to specify the use of mild steel electrodes, and, therefore, the allowable stresses in the welds have not been comparable to the permissible stresses permitted in the parent metal.

The standard follows the form adopted in B.S. 639:1952 in its general and test requirements. An additional test is the controlled thermal severity cold cracking test, which is based on research work carried out by the British Welding Research Association.

B.S. 2520:1954—Barometer conventions and tables. 7/6.

This specification introduces a system which eliminates the confusion and error associated with the complexity of existing barometer conventions. It includes the approved pressure units for use for all barometer purposes and the standard instrumental conditions for mercury barometers.

The reforms introduced arise mainly from the exclusive use of a single conventional value of 980.665 dyn/cm² for standard gravity, together with a single reference temperature 0°C. not only in the definitions of the millimetre of mercury and the inch of mercury as pressure units, but also in the standard instrumental conditions associated with all barometer scales, including those of altitude.

The adoption of the new conventions will greatly simplify the manufacture and standardization of mercury barometers, the correction of their readings to standard conditions, the final expression of pressures, and the conversion of either readings or pressures from one scale unit to another. Since the scales of aneroid barometers are also to be regarded as graduated in terms of the new pressure units, their readings will show the same interrelationships as the scale readings of mercury barometers.

As of January 1st 1955 the conventions were implemented by the National Physical Laboratory and other Government departments in their tests.

B.S. 2550:1954—Lead-acid traction batteries for battery electric road vehicles. 3/-.

This recent publication deals with those types of lead-acid traction batteries which are used for the propulsion of battery electric road vehicles of the four-wheeler, three-wheeler and pedestrian-controlled types. It does not cover batteries for industrial trucks. This standard has sections on design and construction, rating, designation, number of cells per battery, dimensions and layouts of standard units, and gives tests for capacity, variation of duration of discharge with temperature, life, etc. It is illustrated.

B.S. 2553:1954—Spring collets. 5/-.

The committee charged with the preparation of a standard for Spring collets designated a range of collets in nine main types which can be produced by all manufacturers with the absolute minimum of dislocation. This standard sets forth the dimensions necessary for interchangeability of these types of collets and accessories. Much of the information is presented in tabular and diagrammatic form.

B.S. 2558:1954—Tubular box spanners. 4/-.

The range of hexagons catered for in this specification is the same as that dealt with by its immediate predecessor and includes all the unified sizes, B.A., metric, black hexagons and Whitworth large hexagons.

The quality of the spanners is denoted by two grades: A and B. Grade A is the superior quality. The apparent anomaly that the accuracies of the B grade are more exact than those of the A grade is explained by the fact that Grade A spanners are heat-treated and allowance has therefore to be made for any resulting distortion.

The torque test is an addition to this standard.

Canadian standards, Canadian standards association, National research building, Ottawa, Canada.

C.S.A. Z7.3 Series—Specifications for survey photography. $1.25.

There are seven items in this series. Four of the specifications deal with standard dimensions of various sizes of aerial film spools. The others cover dimensions for leaders, trailers and roll film for aerial photography, standard methods of testing the mounting of aerial cameras, and standard format sizes, focal lengths, and operating temperatures for air cameras.

Particularly in the lower numbers of the series, diagrams and tables constitute most of the specifications.

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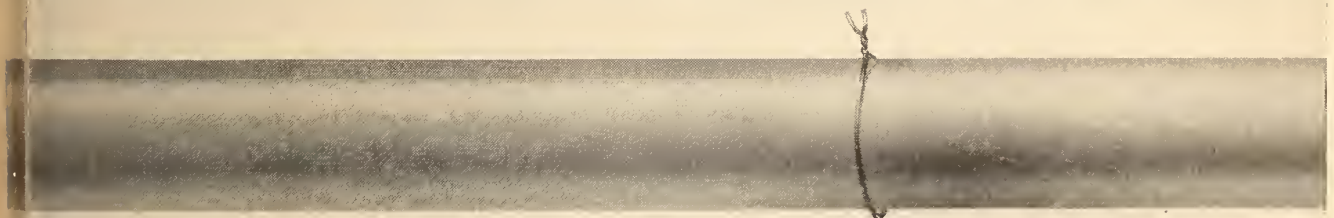

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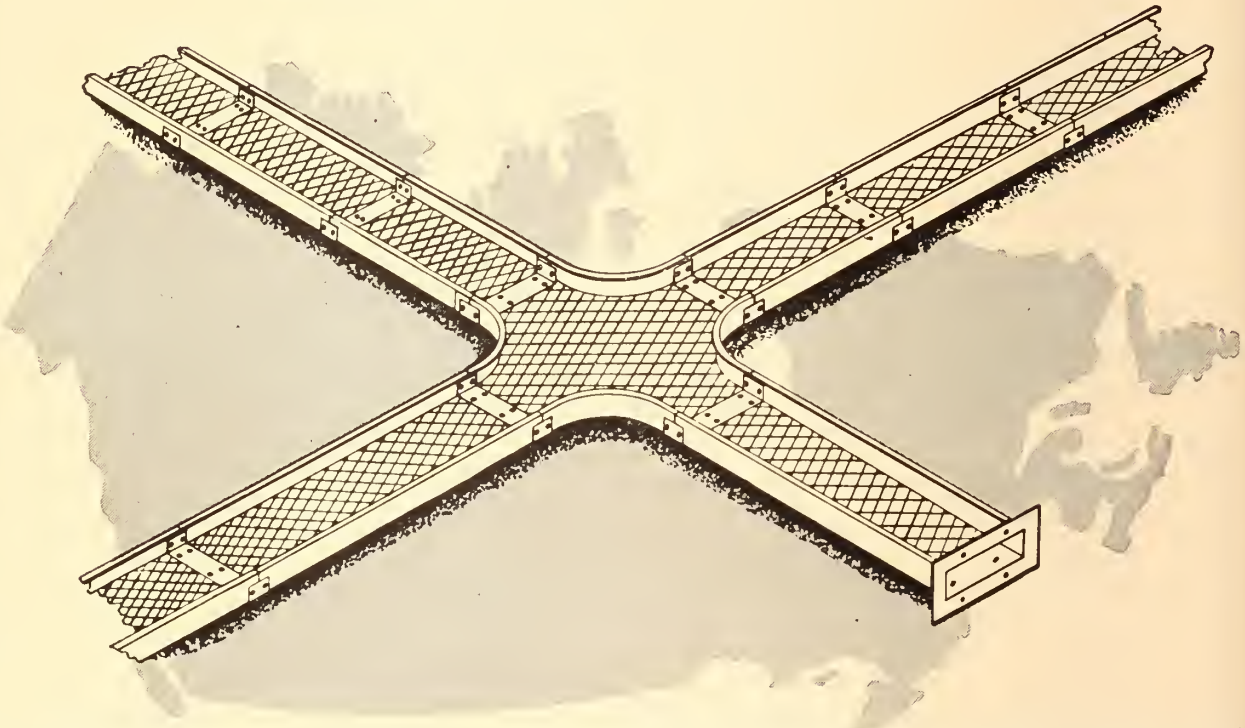

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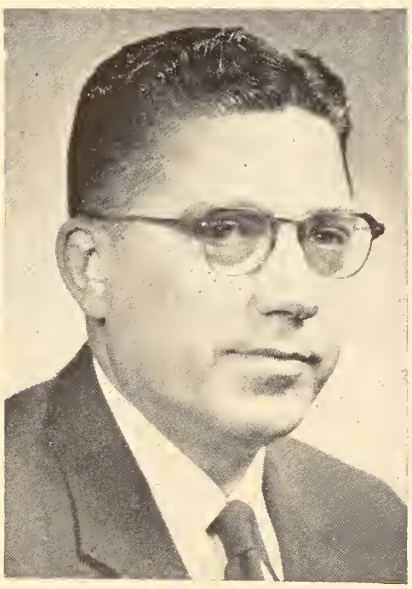
The Editor

Appointments and Transfers

Canadian Allis-Chalmers President.—Harold M. Schudt has been elected president of Canadian Allis-Chalmers Limited, on the resignation of Mark C. Lowe. Associated with Allis-Chalmers since 1929, Mr. Schudt has served in the United States and in England, where he started the company's first manufacturing operations.

●



Harold M. Schudt

New Directors of Montreal Locomotive Works. — At the recent annual meeting of Montreal Locomotive Works Limited four new directors were elected. These were J. G. Notman, M.E.I.C., Percy M. Fox, and Jules R. Timmins, all of Montreal, and Wilson D. Leggett, jr., of Schenectady, N.Y.

●

Management Change. — A. Campbell, vice-president and manager of the Dominion Bridge Company's Western Division, has recently announced the appointment of J. L. Bodie as manager of Standard Iron & Engineering Works Limited (Standard Iron & Engineering Works Ltd. is a subsidiary of Dominion Bridge Company). Mr. Bodie, formerly personnel and industrial relations manager of the Western Division of the Dominion Bridge Company succeeds R. M. Dingwall who has retired from active service.

●

Atlas Steels Director. — R. H. Davis, president of Atlas Steels Limited, has announced the election of John B. Ridley to the board of directors. Mr. Ridley is well known in Canadian financial circles as vice-president and director of A. E. Ames and Co. Ltd., and has been associated with Atlas in connection with the financing of their major plant expansion in recent years.

●

Change of Name.—Linde Air Product Company, Division of Union Carbid Canada Limited, is the new name o Dominion Oxygen Company, Divisio of Union Carbide Canada Limited. Thi is a change in name only and involve no alteration in corporate structur or facilities handled.

●

Change of Address. — Constructio Equipment Company Limited announc that all facilities have now been trans ferred to their new location at 6373 Cot de Liesse Road, Montreal 9.

●

Walker and Webber, Consulting Civi Engineers (Paul G. W. Walker, M.E.I.C and E. Doug. Webber), announce th establishment of their partnership i new offices at 1894 West Broadway Vancouver 9, B.C.

●

New Equipment and Developments

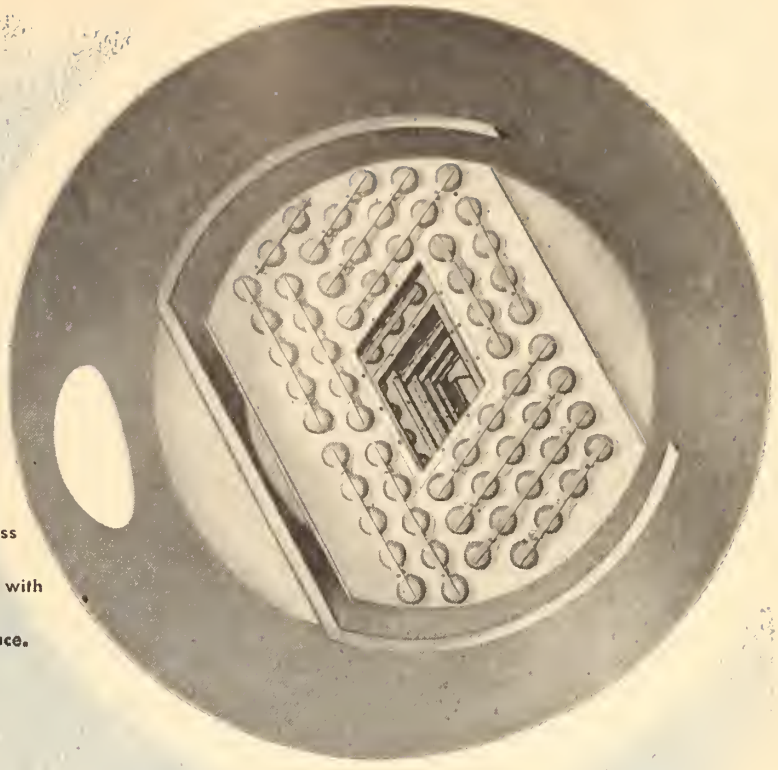
New Bristol Turboprop. — The Bristol Aeroplane Company of Canada has released preliminary details of the parent company's new B.E. 25 constant-power turboprop engine, designed primarily for future Britannia airliners. With a normal rating of some 8,000 h.p., power output is torque limited to about 4,000 h.p., which is available to the propeller up to altitudes of the order of 20,000 feet. Above this "ceiling of constancy" power drops in accordance with the normal rules, but some 3,500 h.p., or nearly twice the power available from current turboprops having the same sea-level nominal rating will be produced at a cruising altitude of about 30,000 feet.

The B.E. 25 is a "two-spool" engine in which a low pressure compressor supercharges a high pressure compressor, each being mechanically independent of one another. The system allows the use of a high pressure ratio (10:1) whic gives a low specific fuel consumption for example, at 25,000 feet and 30 m.p.h., the design specific consumptio is 0.37 lb./h.p./hr.

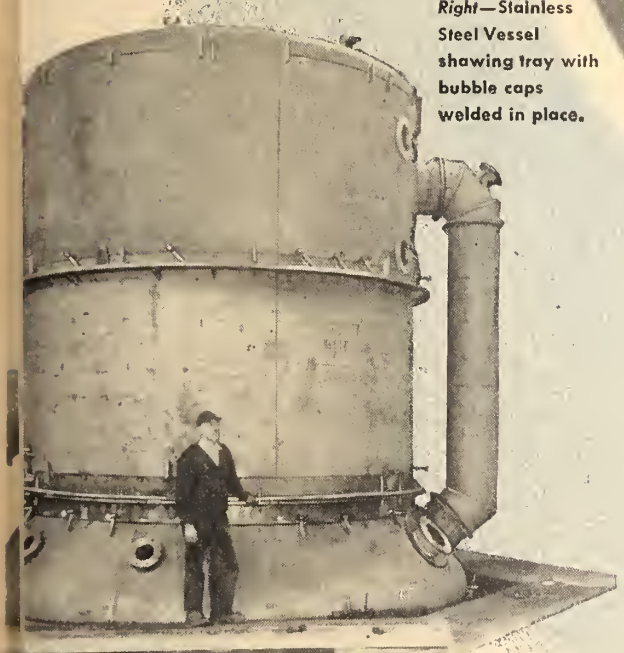
●

Automatic Moulding Press.—Designe to be fully automatic from powd measurement and feed to ejection an checking of finished mouldings, a ne model of a 50-ton moulding press h been announced by Foster, Yates Thom, of England. The press, whic has a fabricated and stress-relieved un frame operates at hydraulic pressures up to two tons per square inch. Th press was on show at the recent Cana dian International Trade Fair togeth with the company's Rotocube di powder mixing machine, which embodi a cube-shaped mixing drum mounte

Stainless Steel Vessels



Right—Stainless Steel Vessel shawing tray with bubble caps welded in place.



The manufacture of stainless steel vessels is a specialized business demanding considerable metallurgical experience, faultless workmanship and the employment of the most modern equipment for the close control of every stage of fabrication. Dominion Bridge—Canada's oldest steel fabricators—have long been recognized as a leader in this specialized field.

Constant research, unrivalled technical resources and exacting standards of workmanship are inherent features of the Dominion Bridge platework service.

Write for illustrated brochure No. PF-100

ove—Oslo
l/stallizer Shell

Left—Stainless Steel Tower—length: 65 ft.

Other Divisions: Boiler • Mechanical • Structural • Warehouse

Plants at: MONTREAL • OTTAWA • TORONTO • WINNIPEG • CALGARY • VANCOUVER

Assoc. Companies at: AMHERST • QUEBEC • SAULT STE. MARIE • EDMONTON

PLATEWORK DIVISION
DOMINION BRIDGE
COMPANY LIMITED

diagonally at a compound angle on trunnions and rotated at approximately 10 r.p.m.; the design is aimed to provide a consistent mix of widely varying constituents. Capacities vary from 10 to 1,600 pounds.

●

General Electric of England Expands. The General Electric Co., of England, has recently purchased 99 per cent of the shares of the Amalgamated Electric Corporation Ltd., of Toronto. The British company, which has no connection with similarly-named companies in North America, has pioneered many developments at the research laboratories at Wembley, England, including centimetric Radar and cold welding, and is at present engaged in developments for the use of atomic energy in industry.

A. V. Armstrong will continue to lead the operations of Amalgamated Electric Corporation Ltd.

●

Federal Public Works Contracts. — Works Minister Winters has announced that contracts involving expenditures totalling $877,822.22 were awarded by the Department of Public Works during the month of April, 1955.

The amount for new works is $556,199.00; for the repair and maintenance of existing structures $193,414.22; and for dredging $128,209.00.

●

C-I-L Plant Developments. — Canadian Industries (1954) Limited is to spend more than $3,000,000 this year in expanding its paint manufacturing facilities in Toronto. The expansion is the second stage in the company's program announced last year. This step in the program will comprise the extension of existing facilities for the manufacture of enamels and resins at the York works and the erection of a lacquer plant to replace those facilities now at the West Toronto works.

The York plant will supply automotive, industrial and automotive refinish products and will allow the other C-I-L paint plants in Montreal and Toronto to concentrate on the manufacture of retail, construction and maintenance paints.

Completion of the York project will more than double the original production capacity of the plant when it was built in 1948. Approximately 125 additional employees will be required when the expansion is completed. Increased plant services such as cafeteria, offices and change-rooms, are included in the plans. Last year, expansion at the York site doubled the size of the paint research and development laboratory and also the plant warehouse.

●

New Company to Make Telephone Cables.—J. R. Bradfield, president of Canada Wire and Cable Company, Limited, recently announced the completion of arrangements with General Cable Corporation of the United States for the formation of a company for the manufacture of a complete line of telephone cables in Canada. The new company, Telecables and Wires Limited, will be under the management of Canada Wire and Cable Company, Limited, and will also have available at all times the extensive engineering and manufacturing experience of General Cable Corporation. It is planned to locate the plant at Winnipeg.

●

Anthes-Imperial Expansion. — The Anthes-Imperial Company Limited of St. Catharines, Ontario, has purchased the Heating Division of Taylor-Forbes (1953) Limited, Guelph, Ontario. The announcement was made recently by D. G. Willmot, President of Anthes-Imperial. The new combined operation will be carried on by The Anthes-Imperial Company Limited through their sales offices. Manufacturing of all heating equipment acquired through this transaction will be transferred to the Anthes-Imperial main plant in St. Catharines. The sales and engineering divisions of Taylor-Forbes are joining the Anthes organization.

●

Canadian Westinghouse Contract. — The Canadian Westinghouse Company will build two 80,000 kva. generators one power transformer, switchgear and control equipment for what will be the largest remote-controlled power plant in Canada under terms of a contract valued at well over $1,500,000. The order was awarded by B.C. Electric Company for the $25,000,000 project at Cheakamus, B.C., north of Squamish on Howe Sound.

The equipment consists of two 80,000 kva., 13.8 kv., 400 r.p.m., 87.5 per cent power factor vertical waterwheel generators, each weighing some 370 tons. The power transformer to be supplied will be 80,000 kva., 3 phase, 60 cycle, 230,000/13,800 volts, type OFW, oil immersed, forced oil, water-cooled, outdoor, surge protected.

The high voltage winding will be connected in star with a grounded neutral and will have three full-capacity and one reduced-capacity, no-load taps. FW coolers will function automatically on the basis of winding temperature.

Much auxiliary equipment is also to be provided.

When the new station goes in service in 1957, the B.C. lower mainland's supply of power will exceed 915,000 hp.—more than four times that available just a decade ago.

●

Tube Manufacturing Development. — The $6-million pipe and tube manufacturing centre for Canadian Western Pipe Mills Ltd. scheduled to go into production this month, at Port Moody, B.C., is the first of its type established in Western Canada. It is rated by observers of B.C.'s development picture as a key secondary industry in view of the natural gas era now dawning in the province in which thousands of miles of pipe and related products will be needed.

Canadian Western Pipe Mills Ltd. is a subsidiary of the Rheinrohr organization of West Germany, who are Europe's oldest and biggest pipe and tube mill operators.

The initial development will encompass some 16 acres of the 100-acre site and provide 145,000 square feet of production floor space, a three-storey head office and administration centre, machine shops, testing laboratories, warehouses, two electric sub-stations, new access roads and railway spur lines.

The main building will be 826 feet long, one of the longest industrial structures under one roof in Western Canada. It will be 251 feet wide at its widest point.

The expansive manufacturing area will be divided into three main halls which will house two complete production lines for pipe, conduit and mechanical tubing.

The pipe mills have an annual potential of more than 60,000 tons of black and galvanized pipe, ranging in diameter from ½ inch to 4 inches, and in length from 10 to 45 feet, for gas, oil, water, steam, air, electrical and structural use.

Initial production plans for conduit cover the rigid type together with it

SUB-SURFACE EXPLORATION

Soil Sampling ✣ Foundation Testing

Core Drilling ✣ Grouting

FOR EXAMPLE:

PAVEMENTS

Job 52/101

British Columbia Highways

Department of Public Works

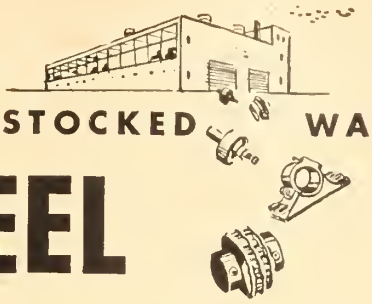
Provincial Government

During October, 1952, one of our crews, with a drill mounted on a light truck, travelled 1,000 miles over B.C. Highways and recovered samples of the bituminous, macadam paving at numerous points along the route. An analysis of the cores, which they recovered, provided valuable information for the department's engineers in their program for more and better highways throughout the province.

BE A LOOK INTO THE EARTH

BOYLES BROS DRILLING COMPANY LTD., VANCOUVER, CANADA

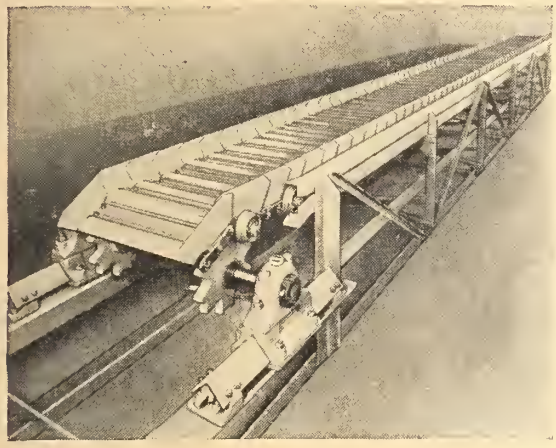
Modern Equipment and Experienced Crews at MONCTON, NORANDA, KIRKLAND LAKE, PORT ARTHUR, EDMONTON and VANCOUVER



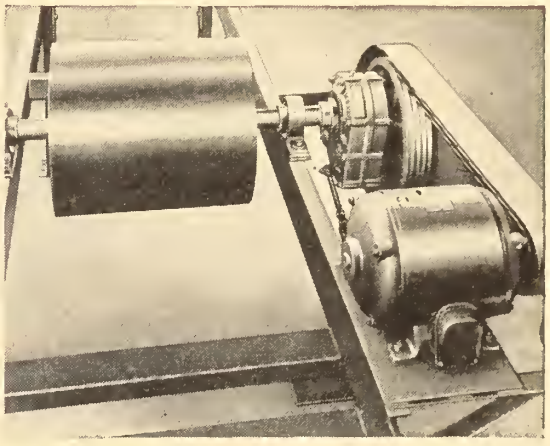
WITH FULLY STOCKED WAREHOUSES

UNITED STEEL

PUTS MODERN POWER TRANSMISSION EQUIPMENT TO WORK FOR YOU *FAST!*



Here's an example—This apron conveyor was completely fabricated and assembled by United Steel. Power transmission equipment and accessories include: Dodge-Timken Pillow Block mounted on Dodge Protected Screw Take-Up, Dodge Cast Tooth Sprockets and Special Conveyor Chain with flanged wheels.

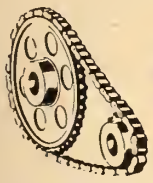


And here's another—This Dodge V-Belt Drive assembly for a conveyor belt installation includes a Dodge Torque Arm Speed Reducer, and Anti-Friction Pillow Block, Shafting and welded steel Conveyor Pulley . . . all fabricated and assembled by Dodge Manufacturing Division of United Steel Corporation.

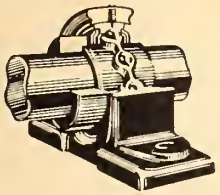
Whether you require a complete, assembled unit, or replacement power transmission equipment, you can count on United Steel!

Over 70 years' experience in serving every branch of industry is your assurance of satisfaction. Completely stocked warehouses and extensive production facilities are your guarantee of fast delivery.

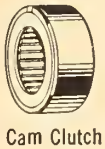
United Steel are also equipped to provide and instal any type of materials handling equipment you may require.



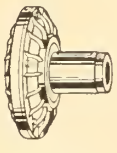
Morse Roller and Silent Chain Drives



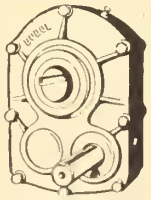
Fafnir Mechani-Seal Pillow Blocks



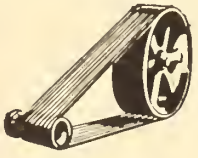
Cam Clutch



Dry Fluid Coupling



Dodge Torque Arm Speed Reducer



Dodge V-Belt Drive

WELLAND · TORONTO · MONTREAL
United Steel
CORPORATION LIMITED
LONDON · KIRKLAND LAKE

DODGE MANUFACTURING DIVISION "the power transmission people"

Toronto	Montreal	Kirkland Lake
ROger 2-8242	WEllington 4277	1017

companion, thin wall conduit, for the whole range of installation work in the electrical field.

The plant also will manufacture mechanical tubing, a high-quality precision product, whose field of application embraces many machine-assembled tubular products. A different grade of tubing also will be marketed for use in furniture manufacture.

All these products will be produced by the continuous cold-forming, electric resistance weld process which is being adopted by more and more manufacturers due to the high quality of the finished product and to fabricating efficiencies.

Steel that will be fed in ribbon-like strips to the sequence of de-scaling, welding, sizing, straightening, cut-off, trimming, threading and testing machines, will come from Canadian and other mills.

●

"Unitized" Transportation—The White Pass & Yukon Corporation has under way a $2,700,000 development program which will introduce a unique "pick-a-back" system to revolutionize freight transportation service to the North country.

Disclosing details of the project in Vancouver, early in the year, a White Pass & Yukon spokesman reported that approximately half of the $2,700,000 expenditure will be made in B.C., for steel freight containers similar to van bodies that can be moved by truck, ship and train, for loading and trucking equipment, and other handling facilities.

Target date to start the new service between Vancouver and Whitehorse is August, 1955, with two movements per month scheduled at the outset.

A new, specially designed ship is now being rushed to completion by unitized carrier specialists of Canadian Vickers Ltd., at Montreal, so that crews can make familiarization runs and the service can be established before winter season storms and fogs.

She will have a cruising speed of 12¼ knots, faster than present vessels in northern freight service, and her propulsion and power plans include two 950 hp. diesel engines, which, with some cargo handling equipment, are being made in England.

Cargo moves from the shipper's warehouse or other marshalling point in the van-like steel containers. After the cargo is trucked by shippers to new terminal facilities to be constructed at West Indies Wharf in North Vancouver, it will be loaded aboard the new vessel which is designed to handle 168 of the van containers per trip, and will have a total carrying capacity of 4,000 tons.

To inaugurate the service, 500 of the van units, each with insulation, heating and refrigeration provisions, will be constructed in Vancouver.

In the service to the North, after a three and a half day, 1,000-mile voyage to Skagway, where receiving facilities will be expanded, the van units will be unloaded onto flat cars of the White Pass & Yukon Railway, for an 110-mile run to Whitehorse.

From the Whitehorse terminals, the "unitized" cargo again goes aboard trucks for delivery to consignees.

On return voyages, the vans will carry asbestos shipments from northern mines.

●

Dominion Rubber Factory. — A new, modern factory for the manufacture of a wide range of foam rubber products, is to be erected in Kitchener by the Footwear Division of Dominion Rubber Company Limited, according to an announcement by company president, C. C. Thackray.

The factory and equipment, utilizing the most up-to-date techniques and methods, represents an investment of over $2,000,000, and when fully in operation could mean the addition of over one-hundred employees to the present large staff of Dominion Rubber Company's Merchants' footwear factory in Kitchener. It will greatly expand the company's line of similar rubber goods. Completion date is set for early in 1956.

●

3M Expansion. — Minnesota Mining and Manufacturing of Canada Ltd., London, Ont., has started a $750,000 expansion program which will include the construction of two buildings and the transfer of the Irvington division (formerly Irvington Varnish and Insulator Co.) from Hamilton to London. Announcing the program, Maynard H. Patterson, vice-president and general manager, said increased sales and the progressive addition of new products and services make the new buildings necessary.

The new buildings, to be completed by August 1, will add 47,400 square feet of floor space to the present plant and will be equipped with the latest machinery and methods for manufacturing varnishes, varnished cambrics, extruded plastics, plastic garden hose, bottle cap laminates and special abrasive and adhesive products for the automotive and aircraft industries.

●

John B. Parkin Associates, Architects and Engineers, Toronto, are moving in June into an all-glass building of 18,000 sq. ft. of their own design, set in four acres of ravine land in Don Mills Village, one of North America's most comprehensively planned and designed communities.

Parkin Associates have been responsible for over one hundred modern school buildings of all sizes in Ontario, many industrial and commercial buildings, hospitals, and other types of buildings. They have served more than one hundred public bodies, public and high school boards, utilities commissions, hospital boards and many leading corporations.

The company is made up as follows: Partners: John Parkin, M.R.A.I.C., F.R.I.B.A., J. C. Parkin, M.R.A.I.C., F.C.I.B.A., A.R.C.A., Edmund Parkin, landscape architect; Associates: R. V. B. Burgoyne, M.R.A.I.C., J. E. Mews, M.E.I.C., P.ENG., mechanical engineer. P. T. Mikluchin, M.E.I.C., P.ENG., structural engineer, J. E. Owen, M.R.A.I.C., J. P. Spence, M.R.A.I.C., E. R. Wilbee, P.ENG., mechanical engineer.

●

Spot-Welding Apparatus. — A manual sigma spot-welding process that makes spot, plug, and tack-welds with the addition of reinforcing filler metal is now available from Linde Air Products Company, Division of Union Carbide Canada Limited. The process overcomes limitations of existing spot welding methods by making extra-strong welds in heavier metals, and by requiring access to only one side of the weld joint.

This inert gas shielded welding process makes stronger spot welds by feeding consumable wire electrode automatically into the weld area. The filler metal makes a 100 per cent penetration in the lapping metals. Spot welds can be made quickly and easily on metals up to ⅛-in. thick, in a horizontal or vertical position. The process can be used on carbon and galvanized steel.

reduced concrete shrinkage

with POZZOLITH

Effect of Drying Shrinkage is Dramatically Illustrated in this Clay Specimen.

Whatever the cement content of a mix or the water-cement ratio, drying shrinkage is governed mainly by *unit water content** (water required per cubic yard of concrete).

Pozzolith, through dispersion of cement, is an aid in producing *lowest* unit water content for a given workability, because it reduces water required by approximately 15%.

Thereby Pozzolith helps produce *minimum* shrinkage in concrete; also helps improve other basic qualities.

Full information on request.

*See U. S. Bureau of Reclamation's current Concrete Manual, Page 130.

THE MASTER BUILDERS CO. LTD.

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Screen and Automatic
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COMBUSTION ENGINEERING-SUPERHEATER LTD.

MONTREAL • TORONTO • WINNIPEG • VANCOUVER — PLANTS: SHERBROOKE, QUE.

stainless steel, copper-based alloys, and other metals.

Sigma spot-welding apparatus can also be used to make plug welds on metals from ⅛-in. to ¼-in. thick, and to make tack-welds on all types of joints for subsequent welding. An operator can make up to 10 welds a minute, including positioning and post-weld argon flow.

The sigma spot-welding machine consists of three main units: 1) a pistol-type, water-cooled torch — lightweight and easy to use in hard-to-reach places; 2) a portable wire-drive unit which houses the rod reel and gas and water solenoids for instant shielding and cooling; and 3) a control box with Linde's new-style, built-in electronic controls. All controls are on a single plane. Special heavy-duty, industrial-type relays and timers are used for maximum dependability. The control box can be installed easily in any desired location.

●

Adjustable Speed Drives.—Printed circuitry and a new simplified control system are features of a new line of full-wave Thy-mo-trol electronic adjustable-speed drives available from Canadian General Electric Company's Apparatus Division.

Believed to be the first circuitry ever to be incorporated in industrial control equipment, the print-board panels can be visually inspected for circuit faults, since the panels are actually current-carrying diagrams. The panels can also be removed and replaced in a few seconds time.

Since the new control circuit uses only a single miniature-type control tube, as contrasted with three conventional sized tubes in previous models, maintenance on the equipment is greatly simplified.

Basically an automatic electronic control for d-c motor drives, the new Thy-mo-trol controls are designed to give stepless speed control from an a-c power source over an 8 to 1 speed range, with higher speed ranges possible for special applications. Consisting of electronic sensing elements and an electronic power rectifier, it maintains very close speed regulation regardless of changes in load or line voltage, and limits starting torque to protect both drive and machine against overloads at all times.

Optional features available at extra cost as part of the Thy-mo-trol control line include push-button reversing, reactor loop control, jogging, and tachometer follower operation.

●

Marconi Plant.—A plant to manufacture magnetrons and various types of transmitting tubes in Canada will shortly be erected by Canadian Marconi Company in the Montreal suburb of Town of Mount Royal, Quebec.

The new factory will have approximately 30,000 square feet of floor space, and will be adjacent to Marconi's head office and factory at 2442 Trenton Avenue, Montreal 16. The building and equipment have been designed specially for the manufacture of this type of electronic tube.

It is expected that the plant will be in production early in 1956; it will employ approximately 100 people at the outset.

H. A. Rice, formerly manager of Marconi's Commercial Products Division, has been named general manager of this new project.

C. P. McNamara has been named to succeed Mr. Rice as manager of Marconi's Commercial Products Division.

●

Steam Locomotives for India. — The first of 120 steam locomotives—custom designed for delivery to India under the Colombo Plan—was completed at the Canadian Locomotive Co. Ltd., in Kingston, in March.

Ordered by the Canadian Commercial Corporation for the Indian Railways, the Kingston-built locomotives, to be produced at a cost of $21,000,000, represent the largest single Canadian contract to date under the Colombo Plan. Many Canadian companies are sharing in the order through work subcontracted by the Canadian Locomotive Co.

All of the 120 locomotives will resemble Canadian steam locomotives in general appearance, with Pacific type 4-6-2 wheel arrangement, but are designed for India's wider-gauge railways—5 ft. 6 in. compared with Canada's 4 ft. 8½ in. gauge. European style centre screw-link couplers and side buffers instead of centre automatic couplers, and steam and automatic vacuum brakes instead of air brakes are other points of difference from North American steam locomotives. In addition, cabs have double roofs and extra-large windows to provide comfort for operating personnel in tropical or sub-tropical climate; and the familiar bell of Canadian steam locomotives is replaced by the high-pitched whistle used by the Indian Railways. The locomotives are rated at approximately 1600 hp.

The company is continuing full production of diesel locomotives for Canadian railways, senior vice-president George A. Mueller said here recently.

Current diesel production includes eighteen 1600-hp. diesel-electric road switchers and ten 1200-hp. switchers for the C.N.R. and an order for the C.P.R.

●

Dominion Bridge Enlarges Facilities. —The already extensive facilities for the fabrication of light and heavy steel plate work are being enlarged by the construction of a new shop adjacent to the Company's plant at Burnaby, B.C., which will be in operation in the Fall of this year. This announcement was recently made by A. S. Gentles, vice-president and manager of the Company's Pacific division, who pointed out that this step, in conjunction with others recently made, will enable the Company to play a significant part in the increasing industrialization of the West Coast.

The Dominion Bridge Company's Vancouver plant has already been active in fabricated plate work for many years. Some two years ago, facilities were increased by the addition of a large stress relieving furnace with attendant equipment for the manufacture of large Class 1 welded pressure vessels such as are required for oil refineries, chemical plants, pulp and paper mills, etc.

Just a year ago, the Company announced that Dominion Bridge boilers, hitherto only made in Eastern plants, would also be made in Vancouver.

The new shop will increase the facilities of the Company in this field and enable such work to be done more speedily and efficiently.

The new building, of ample dimensions to accommodate large work, will be of similar construction to the existing shops and will be fully equipped with a new 800-ton heavy press brake, heavy rolls, straightograph edge preparation equipment, and other machinery. X-ray equipment of the latest type will also be incorporated in the new building.

A railroad track will be laid in the building connecting to yard tracks and to tracks for the stress relieving furnace. By these means heavy loads can be handled to the furnace or shipped direct from the shop without outside loading.

Ample handling facilities are a special feature of the new shop and will include overhead travelling cranes enabling loads up to 100 tons to be lifted. A heavy Gantry crane will facilitate loading and unloading into the stress relieving furnace.

●

British Product.—While "Watco Concrete Hardener" has been widely used for the last 25 years in England, it is now available in Canada for the first time.

Made of oil and resin, Watco is said to penetrate into the pores of the concrete, effectively sealing the surface particles and providing a permanently dustless surface. This elimination of concrete dust has proven safer for both men and machines as well as reducing floor maintenance costs.

Watco is easily applied by unskilled labour and the treated floor is ready for use within eight hours. The manufacturers claim it will last as long as the floor itself—that it is resistant to water, some chemicals and grease.

The Flintkote Company of Canada Limited are the sole agents for Watco Concrete Hardener in Canada.

●

Distribution Transformer. — A distribution transformer designed specifically for distributors and users of electric power and to provide maximum performance through lower losses, higher efficiency and better regulation is now being manufactured by Brown Boveri (Canada) Limited, at their St. Johns, Quebec, plant. These transformers, known as the Brown Boveri "BB-99" series, feature many unique design improvements which contribute directly to superior electrical and mechanical efficiency.

"BB-99" cores are wound from continuous strip, cold rolled steelmaking possible controlled uni-directional grain orientation and thus uniformly higher magnetic permeability. The cores, which are not cut or disturbed in any way during coil assembly, require exceptionally low exciting currents.

"BB-99" coils are wound directly around the core legs by a patented method, which gives them both superior electrical efficiency and a very high mechanical strength against short circuit stresses. Improved cooling with uniform dissipation of heat from all parts of the active assembly guarantees longer insulation life and higher operating performance under all conditions.

The "BB-99" Distribution Transformer is designed to meet all relevant C.S.A. specifications.

Deliveries of the standard sizes from local stocks across Canada.

Information can be secured from your nearest Brown Boveri office or representative, or by writing to Brown Boveri

Someone is looking
(we don't know him from Adam)

for the solution to a problem
(we haven't a clue)

involving a new product
(we don't know what)

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●

Trade Fair Discontinued.—The eighth Canadian International Trade Fair, which closed on June 10, will be the last to be held under backing of the Federal Government. Trade Minister C. D. Howe announced that the Fair had not lived up to expectations as a medium for the direct promotion of Canadian exports. Instead, the government will seek to expand the export trade in other ways; Canada would have exhibits this year at 15 trade fairs in 13 countries.

●

Report of Canadian Pacific Railway. — Several new developments in Canadian Pacific's activities were noted in the address of the president, W. A. Mather, to the annual meeting.

The service of the new transcontinental trains, named "The Canadian", was inaugurated in April and reduced the previous schedule for travelling across Canada by some 16 hours. The month of June sees the start of the trans-Arctic service of Canadian Pacific Airlines from Vancouver to Amsterdam, bringing Europe within 19 hours flying time of Vancouver, followed by the launching on Clydeside by Her Majesty the Queen of the new "Empress of Britain" built for the Atlantic service.

Other progress made in the post-war period included the major undertaking of conversion to diesel power. By the end of 1954 the number of diesel units had increased to 459, and 30 per cent of all road passenger operations, 35 per cent of road freight, and 55 per cent of yard switching were handled by diesel power. At the same time, extensive replacement was made of obsolete freight train equipment. In 1947 almost half the freight cars in service were over 30 years old; by the end of 1954 one-third of the inventory had been replaced. This replacement involved the retirement of over 22,000 cars from freight service and taking delivery of nearly 29,000 new cars. The nine per cent rise in the number of cars represented an aggregate capacity increase of 21 per cent.

Since 1947 more than 2,000 miles of main track were relaid with rail of 100 pounds or over; sidings were extended; and road covered by automatic block signals increased by more than half to a total of nearly 3,000 miles.

This modernization since 1947 required some $600 million of capital funds, of which about $300 million came from depreciation and reserve funds, $200 million from new borrowings, and the remainder from retained earnings. The amount of borrowed capital reached its highest point since 1941, with a consequent increase in fixed charges to be met.

Despite the view that business in general was passing through a stage of economic adjustment amounting only to a pause in the steady growth, the immediate outlook for the railway was not so clear. Some developments which swell the gross national product generate little rail traffic, and export trade has declined in recent years. Control of expenses in 1955 should result in net earnings not less than those in 1954.

●

New Allis-Chalmers Product.—Clinker breakers built by Allis-Chalmers for use with the company's Air-Quenching clinker coolers are now available as optional equipment or for installation on existing coolers. The breaker is designed to crush chunks of clinker discharging from the cooler, using the repeated impacts of the cooler's reciprocating motion. Clinkers which can not pass 3-inch openings in a horizontal grizzly deck are crushed between metal fins mounted on the cooler's discharge end and eccentric discs mounted on the breaker's shaft.

The breaker carriage rides on rails. Pressure from air cylinders holds the carriage close to the cooler. The air cylinders retract to allow the breaker carriage to back off sufficiently to accommodate large clinker. All pieces are reduced to pass the grizzly bar spacing.

The clinker breaker is mounted on concrete piers and extends approximately 11 feet beyond the discharge end of the cooler. A description is contained in Bulletin 07B8202, available from Allis-Chalmers Manufacturing Company, 1270S. 70th Street, Milwaukee 1, Wisconsin.

●

New C.G.E. Meter. — A new type of watthour meter has been introduced by the Canadian General Electric Company, featuring a rotor assembly which floats in a magnetic field.

The new I-55, a 3-wire single-phase 100-amp. meter is designed to replace the C.G.E. I-30 meter. Range of the I-55, from 15 watts starting load to a peak of 23,000 watts, is a considerable increase over the present standard of from 15 watts to 13,800 watts.

Among new techniques used to provide dependability and freedom from maintenance was the use of the magnetic bearing system employed in the rotor assembly. The I-55 rotor literally floats on air. Mounted in the top of the frame is a magnet of high coercive force. The upper end of the disc shaft also contains a smaller magnet of similar material concentrically located.

The I-55 shaft is thus supported by the interaction of the two magnetic fields. Guide pins set in graphite bushings are used only to maintain vertical alignment of the rotating element. Among the new materials used in the I-55 is high dielectric strength butyl rubber. The new stator coils are moulded directly to the core with butyl, resulting in a much more rigid construction. Close control of material and processes and a re-design of the stator assembly have cut down the number of adjustments on the I-55 from three to two. Present meters are adjusted by the utility from time to time for lag, full load and light load. In the I-55 lag adjustment is permanently set during the manufacturing process. The register of the I-55 has also been redesigned for easier reading.

About $400,000 was spent in new manufacturing and testing equipment. On the new test equipment, valued at $85,000, one push button operation clamps the new meter in place, applies current, and puts the product through a full range of tests. An optical system projects the results of the tests onto a ground glass panel, and if the meter shows some deviation from the standard, it can be adjusted by the operator and re-run through the tests.

●

Avro Buys Canadian Car Stock. — An offer from A. V. Roe Canada Ltd. to purchase all of the stock of Canadian Car & Foundry Co. Ltd. at $30 per share, or $22,223,400 for all of the outstanding Class "A" and ordinary shares, was announced on June 8 by the board of directors of Canadian Car.

The board decided to recommend acceptance of the offer by shareholders, and members of the board present would accept it insofar as their own holdings or controlled shares are concerned.

Latest available figures show approximately 7,000 shareholders with 384,554 ordinary shares and 356,226 Class "A" shares, which are convertible into common on a share-for-share basis and hold certain priorities as to dividends.

Authorized total of Class "A" shares is 500,000 shares, or $10 million at the $20 par value and 1,200,000 shares of ordinary stock of no par value.

Latest annual report of Canadian Car showed total assets in excess of $37.5 million as of Sept. 30, 1954, with working capital at $13.5 million. Balance sheet figures indicated a net worth of about $30 million. Net profit jumped sharply in the past two years, rising 38 per cent to $2.2 million or $4.97 per ordinary share in 1953 and another 37 per cent to over $3 million or $7.14 per share in 1954.

Avro is engaged in production of CF-100 jet aircraft and has a development contract for the C-105, an advanced type of jet plane. Since it began operations in Canada over nine years ago with 300 employees, Avro has expanded its operations at Malton, Toronto suburb, until they now embrace 16,000 employees in three main plants.

A. V. Roe Canada Ltd., is a subsidiary of the Hawker Siddeley Group of Britain and operates through three main operating concerns—Avro Aircraft Ltd., Orenda Engines Ltd., and Canadian Steel Improvement Ltd., which produces jet engine blade forgings other precision forgings, and light alloys.

Canadian Car & Foundry Co. Ltd. operates through four main divisions of which the aircraft division at Fort William presumably constitutes the primary interest of Avro in acquiring Canadian Car stock. The Fort William establishment has been engaged for the past year in production of T34 trainer planes and is preparing for production of main components for S2F Grumman attack and search planes, for which airframes are to be produced by the de Havilland Aircraft of Canada Ltd.

The other Canadian Car division are the steel foundry division, Longue Pointe; the car division, embracing the Turcot and Dominion plants in Montreal; and the bus division at Fort William.

Canadian Car had its inception over 45 years ago in the merger of three then-existing companies.

The company's present board of directors consists of E. J. Cosford (president and managing director), J. M. Breen, M.E.I.C., G. Blair Gordon, R. C. Vaughan, J. A. Prud'Homme, Q.C., Colin W. Webster, James G. Notman, M.E.I.C., H. W. Thorp, all of Montreal; and R. C. Berkinshaw, Toronto.

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16,400 copies of this issue printed

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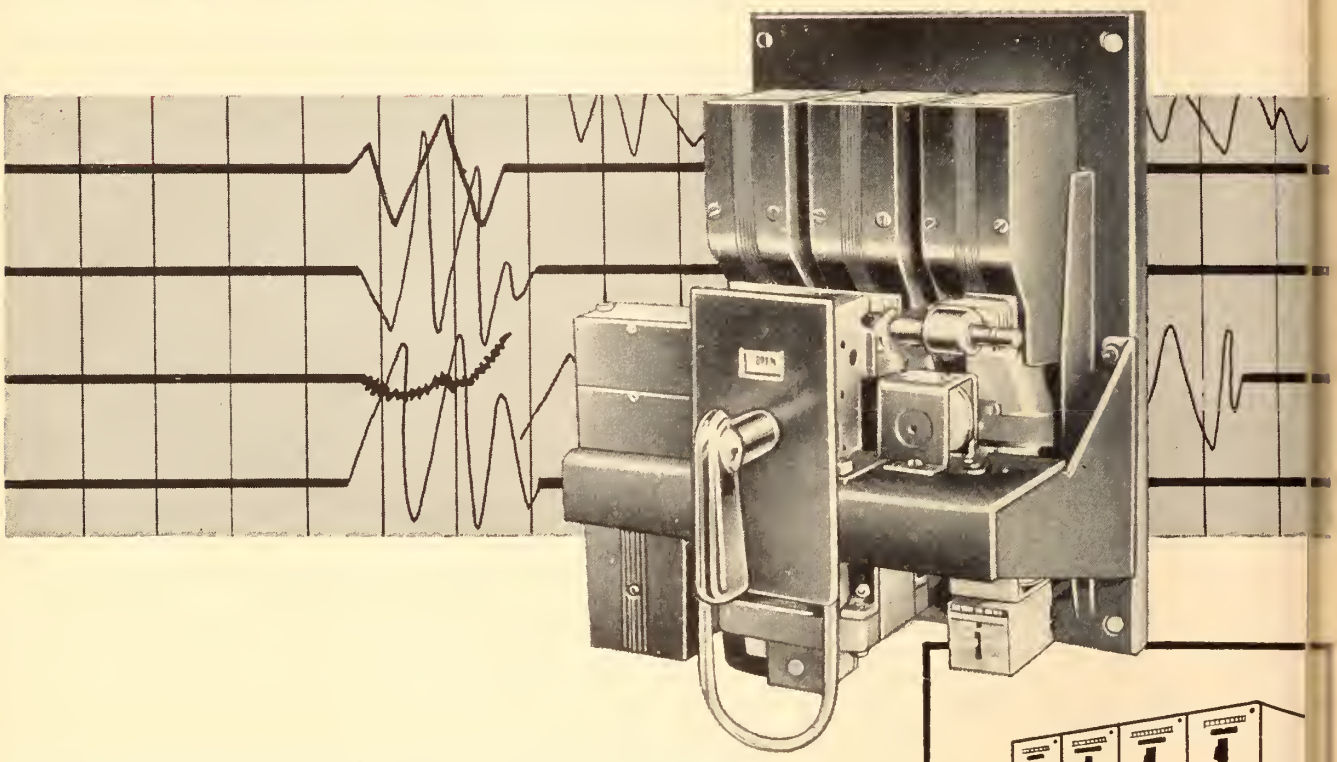
Westinghouse ANNOUNCES NEW RATINGS* FOR LARGE LOW VOLTAGE AIR CIRCUIT BREAKERS



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	NEW	FORMER	
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DB-25	50,000	25,000	
DB-50	75,000	50,000	
DA-75	100,000	75,000	
DA-100	150,000	100,000	
DB-15	25,000	15,000	241-480
DB-25	35,000	25,000	
DB-50	60,000	50,000	
DA-75	75,000	75,000	
DA-100	100,000	100,000	

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55A4

Metallurgical Problems of Modern Steam Turbines and Alternators

by

F. Buckley, *Chief Metallurgist,*
English Electric Company Limited.
England

A paper presented on January 26, 1955 at Niagara Falls, Ont., to the Thermal Section of the Canadian Electrical Association annual convention.

Great advances have been made in the design of steam power plant with a resultant increase in the severity of operating conditions. To prevent costly failures the metallurgist must provide the right materials, often having to develop new ones, and design must forecast and allow for material changes during service.

The main purpose of this article is to give some idea of the methods by which the metallurgist and his associates have faced up to the difficult task of keeping pace with the designers of this type of power plant. The achievements of the latter during the past 30 to 40 years can be judged by the fact that individual sets having outputs in excess of 200 Mw. are now contemplated, steam temperatures have attained the level of 1150°F., and pressures up to 5,000 lb. per sq. in. are to be employed.

These developments have necessitated large physical changes in the dimensions of the major components such as castings and forgings, resulting in pronounced manufacturing difficulties, and in addition the materials themselves have had to be entirely remodelled and many new alloys evolved. These latter have been designed not only from the point of view of accommodating the higher stresses and loads at normal and slightly elevated temperatures but new compositions have been introduced for the higher temperature conditions under which the metal is no longer able to support relatively low stresses without undergoing a permanent deformation. Accurate forecasts and allowances, therefore, have to be made by the designer so that the total amount of deformation or creep likely to occur during the life of the turbine is minimized to avoid the possibility of service trouble.

It is obvious that as a result of these trends every component; either static or moving, has had to receive the most careful attention and whilst it is not possible to deal here with all of them comprehensively a careful consideration of the most important items will probably be the best way of illustrating the improvements.

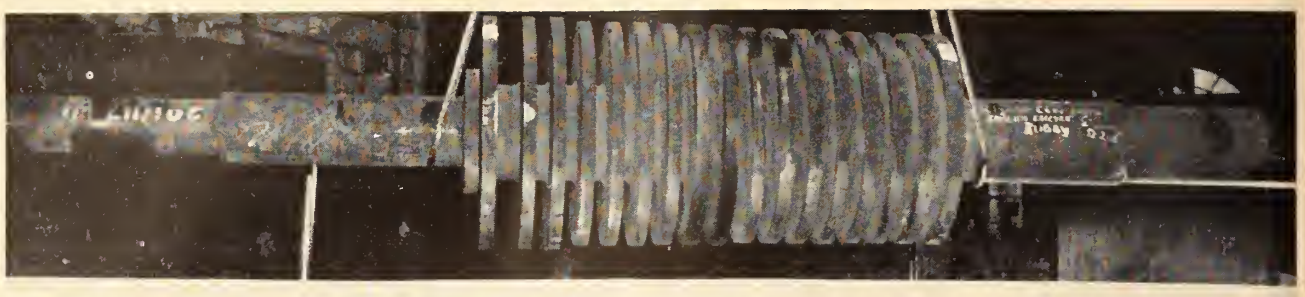
No better example can be selected as an introduction than that of one of the most highly stressed major components in the whole assembly, namely the rotors. Discussing first the turbine rotors, these were originally built up of several parts which were joined by a combination of bolts, shrinkage or large threads; the early twenties saw the advent of the solid steel rotors, discs being gashed from a solid steel forging. (Figs. 1 and 2.)

Early rotors of this type were universally made in plain carbon steel, being used at temperatures below which creep becomes a dominant factor and being of such a size and stressed to such levels that unalloyed steel was perfectly satisfactory. However, with the increasing output of the machines and consequent higher levels from the larger blading and rotor diameters it became progressively necessary to stiffen up the steels and increase the physical characteristics by alloy additions such as molybdenum, nickel and chromium. Thus, comparing the plain carbon steel rotors of about 36 in. diameter and giving test results in the vicinity of 80,000 lb. ultimate strength and yield of 42,500 lb. per sq. in. we now have available rotor sizes up to 54 in. diameter in chromium molybdenum steel which will give us ultimate strengths of 100,000 lb. and 0.2 proof stress in excess of 74,000 lb. per sq. in.

The manufacturing difficulties and care necessary for the successful production of forgings of this type bear no relationship to those encountered in the forging of carbon steel rotors. Whilst still prone to all the complaints inherited from the ingot state such as segregation, inclusions, corner weakness, etc., these alloy steels demand the most careful attention at all stages of melting, forging and, in particular, heat treatment.

The danger is the presence of hairline cracks or snowflakes which, buried deep in the forging and unsuspected by the normal visual and magnetic inspection methods, can if undetected cause catastrophic failure of the forging in service. The successful elimination of these defects has resulted not only in improvement of steelmaking and forging practice but has also revolutionized inspection techniques as applied to these rotors. These cracks are probably due to the joint effect of hydrogen in the steel coupled with internal stresses due to transformation changes and thermal gradients. Great care, therefore, must be taken to keep the hydrogen content of the steel at a minimum particularly during melting.

Steps taken in this direction vary from the selection of special scrap to the drying of the furnace charges prior to the refining process, and the latter is being de-



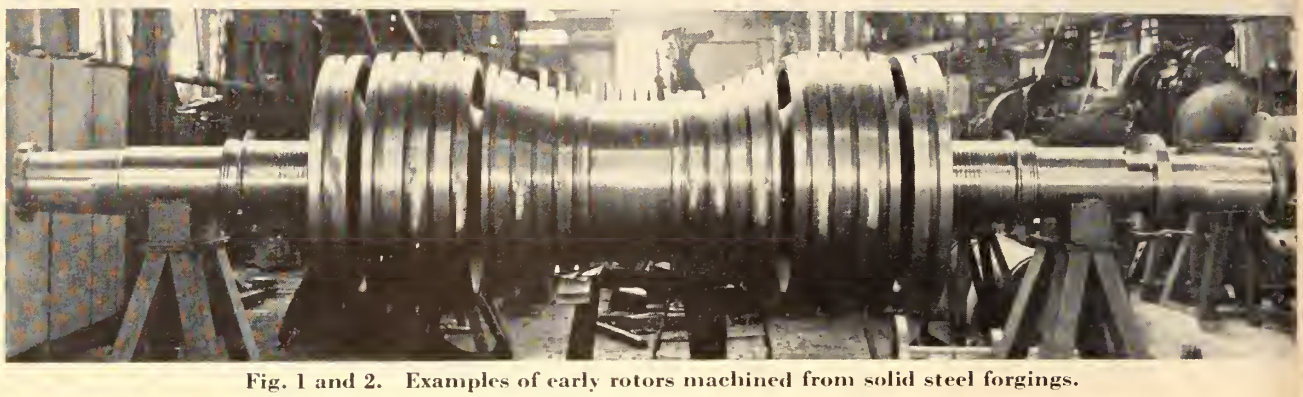


Fig. 1 and 2. Examples of early rotors machined from solid steel forgings.

veloped further by subjecting the molten charge to vacuum degassing.

In addition, internal stresses and thermal gradients must be minimized by heat treatment at high temperatures. Immediately after forging, therefore, and whilst still at a high temperature the forging must be given an elaborate cycle of heating and cooling between approximately 1650° F. and 570° F. (Fig. 3.)

In addition to these precautionary heat treatments it is necessary to subject the forgings to a final hardening and tempering treatment to effect the highest physical properties, which must be as uniform as possible throughout the section thickness. This process may consist of rapid air cooling from a temperature above the change point followed by tempering, or, as is practised more in Europe, the whole forging may be oil quenched followed again by a tempering treatment. There is a certain amount of opposition to the drastic oil quenching due to the fear of heavy resultant internal stresses which may prejudice the service conditions, but if the tempering is carried out with sufficient care experience indicates that there is little to fear on this account.

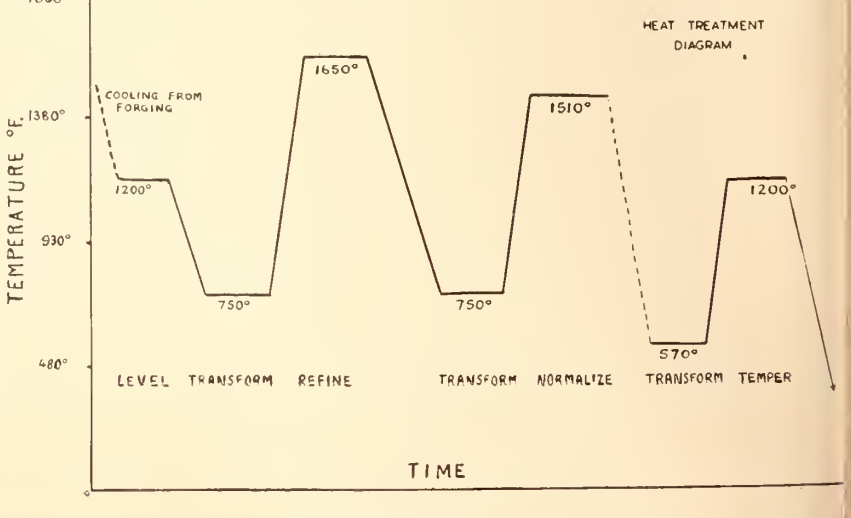
Inspection of the resultant rotors can be classified into four main branches not all of which can yet be the subject of official specifications covering acceptance clauses.

Physical Tests

These will be taken from the three principal directions, longitudinal, tangential and radial and will be an indication of the general quality and treatment of the material. (Fig. 4.) The position of testing will, in general, correspond to the outside of the forging and as such will not necessarily be a true representation of the material at the centre of the forging. A compromise is possible in this respect by selecting a bore test from a trepanned core, or alternatively, and particularly as applied to alternator forgings, a trepanning radially into the body. Careful checks of the material from the outside to the centre can then be made.

By the provision of a bore in the forging it is possible to cover the double purpose of inspection and to assist in the removal of central weakness in the forging the bore being afterwards examined with a magnifying boroscope. It is also common practice to magnaflux the bores prior to this final inspection. The criterion of acceptance is the complete removal of all defects in the main barrel portion of the forging, local chambering being permissible however at the discretion of the design department. It is possible to allow minor defects in the shaft extensions provided these are scattered inclusions and not related to any crack system. Here again and directly as a result of the wider application of ultrasonic examination, which is next

Fig. 3. Heat-treatment cycle for stress relief.



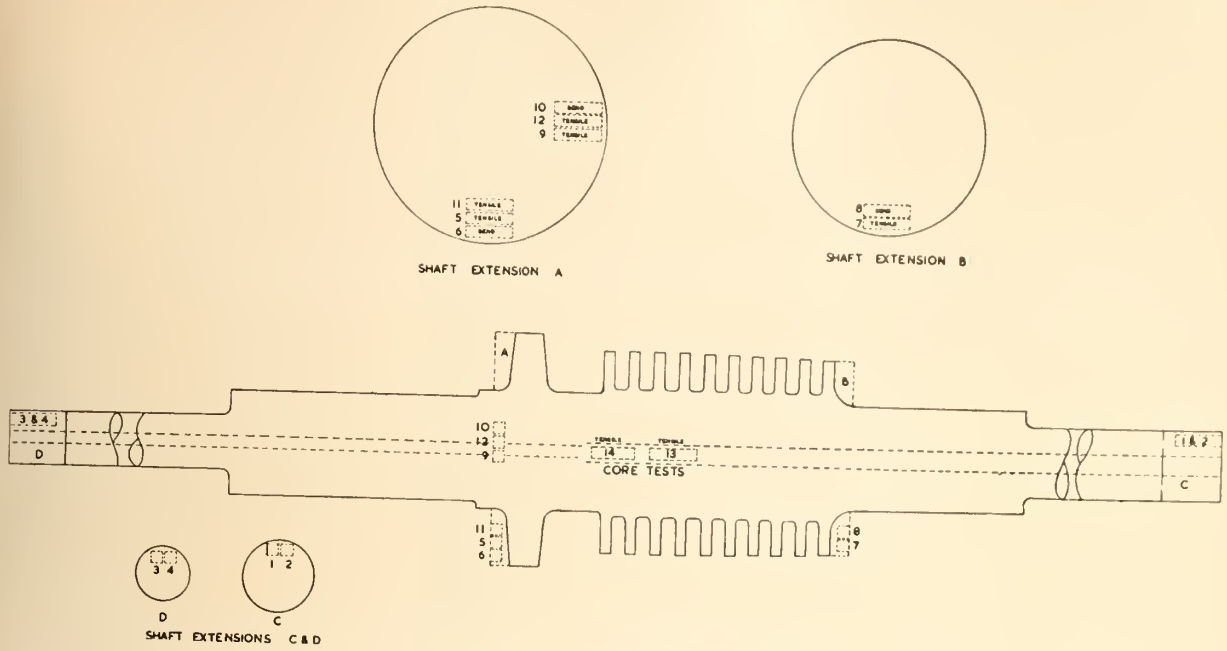


Fig. 4. Locations for physical tests.

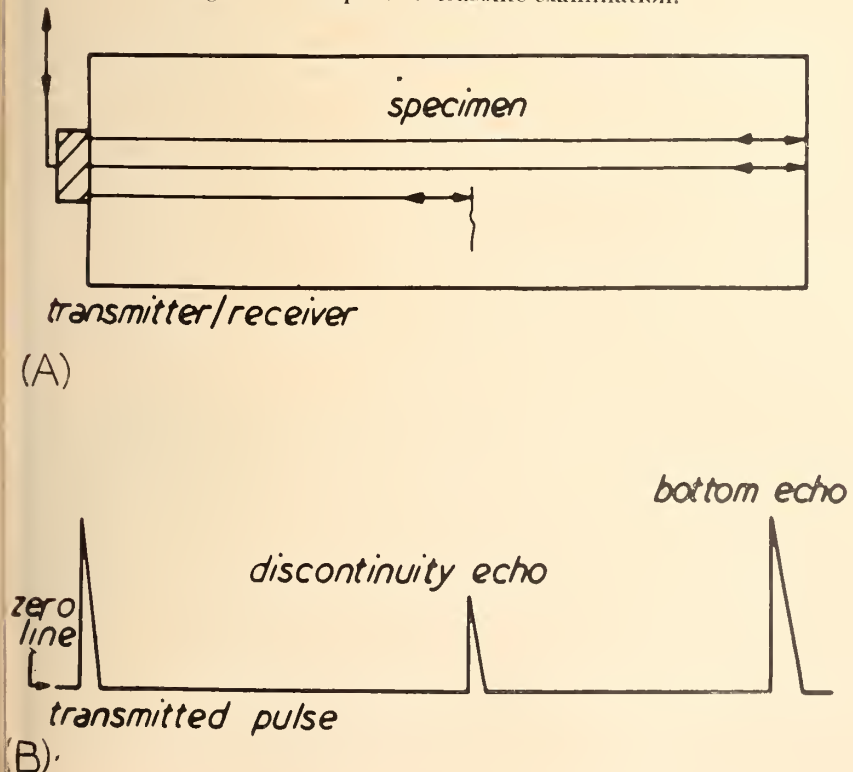
described, certain manufacturers are tending to leave the bores of large rotors solid.

Ultrasonic Examination

Although clauses covering acceptanee based on ultrasonie examination are diffieult to write into a specifieation at this stage, it is understood between suppliers and users of major shafts that this type of inspection will be applied. The principles involved are fairly well known but can be summarized as follows.

Certain crystals such as quartz or barium titanate when excited by high frequency currents vibrate at a very high frequeney and if in contact with steel, for example, the vibrations are transmitted to the material, reflected back at the base and can be picked up by the same crystal. The echoes so produced are received and reconverted into electrical impulses which are registered on a cathode ray oscillograph. (Figs. 5 and 6.) The latter then indicates two or more peaks on the scanning trace, the first being produced when the transmitted wave enters the steel, the other when the reflected wave leaves. If, however, a discontinuity is encountered the vibrations are mostly reflected back and a third peak, intermediate to the first two, is obtained, the position on the oscillograph roughly corresponding to the depth from the surface. In addition, the seriousness of a flaw will be judged by the relative diminution of the bottom echo. It is necessary to apply ultrasonic examination at various stages in the manufacture of the forging since reflections can be obtained from metallurgical features which are not in themselves harmful and which may reduce or disappear during the heat treatment.

Fig. 5. Principle of ultrasonic examination.



Stability

The rotor must, therefore, be of the correct material, heat treated to give the necessary physical properties, free from internal defects as revealed by visual, magnetic and ultrasonic examination and must also be free from internal stresses which, unless corrected, may lead to distortion of the rotor in service. It must also be thermally stable, i.e. it must, on heating up, remain true and not run eccentric at temperature.

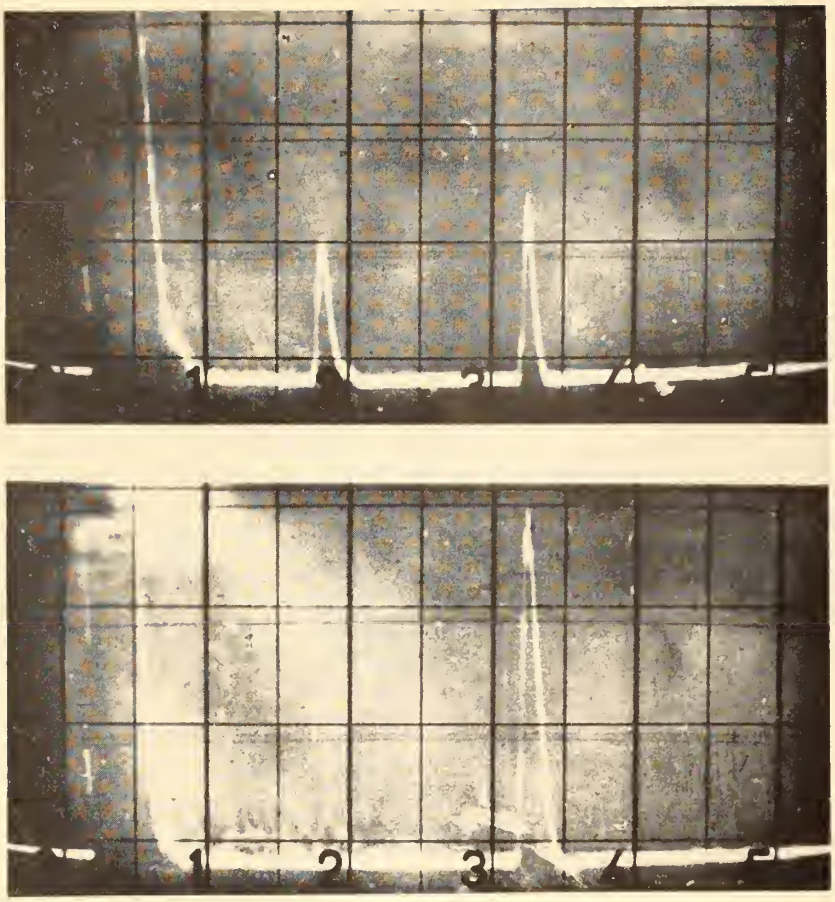


Fig. 6. Oscillograms from ultrasonic examination.

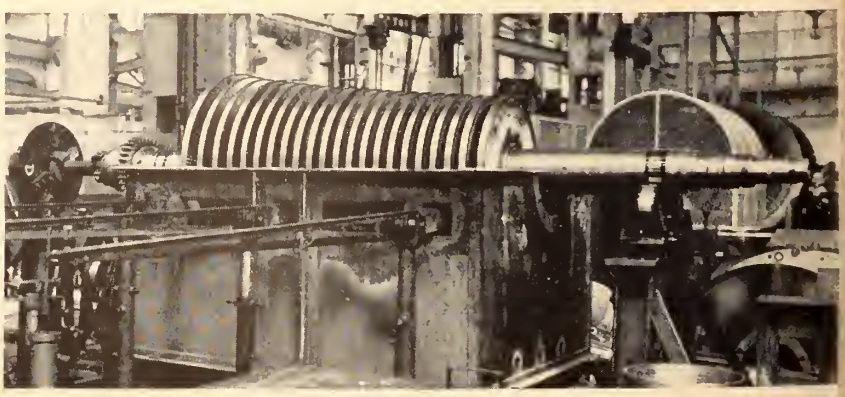
These two dangerous tendencies are checked by subjecting the rotors to special tests in thermal stability furnaces, one of which is illustrated (Fig. 7). The forging is rotated on steadies and driven electrically through a universal coupling, at about 2 rev. per minute, in a furnace which may be either gas or electrically heated to a maximum of 1200° F.

Three levers rest against the bottom part of the shaft at the two ends and midway positions, any movement of the shaft being magnified four times, a typical record of the movement of a shaft being shown in Fig. 8. If there are internal stresses in the shaft the tendency is for the deflection at temperature to be partially permanent. In the case of thermal instability, however, the forging will run eccentric at temperature returning to its normal position when cold. This latter condition is difficult to correct since it means that the material of one side of the rotor has a different coefficient of expansion from the other, this difference being due to a structural variation rather than one of composition. It is possible for differential cooling rates during the heat treatment operation to account for this variation in structure, and the very minor differences in the coefficient of expansion is sufficient to cause the rotor to run eccentric at temperature. The eccentricity permissible at a temperature of 1050° F. is definitely less than 0.001 and with careful heat treatment, particularly with the wider application of vertical quenching and tempering during which the forging is rotated, it is possible to get uniform rotors well within this limit.

The type of test just described also becomes of major importance when applied to rotors which have been bent in service and which have been corrected. (Fig. 9.) The bend is usually associated with pronounced rubbing of the shaft against the glands and it should be noticed that the hump of the bend is diametrically opposite the scored part of the shaft, in other words the final bend is contrary to the bend occuring during the rubbing operation. This is because the scored part of the shaft rapidly attains a very high temperature and becomes plastic, yielding locally due to the compressive stresses of the neighbouring zones coupled with the restraining action of the glands themselves. Thus, on cooling down this side of the shaft contracts slightly and the final bend is found to be in the reverse direction. Correction of the fault, therefore, is carried out by heating the shaft locally and rapidly at the apex of the hump, and repeating in reverse the same process which produces the original bend. On the application of the heat the bend increases, the local area affected is rapidly brought into a plastic state at a temperature in excess of 1400°F., and this zone again is slightly deformed by the nearby retaining stresses so that in cooling the shaft tends to straighten. It may not be possible to straighten in one operation, but by successive and carefully applied heats the bends can be completely corrected. The final heat is always followed by treatment in the thermal stability test rig when it is usually found that a further slight movement of the shaft occurs in the original bend direction, an effect which can be allowed for by slightly overcorrecting the deflection. The final treatment confirms the effectiveness of the straightening and minimizes internal stresses.

As already mentioned, the combined effects of heavier stresses

Fig. 7. Furnace for testing thermal stability of rotors.



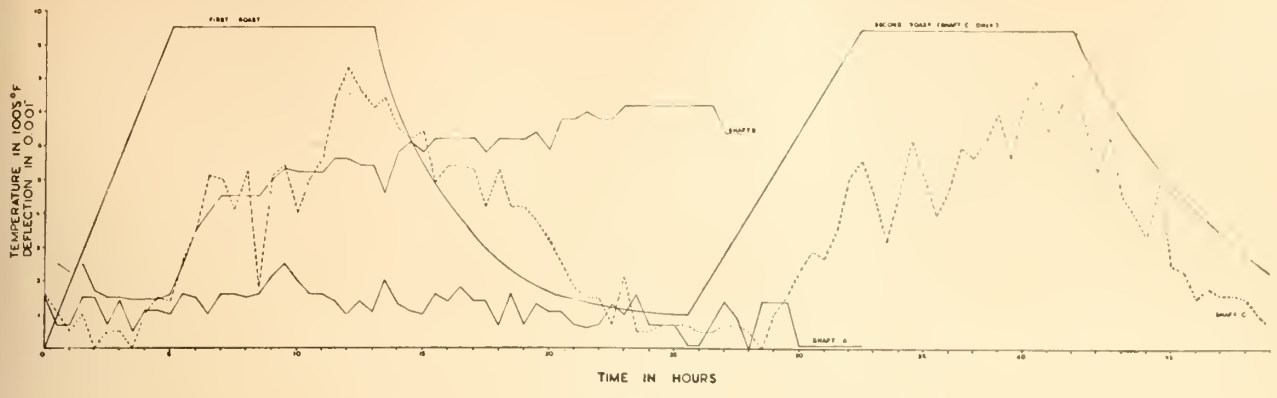


Fig. 8. Record of shaft movement during stability tests.

and larger components has neeessitated a wide adoption, for medium and low temperatures, of alloy steels; nickel, chromium, and molybdenum being the normal addition elements in varying amounts. The resultant steels possess the neeessary yield and strength charaeteristies in the heavy sections now being used. Aeeeptance of these materials and the necessary data for the purposes of design eonstructions ean be adequately gauged from room temperature physical tests provided these are taken from positions representative of the components involved.

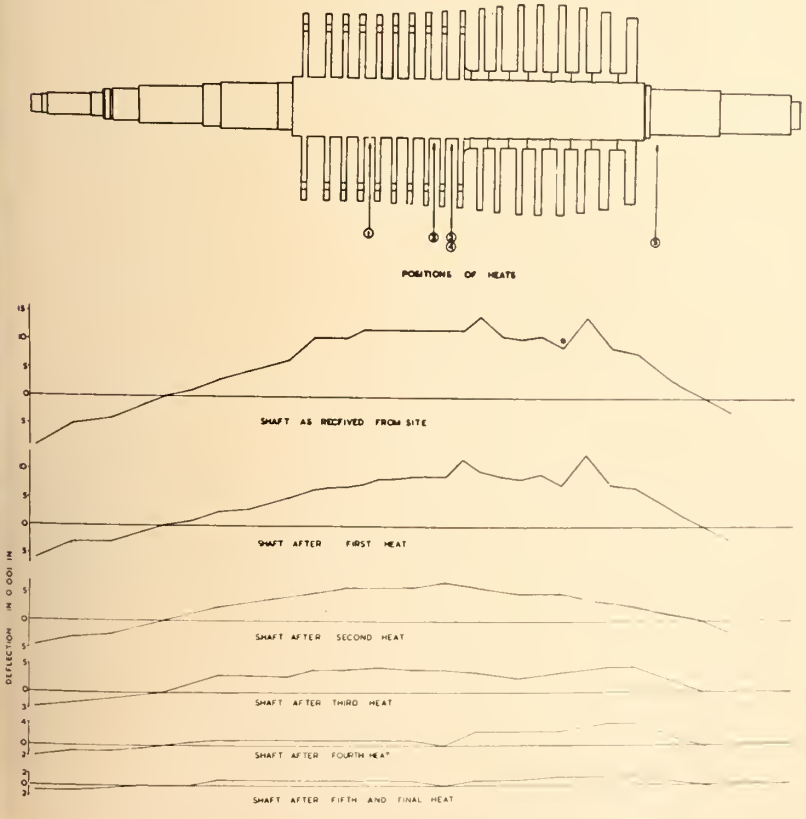
Above temperatures of approximately 850°F., however, the whole question of creep must be taken into consideration, the material in this case being largely non-elastie and a steady stress, a fraetion of the normal low temperature yield stress, may produee a permanent deformation the magnitude of the latter being a funetion of temperature and time. The designer, therefore, must have knowledge of the long time behaviour of the materials he is using and must seleet stress levels which, in the life of the turbine, give deformation whieh will not be dangerous. The permissible deformation will vary with the service duty, but for sueh highly stressed important eomponents as rotors ete. it is not permissible to allow deformation higher than 0.1 to 0.2 per cent in 100,000 to 150,000 hours.

It will be appreeiated that the aeeurate forecasting of the deformation behaviour of a set after a period of 12½ years has, in the past, had to be made on the results of ereep tests running for a fraction of the time, and eontroversies regarding the reliability of any given system of extrapolation have been loud and long.

One method used extensively with a fair degree of safety has comprised the seleetion of a stress whieh has a relationship to the working stress, and ereep tests are earried out at increasing temperatures to a maximum eonsiderably above the working temperature. (Fig. 10.) From the resultant creep curves the times required to give, say, 0.1 per eent deformation or even rupture are plotted logarithmically against the temperature as shown in the diagrams. A certain amount of extrapolation has been used with this and other methods, and as a result of eonfirmatory long term tests such forecasts do not appear to have been very wide of the mark. Happily many actual long term tests started several years ago as an extension of jet and gas turbine testing programmes, are just beginning to come of age and are proving the aeeuraey or otherwise of the estimated life values. In addition, test pieces taken from actual rotors are under test many thousands of hours in advance of serviee eonditions, which will act as valuable guides to the behaviour of the component in practice, and prove the reliability of creep tests taken from small samples.

From all this data, and taking into consideration the whole range of high temperature components, it would appear that molybdenum steels may be used up to 950°F.

Fig. 9. Results from correction of bent shafts by heat treatment.



From this temperature and up to 1050°F. we can rely on the molybdenum-vanadium steels with additions of chromium and tungsten, provided that in the highest ranges the stress levels are kept down to 4,000 lb. per sq. in. Above this temperature a further important factor, that of surface oxidation, must be taken into consideration and considerable chromium percentages must be added to the steel to combat this effect. With contents of about 13 per cent it would appear that the chromium steels of the ferritic type have a useful life up to 1100°F. and perhaps even 1150°F. For the highest temperature the only possibility is the austenitic steels 18 per cent chromium, 8 per cent nickel with 1 per cent columbium. Although it would appear, therefore, that there is a smooth gradation of materials up to the maximum temperature, the change from a ferritic to an austenitic steel is quite marked. The two materials have different coefficients of expansion, the austenitics being 50 per cent higher than the ferritic; they also have varying heat transfer rates and junctions between the two materials are bound to lead to major complications. In many high temperature sets the superior creep strength of austenitic materials can mean lighter sections for a given duty which, in turn, can be turned to advantage by employing more flexible pipework. A major problem develops at the positions where these austenitic pipes join on to the main ferritic component such as the stop valve or turbine casing; the resulting connections must be capable of accommodating the cyclic stresses due to temperature variations as applied to the two materials of vastly different physical characteristics.

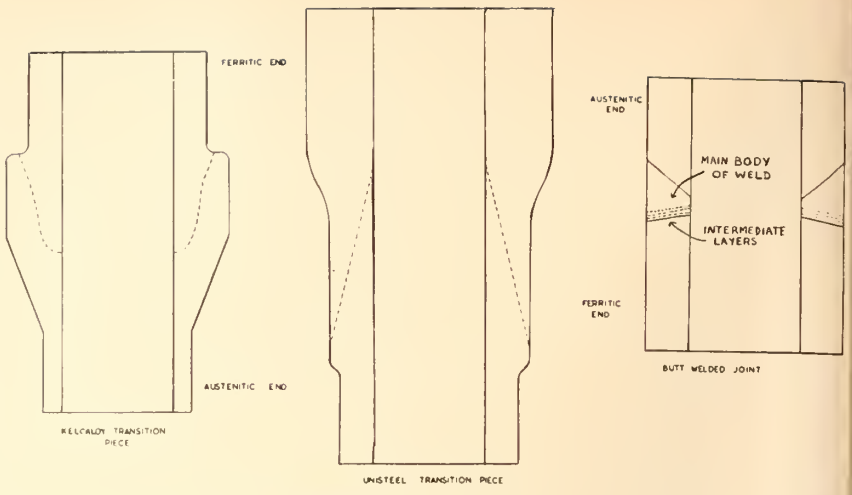


Fig. 11. Specialized joints developed to accommodate cyclic thermal stresses

It is obvious that this position must receive careful attention and the specialized joints which have been evolved for this purpose can be classified as three in number (Fig. 11.)

Kellogg Joint

A heavy stainless deposit is formed on the ferritic base, being built up so as to yield a scarfed joint, the step being such as to prevent a feather edge. Assemblies of this type have been in service for period of six to seven years.

Butt Weld

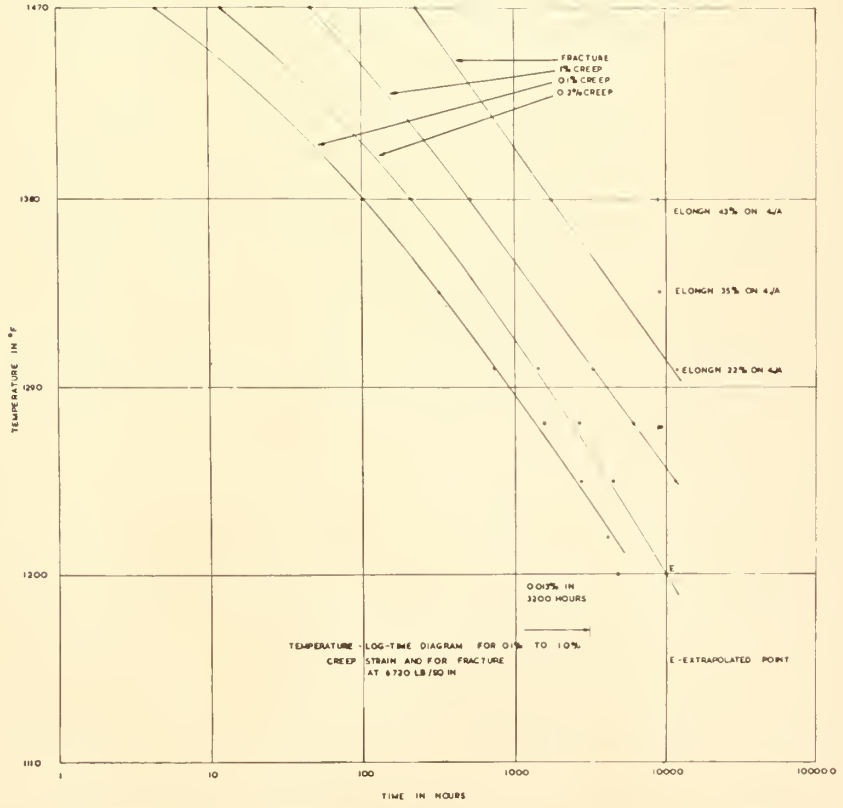
Butt welds between austenitic and ferritic materials have been used employing austenitic weld as the filler material and utilizing special techniques to prevent carbon migration from the ferritic to austenitic material which, if allowed to proceed, leaves an area adjacent to the actual weld which is readily attacked and may be the starting zone of serious cracking.

Unisteel Joint

By this method a composite billet made up of austenitic and ferritic materials is extruded over a mandrel, also to produce a scarfed joint, a layer of nickel between the two materials preventing carbon migration. This is a new joint which is just coming into commission but which shows every sign of having a promising future.

Large components in austenitic have not been used to any great extent in turbines employing steam temperatures in the 1050

Fig. 10. Results of creep tests at increasing temperatures.



1100°F. range but increased conditions may see extension of these materials to the major components. In this connection the experience gained in gas turbine practice will be of considerable value.

The use of these austenitic materials described so far extends to their high temperature applications. When considered for low temperature usage, particularly as applied to alternators, their non-magnetic properties are of major importance. A drawback, as applied to forgings of any appreciable size, is their poor elastic properties. The usual austenitic compositions are relatively soft with low yield points, and for highly stressed components this can only be increased by pronounced cold working. An example of this is the non-magnetic end coil retaining rings for alternators with which many must be familiar. These hollow cylinders are manufactured by one of two methods, of which in each case the initial forging is first upset, punched, reforged and then machined, and quenched in water, which leaves it in its softest condition. The forging is then subjected to one of the following heavy cold working processes. (Fig. 12).

(i) The rings are pressed locally between an internal mandrel and the press head in series of axial steps until the whole circumference is treated as uniformly as possible.

(ii) The work hardening effect is produced by an internal expanding mandrel which is made up of segments operating independently and governed by radial 'T' slots. The eight segments are tapered in the centre to allow the entrance of a taper mandrel which is driven in by a press, thus forcing the segments outwards and expanding the ring. In a further endeavour to attain uniformity in the forging the ring is rotated slightly and intermittently during the operation.

It would appear that method (ii) tends to give the most uniform end rings, as regards physical properties, and yield points of approximately 127,000 lb. per sq. in. with ultimate strengths of 150,000 lb. per sq. in. are obtainable.

It must be appreciated that this cold working process involves an increase in diameter of the forging of approximately 30 per cent

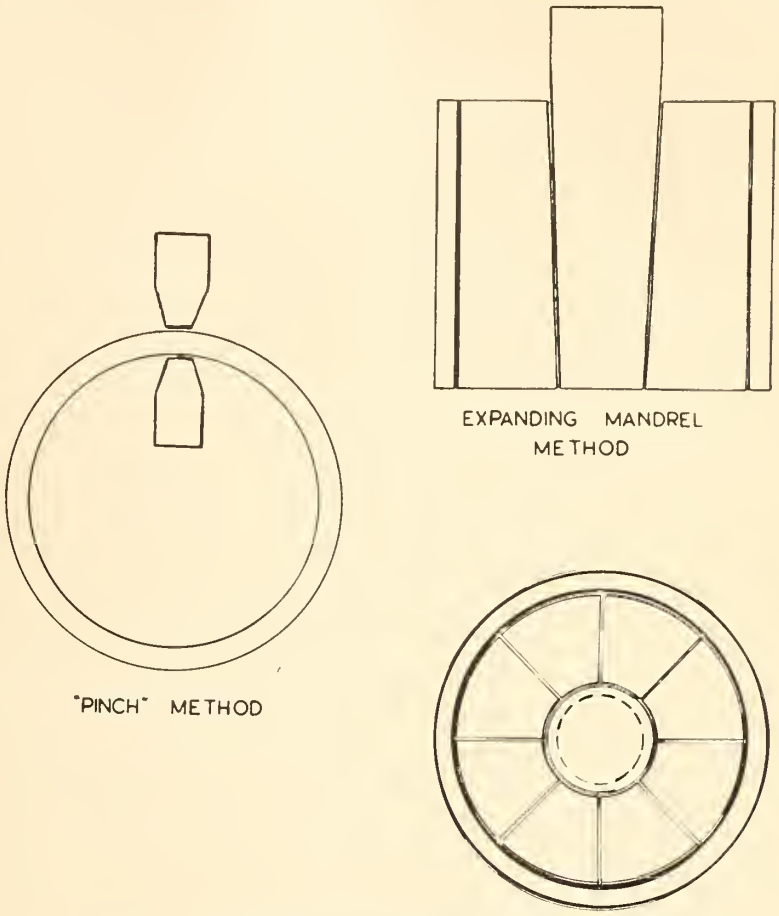


Fig. 12. Alternative methods of cold-working end-bells.

and an increase in hardness up to 350 Brinell. Great care has, therefore, to be taken with the material to avoid any further work hardening effect which may completely rob the material of any remaining ductility or ability to accommodate, by plastic deformation, any overstress. The drilling of ventilation holes, for example, unless carried out with extraordinary care, may give this additional work hardening effect in addition to acting as stress raisers, and it is advisable, even at the risk of slight decrease in cooling efficiency, to eliminate these. The material in the highly stressed state is also susceptible to stress corrosion effects and the most careful attention to storage, and protection during manufacture and during actual running is fully justified.

Use of Castings

The discussion so far has dealt generally with the question of forgings. Turning next to the problem of castings, it is found that in steam turbine assemblies general practice is to use cast iron for such purposes as casings and exhaust chambers for maximum temperatures of 450°F. This figure, however, has been increased, in the United States, to 650°F. for the improved fine graphite structures such as Meehanite and it is possible that other countries will tend to increase the somewhat conservative figure of 450°F. Although ductile iron has not been used to any great extent in steam turbine practice it is possible that it could have a useful field of application for castings subjected to intermediate temperatures since there is evidence that the growth and heat resisting characteristics of nodular structures is better than the normal cast irons.

Considering steel castings, which again constitute a major problem, compositions in general coincide with those adopted in forgings, care being taken to keep carbon contents low for weldability purposes. For any given composition the creep value of a casting on the results of actual tests is rather lower but of the same order as those attained from forgings or bar material. Without minimizing the importance of composition as applied to steel

castings, it should be clearly understood that the most important feature is soundness and it is this factor which completely overshadows everything else.

Assembling the components of a large machine such as a steam turbine can occupy a period of months necessitating a co-ordination of finished parts to a strict time schedule which can be completely disorganized by prolonged rectifications and possible rejections at a late stage of manufacture. Unfortunately, no article is likely to give more trouble in this respect than a steel casting. The reasons why these difficulties result are not hard to appreciate when it is remembered that the casting process consists of pouring a liquid of limited fluidity and high shrinkage characteristics both in the liquid and solid states into a friable sand mass of dubious mechanical properties. Further, the latter offers major resistance to the free contraction of the castings at temperatures corresponding to minimum strength conditions of the steel. Success can only be achieved if the design state readily responds to the stringent conditions imposed during the casting and cooling processes. This calls for active and intense collaboration between the designer and the foundryman, without which there is no hope of success. It should be remembered that the contraction of liquid steel amounts to 1.6 per cent for every 212°F. drop in temperature and the contraction at the moment of solidification is 3.5 per cent of the subsequent volume at room temperature (Fig. 13). In any steel castings, therefore, cavities with or without hot tears will inevitably occur unless the cooling conditions are such that the last part of the metal to freeze is outside the casting and in the riser. In addition, after solidification there is a great danger of hot cracking or the formation of tears at a high temperature unless the component parts are free to contract with a minimum of interference. It is vital, therefore, that all parties should be aware of the method of moulding so that some idea of the pattern of solidification can be formulated.

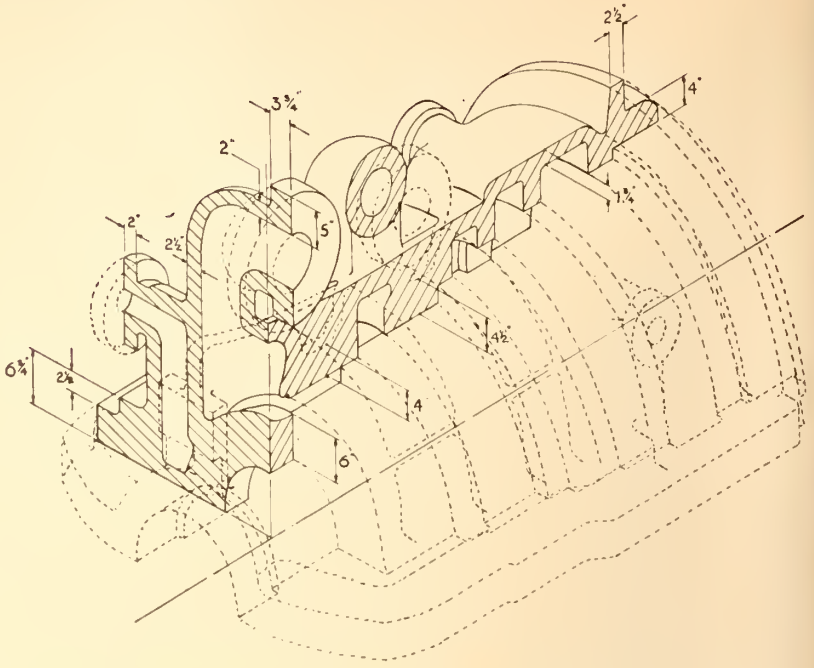
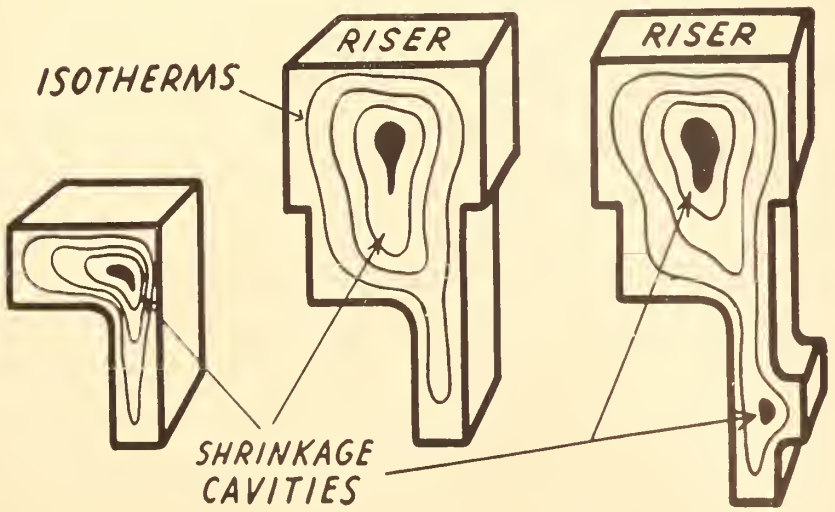


Fig. 14. Turbine casing illustrates complexity of casting problems.

Fig. 13. Formation of shrinkage cavities in castings.



By consideration of these details section thicknesses can sometimes be so arranged that solidification proceeds progressively from the positions furthest away from the riser whilst the last portion of the molten metal is in the riser itself. Unfortunately the number of castings which allow such forecasts to be made with any accuracy are very few and a typical problem, as applied to a steam turbine casting is illustrated in Fig. 14. No matter which way the job is made there will be zones which will be most difficult to feed and the utmost skill is called for from the foundryman as regards positioning of risers and chills to accelerate cooling of isolated heavy sections. This again is a function of experience more than anything else and the successful production of a casting such as the one shown depends more often than not on a slow empirical build up of know-how.

The turbine designer can help in this respect by concentrating the manufacture of this type of complicated work into a minimum number of foundries for sufficient periods of time to enable the techniques to be acquired.

In addition it is necessary to assist the foundryman as far as possible by simplifying the construction and incorporating the composite welded and cast structure where possible. The breakdown of a structure will, in turn,

call for the utmost care on the part of the designer to avoid such undesirable features as heavy stress concentrations in the vicinity of the weld. This breakdown into component parts simplifies the pattern constructions, enables the mode of solidification of the individual units to be forecast and facilitates the finishing operations, since considerable machining is possible with a consequent saving in heavy machining time. The composite casting techniques can be illustrated by a comparison of Figs. 15 and 16 with Fig. 14. In

Fig. 15 (above); Fig. 16. Welded construction permits use of separate castings in different materials.

the first two all the branch pipes and auxiliary connections are produced separately, partly machined and directly butt welded into position. This type of construction allows the employment and welding into position of highly-alloyed components with specialized properties such as good creep resistance whilst the main casting may be of a lower alloy content.

To illustrate this type of trend, consider a nozzle box subjected to maximum steam conditions of 1050°F. and 1500 lb. per sq. in. This may be 3 per cent chromium, molybdenum, vanadium, tungsten alloy whilst the main casting is a 0.5 per cent molybdenum, vanadium alloy. Similar assemblies have been used in which the nozzle box is austenitic, additional modifications, in this case, being necessary to accommodate the differential expansion characteristics.

Inspection of Castings

Inspection has an important part to play since it is vital with steel castings that the complete lay-out and summation of defects should be ascertained as soon as possible in the life history of the component. The methods adopted include: magnetic crack detection; radiography; acid pickling; and ultrasonic examination.

Magnetic Crack Detection

This is based on the interruption in a magnetic field produced by defects such as hot tears, shrinkage cavities and allied phenomena. In the same general field of inspection can be included the use of penetrating dyes and so on.

X and Gamma Radiography

These play an important role not only in the exploration of pilot castings in the foundry but also in routine examination of specialized zones in large castings.

Although portable X-ray equipment is available in sizes up to 250 kv., allowing effective examination of material 2½ in. thick, the larger sets of 400 kv. and upwards, suitable for thicknesses of 4½-7 inches and over, necessitate permanent installations with protective measures for the operators. For greater thicknesses, examination of heavy sections with rays generated by orbital accelerators are now being employed. These accelerate particles to high energies, and liberate X-rays after bombarding targets.

The energy from X-rays generated at medium voltages up to 400 kv. are relatively easily absorbed, and plates of high contrast are obtained provided sections of approximately the same thickness are examined on the one plate. Where marked changes of sections are involved, precautions against loss of detail at edges and changes of section are necessary; but, when these are taken, a higher degree of contrast can be obtained than with gamma radiography.

The chief sources of gamma rays are radium, radon, and the radioactive isotopes. The first-named is obtained from natural sources; radon is a gas, the product of spontaneous disintegration of radium. This gas is absorbed in activated charcoal within a glass tube and, in common with all these materials, emits gamma rays at a rate decreasing with time. The principal radioactive isotopes used are those of iridium and cobalt.

With the exception of iridium, radiation from all these materials is very similar. They have a low absorption capacity and no special precautions with variable thicknesses are necessary. Iridium 192, which has a low gamma ray emission, yields relatively high contrasts, and is suitable for thicknesses up to 2 in.; cobalt 60 and radon are applied to greater thicknesses. The smaller the source of radiation, the sharper the image; the radon tube fulfils this requirement for a high specific activity, which is the chief consideration for heavy-section radiography.

With regard to radiographic standards, there are in existence such publications as the A.S.T.M. Standards. The main point regard-

ing these standards is to emphasize that a clear understanding about their use and the areas and zones to which they are going to apply is necessary at the start between the user and founder. Failure to agree on these points before the casting is made is responsible for considerable disputes and controversies. Unfortunately in so many steam turbine castings the difficulty is interpreting X-rays, particularly when taken in the vicinity of the junctions which are the most likely sources of dangerous defects such as hot tears, etc. (Fig. 17). Great care is therefore necessary since indications may be isolated defects or the outcrops of far more dangerous defects and it is only a clear understanding of the solidification procedure which enables a clear analysis to be made.

Acid Pickling

Pickling in hot sulphuric acid with restrainers is particularly good for showing hot cracking zones and has the additional advantage of removing burnt-on sand defects which may otherwise come adrift and damage blading. Objections have been raised to this process by some founders on the grounds that the hydrogen liberated may aggravate the cracking, but these fears appear to be ill-founded provided the casting is heat treated before and after the operation.

Ultrasonic Examination

This method of examination as applied to castings for steam purposes, which are usually of a complicated nature, has only limited application. Not only are there the difficulties associated with surface conditions but also the discrepancies inherent in castings of this type, which are of minor importance from the point of view of service duties, but complicate the reflection patterns obtained in examination.

Identification and assessment of defects by any of these methods must be relative to the service duties and if repairs are possible they usually involve complete removal followed by an agreed welding technique and corrective heat treatment.

Other Problems

One would have appreciated more time to have dealt with other metallurgical features of both turbines and alternators. Subjects which are deserving of more attention include, for example, the rotor windings of the alternators and the steps taken to overcome copper shrinkage. This occurs in windings of large turbo-alternators which are subjected to shift working to cope with peak-hour loads and it is only by the introduction of copper alloys containing silver additions, which increase the creep strength and reduce the softening tendencies following cold working, that these difficulties have been overcome.

One further major problem which will tend to increase as temperatures are elevated is that of metal to metal contact, and the selection of surfaces with adequate anti-galling properties, with particular reference to valve spindles, etc., becomes of major importance. Nitrided surfaces appear satisfactory up to 950° F. but above this it would appear that we may have to call upon much more complicated materials such as Stellite and silicon Monel for bushes and stainless materials for spindles.

The development of materials for condenser tubes could be the subject of a very admirable lecture illustrating the manner in which dezincification and impingement attacks have been, in the main, successfully overcome. Small arsenic additions to 70/29/1 Admiralty brass metals are effective in avoiding dezincification, and the development of aluminum brass 76/22/2 with arsenic additions has successfully eliminated impingement attack except in highly polluted waters. In addition and coincidentally, the cupro-nickels have been successfully developed for service in many difficult waters; these usually contain small percentages of iron and manganese. However, they have a lower thermal conductivity, which must not be neglected. As a result of the shortage of nickel, new cupro-nickel alloys have been developed with approximately 10 per cent of nickel coupled with 2 per cent of iron. These have given good results in power stations where other materials have not proved adequate. There are cases where both cupro-nickel and aluminum brass have failed and it may be that tin bronzes may have corrosion resistance which the others do not possess; at any rate considerable experimental work is being carried out on these materials.

Summary and Conclusion

To summarize, the general trends by which the metallurgist forgemaster and founder have been able to meet the demand of the turbine designer have been outlined. The latter are by no means static and in the future it is obvious that even greater calls will fall on the technical skill of the producers of the major components. Happily there is a clearer understanding of the processes which control the occurence of defects in both forgings and castings and this fact gives confidence that the production of these higher components will be possible. It should be remembered also that the techniques of inspection are improving probably faster than those concerned directly with manufacture and whilst this is a source of satisfaction to the turbine user, a heavier responsibility is placed on those concerned with the acceptance and manufacture of these materials. √

Fig. 17 Care must be taken in interpreting X-ray pictures of junctions liable to defects.

Control of Air Pollution in Great Britain

by

Sir Hugh Beaver, M.E.I.C.

Managing Director,
Arthur Guinness' Son & Co. Ltd.,
London, England

A paper presented before the Engineering Institute of Canada, Montreal Branch, March 17, 1954.

During the past few years Canada has become conscious of its air pollution problems. To solve them will require not only much technical investigation, but study and action along legislative and administrative lines. This paper, which describes what is currently being done in Great Britain, is therefore particularly timely.

Many of you, of course, know the Old Country very well, but you have probably never considered it from the air pollution point of view. I shall start therefore by giving you a brief summary of its salient characteristics from this aspect.

England, Scotland and Wales comprise in all some 85,000 square miles, and have a population of about 51 million persons. But a considerable part of Britain is very sparsely inhabited and almost the whole population is contained in an area of 60,000 square miles. England itself is, indeed, the most highly industrialized country in the world. In this space of 60,000 square miles there are congregated, we estimated, at least 200,000 factory chimneys and some 12,000,000 houses. The traditional method in Britain of heating houses and of individual rooms in office blocks and hotels, is by open fireplaces burning coal. I once made some rough calculations, and came to the conclusion that there were at least 20,000,000 chimney pots in the Greater London area. I may even be underestimating by a few million. They are not, of course, all operating. But there they are — at any moment any one of them could pour out smoke. For you have to remember that the great bulk of the English and Scottish coals have a very high volatile content. Our low volatile coals and anthracites, are of limited amount.

This area of 60,000 square miles is something over 600 miles in length and generally under 100 miles in breadth, and surveys have shown that substantial traces of coal combustion pollution—smoke, fine dusts and sulphur dioxide—are found a long way from their sources; indeed, up to 50 miles and even more in certain conditions. The whole area, therefore, except such parts as are near the coast and have the benefit of strong sea breezes, is permanently polluted.

I would like to give you some idea of the amount of pollution from which we suffer.

In 1953 our total use of the main pollution-producing fuels was:

173 million tons of solid fuel, of which 21 million tons was coke;

9 million tons of diesel and gas oil, fuel oil and creosote and petrol;

202 thousand million cubic feet of unpurified coke oven gas;

Without going into details this fuel produced about:

2 million tons of smoke;

800,000 tons of grit and dust;

5¼ million tons of sulphur dioxide;

As is natural in a heavily industrialized country, there are areas of intense concentration both of manufacturing and of population. The Greater London area has some 8½ million people. Lancashire and Yorkshire have some 20 million people in a 50-mile circle. The Midlands, and the so-called "Black Country" and Glasgow are other typical heavily populated and industrialized, and therefore heavily polluted, areas.

Incidence of Pollution

Because of meteorological conditions most of the densely used areas are subject to natural fog, particularly in the winter months. My committee compiled a map which showed all the areas with an annual fog frequency of 30, 40 and 50 days per annum, and we plotted on this map the main industrial areas and the densely populated areas. Where these areas coincided were obviously the worst conditions of pollution. These we called "black areas." We found that almost half the population lived in these black areas, which are in all less than a tenth of the total area of the country.

I will not give you details of the variations in pollution from which these areas suffer, but the following are typical of all the really bad ones:

Smoke: 2 milligrammes per cubic metre rising exceptionally to 6 mg. per cubic metre.

Sulphur dioxide: One-quarter part per million, rising very exceptionally to 1 part per

million (or 2.86 mg. per cubic metre of air).

Deposited matter: 500 tons per square mile, rising in some places to 2,000 tons per square mile.

You will agree that this sort of thing must be an intolerable nuisance. And nuisance has for a very long time been the way that it has been considered. But what you must realize is the human and economic cost.

In the first place, consider health. I am referring not to exceptional occasions of abnormal pollution, but to the regular experience, year in and year out. The most serious effect of air pollution in Great Britain is on the lungs and bronchial tubes. There has been established an unchallengeable association between air pollution and the incidence of bronchitis and other respiratory diseases. The death rate from bronchitis in England and Wales is far higher than in any other European country for which reliable figures are available. The average death rate per 100,000 from bronchitis in England and Wales is about fifty times that in Denmark; something like twenty times that in Norway and Sweden. And as between our urban and our rural areas the rate is something like 50 per cent higher in the former. In the big urban areas in England and Wales, with populations of 100,000 and over, the death rate in 1952 from pneumonia, bronchitis and other respiratory diseases, including influenza, was 120.65 per 100,000; in Scotland it was 119 per 100,000. To put that into perspective, let me quote the average annual deaths from typhoid in England in the earlier parts of the last century, when typhoid was rightly recognized to be a terrible and frightening scourge. The average typhoid death rates in 1870 were 39 per 100,000 of the population.

The annual total of deaths in Britain from bronchial-respiratory diseases is every year far higher than the highest experienced in the worst of the terrible cholera epidemics that swept England at intervals in the nineteenth century.

The great 'killer' years were 1831, 1848, 1853, 1866 and 1893. In these last four epidemics the total number of deaths known to have been due to Asiatic cholera in Great Britain was 93,127.

And then to this you have to add another vast figure, that of all the ill-health, retarded growth and unhappiness that comes from pollution and the deprivation of sunlight.

Economic Effects

Let me turn to the economic effects. Everybody has always known, but too lightly dismissed, that there obviously is and must be a heavy waste and expenditure due to air pollution. We finally came to the conclusion that a conservative figure would be £250 million ($750 million) a year. More than half of this was what we called direct costs:

Laundry	£25	million
Painting and decoration	£30	million
Cleaning and depreciation of buildings other than houses ...	£20	million
Corrosion of metals	£25	million
Damage to textiles and other goods	£52½	million

making a total of at least £152½ million per annum of *direct* cost.

There is a further large bill for indirect costs much more difficult to assess. The largest item here is the loss of efficiency because of absence from work or underworking due to actual illness and to ill-health. This we considered on such evidence as we could get to be at least one per cent of the country's total productivity. For instance, the loss of working days from bronchitis and chronic bronchitis and from other diseases of a respiratory type was in 1953 16½ million days. We were not able to calculate the loss to agriculture, but it is proved that it is very considerable, certainly £10 million or more. We made some calculation of the effect on transport and distribution. We considered that altogether it was conservative to put the indirect costs due to all these effects at a figure of at least £100 million a year. We are satisfied that our figures are under rather than over the truth. This means something like the astounding figure of £10 per head per year throughout the black areas. To complete the picture, one must add that the waste of coal through inefficient use, amounting to about 10 million tons a year, costs something between £25 and £50 million. You can imagine what a difference that 10 million tons of coal would make, seeing that we are actually importing coal.

I think I have said enough to give you some idea of the burden of air pollution in Great Britain. You might well thing it strange that in those circumstances the evil has continued so long. Indeed agitation has gone on for a very long time, but for the most part it has been sporadic and disjointed. It has depended largely on comparatively few individuals and on a few enlightened local authorities. But it will be obvious that it had, until recently at any rate made little headway. There was a committee that reported in 1922 the successor of many committees starting more than a hundred years earlier. Its report had no great effect, but did lead to the inclusion of some smoke clauses in a new comprehensive Public Health Act in 1936. Those clauses were, and are, the principal legislative weapon to deal with air pollution, although various local authorities had obtained certain powers for themselves and there were sundry other acts that added a bit here and a bit there.

Anti-Pollution Legislation

The Public Health Act of 1936 contains no provisions for regulating domestic smoke; smoke from the chimneys of private houses is expressly excluded. There is no provision in any of these acts for the creation of smokeless zones; local authorities have obtained the necessary powers hitherto only by promoting local bills. The acts do not directly prohibit smoke and the procedure for enforcement is circuitous. It is a defence, except in proceedings in respect of "black smoke," for the person responsible to show that the best practicable means have been taken to prevent the emission of smoke. The term "black smoke" is not defined in the acts and is difficult of proof in a court of law; in fact, it is doubtful whether smoke is ever "black" in the strict sense of the word when it leaves a chimney. Under the general law it is also necessary when proceedings are being taken in respect of the emission of smoke from a chimney, to show that this smoke constitutes a nuisance; this is a matter of considerable difficulty in built-up areas where smoke is being discharged from a number of different chimneys simultaneously.

Local authorities may, under Section 104 of the 1936 Act and subject to confirmation by the Minister of Housing and Local Government, make by-laws regulating the emission of smoke "of such colour, density, or content as may be prescribed by the by-laws." No by-law has yet been made so as to apply to anything but black smoke, and if it were, the defence of "best practicable means" would still be available.

Section 109 of the Act of 1936 provides that the smoke abatement provisions of the act shall not extend to a mine so as to interfere with its efficient working, or to a number of metallurgical processes so as to interfere with or obstruct any of those processes and so on.

We summarized our views as follows: "It is indeed apparent from the conditions which prevail today that the law has failed to achieve its purpose, notwithstanding that it has been in operation for many years and that considerable progress has been achieved in the technique of smoke prevention."

Lethal Pollution

This then was the position. As the Committee of 1922 had said, "The great majority of the public have never given any thought to the question of smoke prevention. Residents in industrial districts who have grown up and passed their lives in surroundings which occasionally appear to be almost intolerable, are found to acquiesce in a state of things which they believe to be unavoidable!"

And then occurred the London "smog" from the 5th to the 9th of December, 1952. For about four and a half days London was blotted out. Smoke pollution rose to over five times the average rate in ordinary winter conditions; sulphur dioxide to over four and a half times normal. The death rate immediately went up to three times normal. It was calculated that at least 4,000 deaths were due to those days of smog. The closest investigation has failed to disclose any particular reason for this. That the smog was exceptionally lethal is obvious; why it was so has eluded us altogether. It had no traceable peculiarities; it was only noticeable in its density, its length and in the low temperature prevailing. There was no exceptional pollution element; the composition was much the same as that of all the bad London smogs. So what has occurred once can occur again.

Action Taken

There is no doubt that once the extent of the calamity was realized, it had a tremendous effect. For the first time there was public clamor for action and indeed many of the public were thoroughly frightened. It was out of this, although after a delay of nearly eight months, that my committee was appointed.

From the outset we decided to adjust our approach, to mould our tactics, to these special conditions. We were determined not to waste our time producing just another volume for the shelf of air pollution reports, if we could help it. We decided not to adopt the ordinary procedure of a committee. We recorded no formal evidence; we subjected nobody to cross-examination. We had discussions with, or received information or views from, altogether something like a hundred bodies, authorities, associations and corporations, many of them vitally concerned, including the coal industry, the electricity and gas industries, the railways, all of which are nationalized statutory bodies. We saw the representatives of industry and of organized labour. We saw representatives of many local authorities and interested local bodies.

To all whom we saw we put the proposition that there was no argument about the necessity for dealing drastically with air pollution; the only question was the practicable means. This attitude was invariably accepted. We then turned our meetings into round table discussions, where nobody was on the defensive or on the attack. We took no formal evidence; we carried on much of the investigation by subcommittees and informal meetings. When we produced our report it was to a large extent virtually an agreed document. I do not claim that this is a method that could ordinarily be adopted, but I think it could probably be adopted more frequently. In our case it certainly paid.

I will not attempt to take you through the report, although it is only about 12,000 words long. Briefly, we decided first and foremost that although Britain is a small island, and although smoke and air pollution know no boundaries, and although we have some 1,500 local authorities of all sizes—great cities and boroughs and small urban district councils—yet the bulk of the action to prevent smoke should nevertheless remain in the hands of these local authorities and that they should be appropriately armed. On the other hand, we decided that the necessary new legislative powers should be secured by national, country-wide legislation and not by local acts. We recommended that there should be a new all-embracing Clean Air Act which would sweep up all the bits and pieces into a workable and much strengthened whole.

So far as industrial smoke was concerned, we recommended that *no* dark smoke from boiler plants and ordinary furnaces should be permitted, that is to say smoke of a density of, or above, Ringelman 2, except for short specified periods at lighting up or of soot blowing; and that effective steps could and must be taken to trap grit and dust. We recognized that there were a number of industrial processes where clean methods had as yet not been developed. All these are, according to our recommendation, to be scheduled and are to be dealt with by a corps of highly qualified and specially experienced inspectors and not by the staffs of local authorities This recommendation does not require the creation of a new lot of government inspectors. They exist already and deal with some special industrial processes, but not at present with anything like all of them.

No Exemption

We consider there should be no process exempt in any way from challenge. Either a process is recognized as offering special problems, in which case it will be scheduled, and then it will be the business of this inspectorate to secure that research is continuously directed to finding inoffensive means of operating. As such means are devised they will be applied throughout that industry. If and when it is decided that effective means of preventing nuisance in any special process are already known, the process will be descheduled; it will then have to comply with the normal law prohibiting dark smoke.

But one half, and in winter

more than one half, of the air pollution is due to the domestic chimney. The only cure of this obviously is to obtain the required heat smokelessly. There will naturally be some extension of the domestic use of gas and electricity for heating, but both are much more expensive in Great Britain than is solid fuel, and we had no doubt that within the period for which we were planning, say 10 to 15 years, most space heating would be done with solid fuel. The amount of really low-volatile coal in Britain that can be directed to domestic use is, as I have said, limited; there are manufactured smokeless fuels, but they are above the low-income purse. The solution must therefore rest on adequate quantities of good quality attractive domestic coke, and for this there must be the proper domestic appliances.

While we were not prepared to speculate on the ultimate pattern of fuel use over the years, we were satisfied that in the initial years and for some considerable time ahead the right type of coke at the right price could be made available. We recommended therefore that local authorities should be given powers to create two types of smokeless areas. The first is that known as "Smokeless Zones," of which a few already exist, where absolute smokelessness is required. This means, of course, the use of smokeless fuel throughout. Obviously no really industrial area could come into this strict category. Our second type of area was what we called a "Smoke Control Area," where we aimed at an 80 per cent reduction of smoke. In this it would be possible to include the great bulk of normal industrial and commercial activities where dark smoke is to be prohibited. Clearly, such smoke control areas will not admit those processes where the prevention of smoke is still not practicable, so they cannot be applied universally. But by this device of a semi-smokeless area we considered that it would be possible to deal in an effective way with a very large part of all the industrial and densely populated areas.

Since we had emphasized that there was vast national wastage in present conditions of air pollution, we thought that it was right that financial assistance should be given to householders for the conversion of domestic grates to burn coke, as well as to industrial plants, where justifiable, for the installation of automatic stoking and of grit arresting plants, etc.

Power Stations

Power stations, being individual sources of great potential pollution, gave us much to think about. A modern power station consumes a million tons of coal a year and more, and size is always increasing. Moreover, many of these, unfortunately from our particular point of view, are situated right in the centres of population. Even the most efficient of electrostatic dust precipitators may leave some 10 tons of the finest dust to escape and settle every day on the surrounding property.

Power stations by their very size emphasize too the problem of gaseous pollutants, particularly sulphur dioxide. The committee's report was necessarily incomplete in this respect because of the present inadequacy of knowledge. High chimneys produce wide diffusions of flue gases, but we did not find that sufficient. We considered that flue gas washing in large plants like power stations, even though it reduced the temperature of the emitted gases and thus reduced the diffusion was, nevertheless, desirable *if* 90 per cent effective. We recommended that washing plants should be installed in all new power stations in or near heavily populated areas, even if it added to the cost of electricity. We reckoned that it would add about four per cent.

There is not space here to go further into the details of the report. But there is one recommendation we made, which is perhaps unusual, but by which we set considerable store. In order to keep public opinion awake—which is an essential factor in success—and in order to measure progress, we recommended that every local authority should each year make a report to the central government showing exactly what it had done in that year and what was contemplated towards the prevention of air pollution. Moreover, seeing that there were so many different government departments and other interests concerned, we considered that it was essential that there should be set up an influential, authoritative Clean Air Council whose annual report covering the whole country should come to Parliament each year and if desirable be debated.

With regard to program, we considered that there should be a three-year period from the publication of our report before the new law became operative in regard to industry, and that the conversion of the country into smokeless zones and smoke-control areas should be spread over some 10 to 15 years.

Our report was issued in November, 1954. It was received with unusual unanimity of approval. At the beginning of February, 1955, the Government stated that it accepted the report in principle and would proceed to introduce in this Parliamentary session—probably by April, 1955—the necessary bill to give legislative effect to my committee's recommendations.*

So far so good, but it is only "so far." It was clear to my committee that there is a great deal that yet remains to be done and in our report we underlined this fact. We know all too little, almost nothing, about the problems of the gaseous pollutants. With the rapidly increasing use of fuel oil and of diesel engines in Britain there is going to develop a problem of growing magnitude from this form of pollution. Some medical authorities have stated that the real, almost the only, lethal element in smog is the sulphur dioxide. We found no justification for this extreme view. Indeed, the bulk of medical opinion holds that it is the combination of smoke, sulphur dioxide and the tarry particles of soot that presents the worst danger. But sulphur dioxide is a very baneful and dangerous pollutant and while we pour three million tons a year of sulphur into the air, we import about as much for industrial use. There is scope here for productive investigation.

There are many important fields where intense and purposeful research beyond what has yet been done is required. To watch, encourage and evaluate this was another task that we thought could be undertaken by the Clean Air Council. A start on this problem of air pollution is now being made, or about to be made, in a big way, but it is essential that the pressure be kept on continuously. √

* A general election took place in May and the new government has undertaken to introduce a Clean Air Bill.

Power Transmission by Insulated Cable

by

Dr. L. G. Brazier,

Research Department,
British Insulated Callender's Cables,
London, England

A paper presented before the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, at Toronto, May 1955.

Drawing a comparison of cable manufacturing procedure and of the component materials used, as between Britain and North America, the author presents statistics on temperatures, stresses, tests, failures and joint trouble rates experienced in the two countries. Outlining future developments, he points out Africa is the only continent left with a clear surplus of hydro power, and predicts use of its energy for production of plutonium to be exported where needed as packaged. Yet he predicts transmission lines and cables are likely to increase, with a growing demand for high voltage d-c transmission, raising a whole set of new problems for the cable manufacturer.

The use of helically-lapped impregnated paper tapes for the insulation of super-tension cables is nowadays so commonplace in the electrical industry that its introduction tends to be forgotten. The idea was conceived by an American in 1886 when E. D. McCracken and friends formed the Norwich Wire Company in America, to make telegraph and electric lighting cables with impregnated paper tapes, (1) the idea having been first suggested by his former employer J. H. Wortendyke in 1872.

The first application for power cables was made when J. B. Atherton acquired the British rights for the process, and formed a company in 1890 known as the British Insulated Wire Company, the board of which was joined by a famous name in the history of the electrical industry, Sebastian Z. de Ferranti.

Ferranti had used longitudinally applied paper rolls for insulating the Deptford 10 kv. mains in 1889, (2) but when in 1893 the London Electric Supply Corporation decided to replace part of this system running on a railway parapet, an order was placed for two 30-yd. lengths of 11 kv. experimental concentric cables with the B.I. Company, using the new helical-lapping technique. These were the first flexible paper-insulated cables to be employed at this voltage anywhere in the world.

From the time of this early start, the cable industry in Britain has been larger in proportion to population, and the cable network in operation more extensive, than in other countries. This is partly due to the dislike of the British for the untidy appearance of overhead distribution, but is also partly the consequence of the agglomerations of industry over large areas such as Greater London and the industrial Midlands.

In addition, the British cable industry has always made cables for the world and at the present time exports 30 per cent of its manufacture, whereas not more than 2 per cent is exported from the North American production. Canada has a population about one quarter that of Great Britain. The total annual consumption of electricity, however, is about the same, namely, 65,000 Mwh. The enormous use of electricity per head of population in Canada is doubtless associated with the electro-metallurgical industry.

In this connection the report of the Paley Commission makes interesting reading. It is there estimated (3) that between 1950 and 1975, U.S. consumption of primary aluminium will increase by 4 times, and the electricity required for refining this metal will be 65,000 Mwh. a year, viz., the same as the total consumption in Britain or Canada today. This gives an impressive idea of the massive electrical development to be faced in North America during the next two decades.

Types of Cable

The types of cable currently in use in Britain and North America are largely similar. For mains distribution up to 11 kv. there is the standard solid type cable. For 33-kv. there is the screened 3-core solid cable. For voltages of 33-kv. and above there are the various designs of high performance cable in which the deleterious effects of void ionization are eliminated.

These are, firstly, the oil-filled cable based on the pioneer work of Emanuelli after the first world war; secondly, various forms of pressure cable largely developed in Europe, including the impregnated pressure cable in which the gaseous pressure is brought into free contact with the dielectric, and the compression cable in which the gas is kept separated from the dielectric by means of an additional lead sheath as an

impermeable membrane. Thirdly, they include the oilostatic cable largely developed in America, and its variations such as the oilostatic cable with a polythene membrane, and the S.M.D. cable with a gas pressure medium filling the tube.

Cable installation conditions have for a long time been systematically different on the two sides of the Atlantic. It is interesting to observe how American preference for the development of a steel pipe cable derives from the practice of installing cables in ducts, as opposed to the British practice of burying them direct in the soil. Nevertheless, there is no great or overriding difference in the types of cable on the opposite sides of the Atlantic.

Moreover, the differenees in practice that derive from the difference in installation, i.e., ducts instead of cables laid direct, are sufficient to defeat always any attempt to make an effective overall comparison of the engineering and commercial efficiency of American and British cable installations. Therefore the comparison is preferable on the basis of the component materials and manufacturing processes used in the two cases, rather than on a basis of cable types.

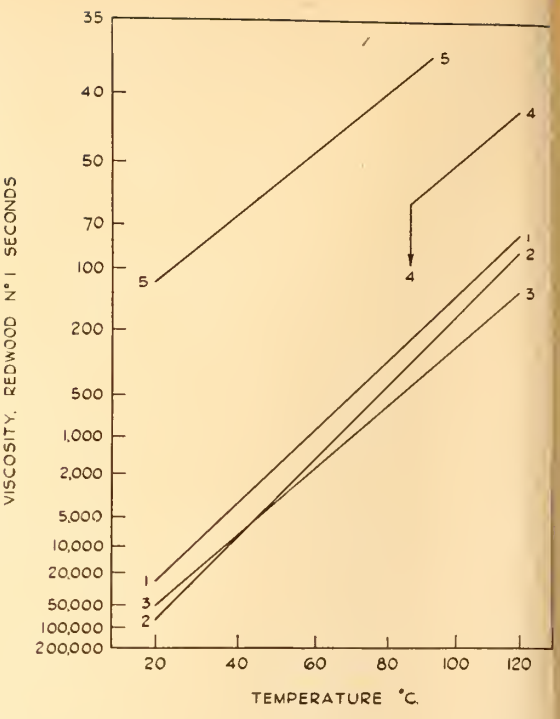


Fig. 1. Viscosity-temperature curves for various cable impregnants. Curve 1, straight 900 seconds oil; Curve 2, oil thickened with refined rosin for 'solid' type cable; Curve 3, oil thickened with hydrocarbon polymer for pressure cable; Curve 4, microcrystalline wax compound; Curve 5, 'transformer' oil for 'oil-filled' cable.

Conductors

The plain stranded conductor involves a waste of space which results in an unuseful increase in the conductor diameter of 15 per cent, and a corresponding useless increase in the volume of dielectric and sheath. Compacting of the conductor has been only partially used in Britain, whereas in America practically complete compacting is achieved by means of heavy rolling.

It is perhaps a question how much of the gain in copper space efficiency is lost by the increase of resistanee, due to the hard working of the copper that is involved. It is possible that better results could be obtained among the smaller sizes, by using solid copper conductors, if suitable means of handling at the paper taping machine were developed. On the other hand, large conductors are more regularly used in America than in Britain. This has led to the use of compacted conductors with insulated segments to minimize skin effect. These conductors have not been used in Britain.

In the case of very high voltage cables for comparatively small powers there is sometimes an advantage in large conductor diameter. In these cases compacting may be a retrograde step. In such cases an aluminium conductor acquires an added advantage. For a given conductance the relative cost of copper and aluminium (at present day prices) shows an advantage in favour of aluminium of over 4 to 1. Unless there is a big change in the relative material prices it seems likely, therefore, that there will be a steady increase in the use of aluminium, especially at the very high voltage end.

Conductor Screening

When the conductor is not compacted there is an increase of stress at the crest of the individual strands, amounting theoretically to about 39 per cent. (4) Experimental results on impulse breakdown, however, indicate that the effect is in fact limited to 10 per cent. Nevertheless it gives rise to great interest in constructions which effectively convert the "stranded" surface into the smooth enveloping cylinder.

In Britain a lapping of three metallized paper tapes (i.e. paper backed with aluminium foil) immediately over the conductor is used, but in N. America layers of carbon paper are preferred. (5)

It is claimed that the adsorption power of the carbon black introduced into the paper pulp results in oxidation and ageing products in the impregnant (including the metallic soaps) being adsorbed, thus maintaining the impregnant in a higher state of purity. This effect has been confirmed in experiments in Britain but the overall improvement on a wall thickness of paper is not very marked.

Paper

British cable makers have in the past favoured paper containing manilla fibre for super tension solid cable, but the use of all wood pulp fibre is now nearly universal. The American paper has a higher fibre density and is more heavily calendered. There is, therefore some risk of a raised permittivity and of difficulty of achieving complete impregnation.

Nevertheless the American paper is undoubtedly a fine dielectric medium. Paper thicknesses are about the same. French and Swedish cable makers by using very thin paper (0.5 mils) near the conductor have made an impressive advance. The 380 kv cable at Harspranget (6) for example works at a maximum stress of 136 kv. per cm. and a mean stress of 75.6 kv. per cm.

Current researches tend to emphasize the importance of uniformity in the paper sheet in affecting the dielectric performance of an insulation wall, and that a further advanee in performance should be obtainable by attention to micro-uniformity.

Impregnants

On the whole there is little characteristic difference in the composition and viscosity of the impregnants for the different types of cable in the two countries. In Britain for solid cables vacuum refined natural resin is used as the thickener. Its use enables the power factor of the compound to be reduced without the risk of solution instability, which arises if the equivalent chemical abietic acid is used. In both countries for the highest voltage pressure and oilostatic cables, resin is substituted by poly-iso-butylene.

The general adoption of naphthenic based oils in the past 15 years is due to their greater capacity for absorbing any gas thrown out of the impregnant by the electric stress, or by ionization in void spaces. Current researches indicate that certain fractions of aromatic extract oils can be separated which, when used as additives, will both increase the gas absorption and also the chemical stability of the impregnant against ageing or oxidation.

In Britain there has been a notable development of non-draining compounds. The difficulties caused by compound drainage on gradients or vertical installations have beset cable makers from the earliest days. The ideal impregnant would have a low viscosity at impregnating temperature, say 120° C. to facilitate impregnation, and from 100° C. downwards would have a very high or preferably infinite viscosity.

How little the available thickeners contribute towards this ideal is shown by the viscosity temperature graphs of Fig. 1 for a range of compounds. Based on the micro-crystalline waxes now derived by the petroleum industry, formulations have now been devised which have a transition point at a high temperature as indicated in Fig. 1. Mass Impregnated Non-Draining cables with these impregnants are now made up to 11 kv. and with an operating conductor temperature of 80° C. Non-draining cables are also being made in Canada.

Dielectric Processing

Techniques of vacuum impregnation of lapped paper cores do not differ substantially in the two countries, except for isolated features, such as the use of horizontal impregnators, and soaking tanks as part of the impregnation process in American factories.

In British cable factories an alternative to impregnating on the drum is to coil cores into shallow trays, in which both pre-drying and impregnation may be carried out, but tray impregnation appears not to be popular in America. It has the advantage of subjecting the cable to less bending (i.e. greater radius of curvature) during all stages prior to impregnation, — the period when wrinkling or other damage to the paper taping is liable to be set up.

Dielectric Screening

At and above 11 kv. the need to ensure that the electric field between conductor and sheath is a radial one, makes dielectric screening advisable, and this is found in all paper insulated cables of higher working voltage. American practice is to use screening at and above 8 kv., the screen usually taking the form of thin lapped copper tape, whereas standard British practice largely employs perforated metallized paper.

In the case of single core oil-filled cable reliance has in the past been placed on a tight fit between the sheath and the core. It is now a British practice to interpose a screen consisting of aluminium tape intercalated with paper tape. The practice of screening single core oil-filled cable is extending in America.

Sheathing

Lead and its alloys is the traditional material for the sheathing of power cables. Interest in America has perhaps centred around the manhole repeated flexing problem, while in Britain special interest has been taken in sheaths suitable for the particular conditions in a pressure cable. In America the low pressure unreinforced cable, and the manhole flexing problem, have both led to particular interest in the arsenical alloys. They are being studied in England, but have so far not been used.

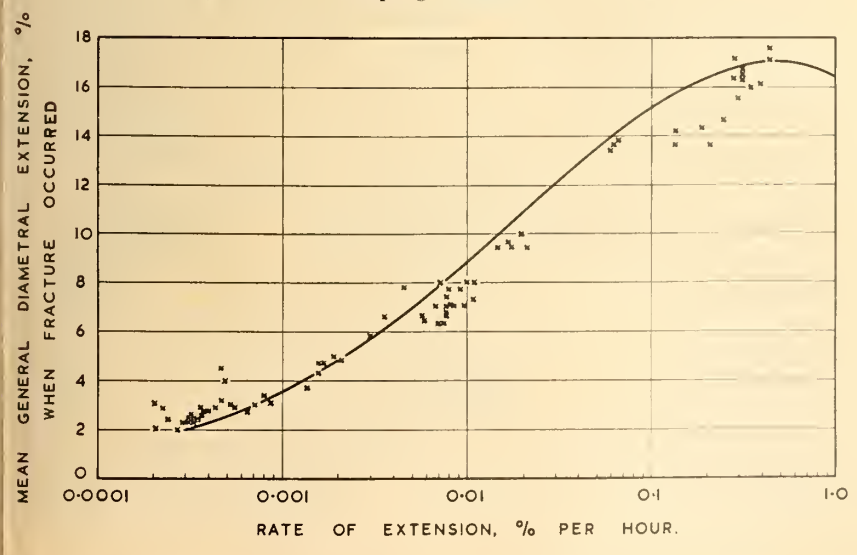
When pressure is admitted to the interior of a pressure cable there follows a slow extension of the sheath until it is bedding hard up against the reinforcement. This slow extension may take several months. Study of this requirement has revealed a disturbing characteristic of lead.

A lead which may appear ductile, with an extension before fracture, of 20 per cent on an ordinary laboratory test, may behave in an extremely brittle manner with an extension before fracture not greater than 2 per cent if the stretching process is carried out sufficiently slowly, that is a strain rate of say 10^{-4} per hour. This feature is known as the "drooping characteristic", (Fig. 2).

The bulk of ordinary purpose cables in Britain are sheathed with a dilute alloy (0.1% antimony). Where fatigue resistance is required on solid cable, alloy E (0.4% tin, 0.2% antimony) is used, while for pressure cable, in order to obtain a minimum drooping characteristic, there is a preference for a dilute alloy (0.1% tin).

The oil-filled cable is unique in that *after* sheathing, the lead is subjected to a cable impregnating process with a long cycle at high temperature. These are the ideal

Fig. 2. The 'drooping characteristic' of lead.



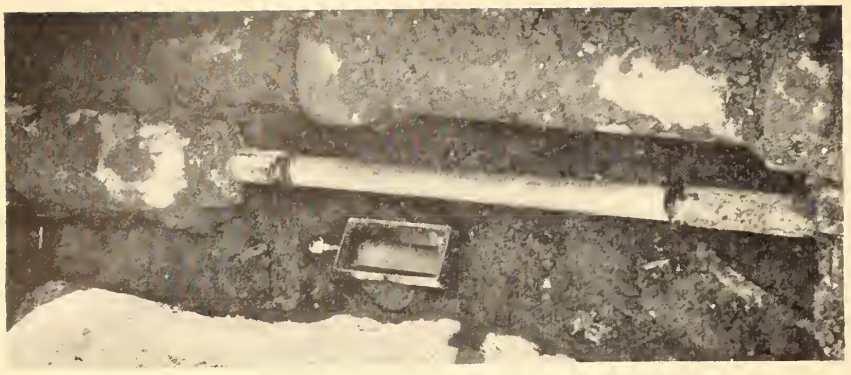


Fig. 3. State of aluminium sheath after five years' burial.

conditions for grain growth with consequent loss of properties. The desirability of resisting grain growth has largely determined the choice of Alloy ½C (0.2% tin, 0.075% cadmium) for oil-filled cable.

There is little difference in extrusion practice in the two countries, and the screw press developed in Britain is being increasingly used in America. Compared with a ram press the economy of space and the efficiency of operation are remarkable, but careful technical control is required.

The same alloy extruded on a ram, and a screw press, never has quite the same properties, and the screw press may jib at a hard alloy. With some alloying additives, particularly copper, there is a marked tendency for segregation to occur, with copper concentrations deposited in the press and intermittently released.

Aluminium has received steadily increasing attention in recent years as an alternative to lead for cable sheathing. The present price per volume of aluminium and lead shows an advantage of 3 to 1 in favour of aluminium, and it seems inevitable that in the long run this price advantage will ensure considerable usage of aluminium for sheathing purposes.

The present method of manufacture is to draw in the cable into an over-size aluminium pipe and to die down or "sink" the aluminium pipe to fit the cable. This is, in fact, a reversion to the earliest method by which cables were lead-sheathed. A certain amount of work hardening of the aluminium is caused by the dieing down, but this is not necessarily a disadvantage.

In the case of pressure cable, where the mechanical strength of the aluminium sheath is relied upon to withstand the internal pressure, and so eliminate the expensive reinforcement layers, the added mechanical properties are advantageous and there is no serious loss of handling properties.

The great enigma in aluminium sheathing is the question of corrosion. Under acid conditions aluminium is more resistant to corrosion than lead, but it is very susceptible under alkaline conditions. Unfortunately the corrosion takes place preferentially in deep pitting, instead of being spread uniformly over the surface.

The British practice of laying cables direct in the ground has always demanded a special interest in protection layers. The protection which has been developed for the pressure cable, where it is vitally necessary to protect the steel reinforcement tapes from rusting, will be found adequate for protecting aluminium sheaths from corrosion. This protection system consists of a sandwich system of self vulcanizing rubber, between polyvinylchloride.

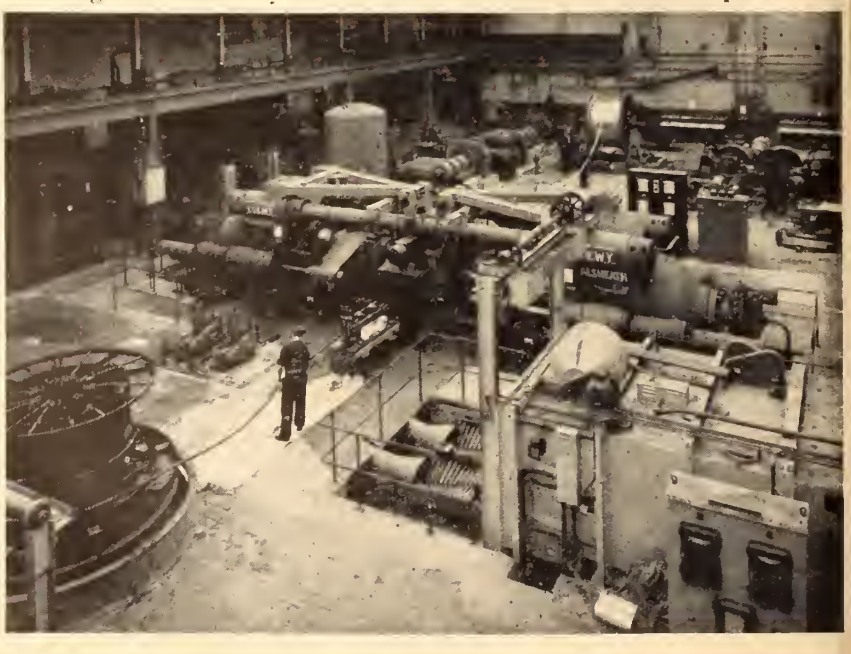
A length of 6 kv. cable with an aluminium sheath was installed in West London in 1949. The protection system here was far inferior to that referred to above which has been subsequently developed. The feeder has been examined regularly over five years. The state of the aluminium at the last examination is shown in Fig. 3. The aluminium is not entirely unmarked but the condition is such, after a period of five years service, that no further examination need be made for a further period of two years.

The price advantage in favour of aluminium mentioned above is largely absorbed by the necessity of fabricating long lengths of thin-walled tube suitable for the dieing down process. Probably the price advantage will not be fully realized until the aluminium sheath is directly extruded on to the cable. The problem here is that aluminium is normally extruded at 450-500° C., compared with lead at 220° C. The exposure of the cable to this temperature would result in the burning or scorching of the dielectric.

The Alsheath Press has been developed in Britain purposely to overcome these difficulties. Normally, right angle extrusion of aluminium is impracticable, because the pressure necessary to force the aluminium stream to divide and pass round both sides of the cable, and re-weld on the underside of the cable, is excessive.

To overcome this, straight-through extrusion with annular split billets has been proposed.

Fig. 4. View of layout of 'Alsheath' aluminium extrusion press.



Unfortunately this means that the cable has to pass down through the ram and through the billet, and this enormously increases the time of exposure to the high temperature.

In the Alsheath Press right angle extrusion has been achieved by arranging two horizontally opposed cylinders extruding simultaneously on to the cable. By this means, the aluminium stream, after dividing, has to travel only a quarter way round the circumference before meeting the stream from the other cylinder and welding with it. Thus the extrusion pressures are reduced and have become manageable. The improvement is also reflected in the lowered extrusion temperature. Commercial purity aluminium (99.8%) is extruded at 280° C.

To obtain a high quality sheath without air inclusions, the extrusion is carried out under a high degree of vacuum. An elaborate system of auxiliary rams supports the die and core, by balancing the additional forces introduced by the main ram as soon as it begins to exert an extrusion pressure.

This maintains the positional accuracy of the die assembly, and hence the dimensional accuracy of the extruded sheath. Special attention has been given to the automatic billet changing equipment, so that the whole process of changing billets, from the stopping to restarting, can be accomplished in 15 seconds, and it is hoped to improve on this time. A general view of the Alsheath Press is given in Fig. 4.

Alternative methods of sheathing a cable with aluminium are under study and development in various countries. In Britain an oversize aluminium tube with a cable drawn into it, instead of being drawn down to fit the cable, may be rolled into a helical corrugation, thus greatly improving the flexibility of the aluminium sheath.

In America the Yoder process welds aluminium strip longitudinally into a cable sheath. The weld is made by high frequency induced current heating, under a reducing atmosphere of argon or helium. The effective speed is reputed to be very fast, up to 120 ft. per minute; but obviously any line welding process depends on the absolute perfection of the weld throughout the whole run. In England a slower process based on argon arc welding has been developed.

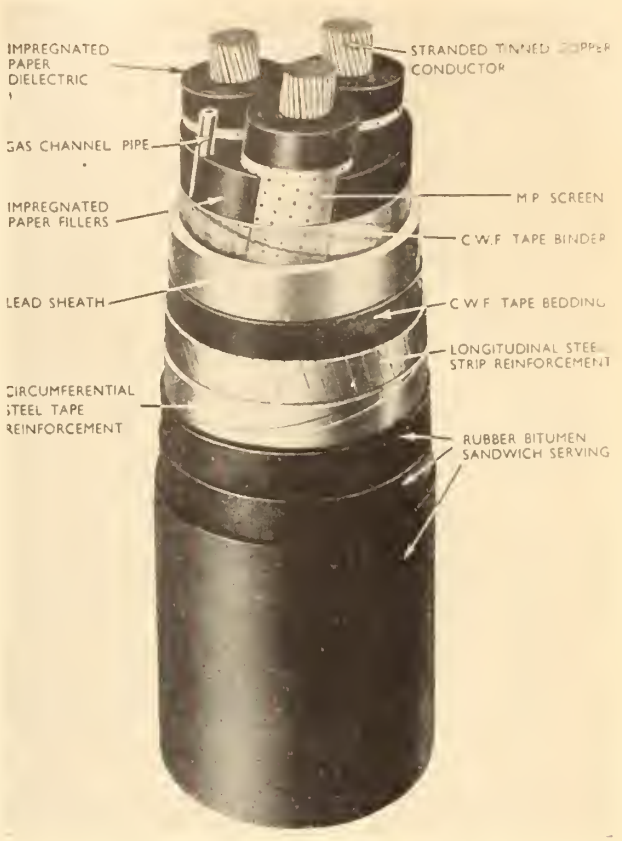


Fig. 5. Section of 3-core 132 kv. impregnated pressure cable, showing longitudinal and circumferential reinforcement.

Although aluminium-sheathed cables have become more extensively used in Britain than in America, there are two notable installations of aluminium-sheathed cable for high voltage in Canada. These are the Kitimat oil-filled cable, (7) operating at 300 kv. and 60 lb. per sq. in. oil pressure, with both conductor and sheath of aluminium, and the 69 kv. gas pressure installation at Vancouver, (8) using single core aluminium sheathed cable.

Reinforcement

For pressure and oil-filled cables sheathed with lead, some form of reinforcement is necessary to give the lead the necessary mechanical support. In multi-core cables steel tapes are generally used, but the use of steel is prohibitive in single-core cables due to magnetic losses, and copper, cadmium copper, tin bronze or brass are used in this case.

Pressure inside a cylinder sets up both radial bursting forces and longitudinal tensile forces in the cylinder wall. To resist these forces the reinforcement tapes in pressure cables are generally arranged in two layers—an inner layer of tapes arranged longitudinally or as nearly longitudinal as practicable, and outer layer arranged circumferentially. (Fig. 5)

Armour and Protection

British practice of laying cables direct in the ground accounts for the outstanding difference between cables in the two countries, in that it is necessary in Britain to protect cables from mechanical damage by armour, consisting of heavy gauge galvanized steel wire or tape. Aluminium and copper alloys are preferred in single-core cables where magnetic materials would cause undesirable electrical losses.

Protection of armouring from corrosion is achieved in Britain by layers of hessian and bitumen. The development of rubber or neoprene jackets for the protection of lead sheaths in solid-type cables has been undertaken in America. The use of such jackets possesses the added attraction that greater resistance may be offered to the movement of sheaths in manholes during heating cycles. These continuous or seamed jackets of rubber or neoprene have not found favour in Britain, where it is considered that the heat of vulcanization will cause deterioration.

In both countries there is now a development of extruded plastic protections such as P.V.C. or polythene. In Britain, the vulnerability of the steel tape reinforcement of pressure cable has led to considerable activity in developing protection layers laid on in tape form, but of which, nevertheless, the integrity is entirely reliable. The system developed consists of a double layer of self vulcanizing rubber sandwiched between P.V.C.

Accessories

A feature of pipeline installations in America is that semi-stop joints are in common use for sectionalizing lines. In these, oil or gas may slowly seep from one section to another when a pressure differential exists. A true barrier type of joint in gas pressure cables, it is claimed, is not now so much in demand, as nitrogen gas is available in sufficient quantities to fill lines up to 12 km.

Porcelain terminals for high-pressure installations require great attention, since they must withstand not only the high electrical stresses, but also the full mechanical stress of the pressure medium. This is particularly important in the trend towards higher operating voltages. In impregnated pressure cable terminals, bakelized paper tubes were used in earlier designs as gas pressure retaining barriers.

A great improvement resulted from the British development of a porcelain, capable of withstanding by itself the full internal pressure. Normally a stress cone within the terminal is employed to reduce electric stresses to a safe value but the use of porcelains with internal semi-conducting glazes for stress control has been studied in Britain.

In Britain the humidity and dirtiness of the atmosphere have led to the standardization of an anti-fog shed, which is elaborate and heavy. The use of a semi-conducting glaze on the outside of the porcelain enables a great simplification in the shed profile to be obtained, (Fig. 6). Porcelains with external semi-conducting glaze, up to 132 kv. are under field trial in Britain.

In America all early designs of terminals for high pressure installations incorporated "stop-tubes". A later design used four strings of high-strength strain insulators to take the longitudinal thrust of the gas pressure, and a main porcelain to withstand the electrical stress. Another development consists of a single pressure porcelain and an inner porcelain tube with conductive glaze for stress control purposes.

Table 1. Comparison of American and British Conductor Operating Temperatures for Solid Type Cable.

	Voltage	Maximum Conductor Temperature
British:		
Belted cable up to	6.6 kv.	80°C
Belted cable up to	20 kv.	55°C
Belted cable (armoured in duets)	20 kv.	80°C
Belted cable (unarmoured in ducts)	20 kv.	50°C
American:		
Belted cable	1 kv.	85°C
Belted cable	15 kv.	75°C
British:		
Screened, laid direct	33 kv.	65°C
	66 kv.	
American:		
Screened in duets	9 kv.	85°C
Screened in duets	35 kv.	70°C

Installation

The use of ducts to carry power cables of all types except pipe-line is general in America. In Britain ducts are mainly used, in short lengths, in locations where trench excavation would be difficult, such as at road crossings and under railway embankments. Occasionally ducts will be installed where it is known that additional cables will be required in a few years.

In other cases direct laying in trenches on a bottom surface of riddled soil is the normal practice. The initial cost of laying cables in ducts is higher than direct laying. In Britain, however, we do not have a long winter period when the soil is frozen too hard to work.

Where 3-core cables are laid in trenches British practice is to space the cables 12 to 18 inches apart, to reduce mutual heating effects and the likelihood of two cables being damaged simultaneously. Single-core cables are laid in trefoil formation, apex upwards and bound at short intervals with tarred jute yarn.

Pulling eyes or stockings are used for pulling into the trench, a swivel joint being included to prevent transmission of torque from the pulling load, and the cable is pulled over rollers spaced at intervals on the bottom of the trench. Minimum handling temperatures are recommended for installations, the cable serving being the controlling factor. Drums of cable are sometimes warmed by hurricane lamp to reach safe handling temperatures.

For pipe-line installations it is claimed that the cross-sectional area of the structure is smaller than the comparable duct installation, and that it is often easier to avoid other underground structures. The number of manholes and joints is reduced to a fraction of those required in the duct type. On the other hand, repairs to a pipe-line may involve the withdrawal of much greater lengths of cable.

Operation

Conductor Temperature. The permissible current which a cable may carry depends on the rate at

Table 2. Comparison of American and British Mean Electric Stress in Super-tension Cable.

	Voltage Range kv.	Mean Stress Range kv.cm
American Oil-filled	35 - 138	47 - 62
British Oil-filled	33 - 132	47 - 71
American Pipe Line	33 - 138	44 - 62
British Pressure	33 - 132	58 - 79

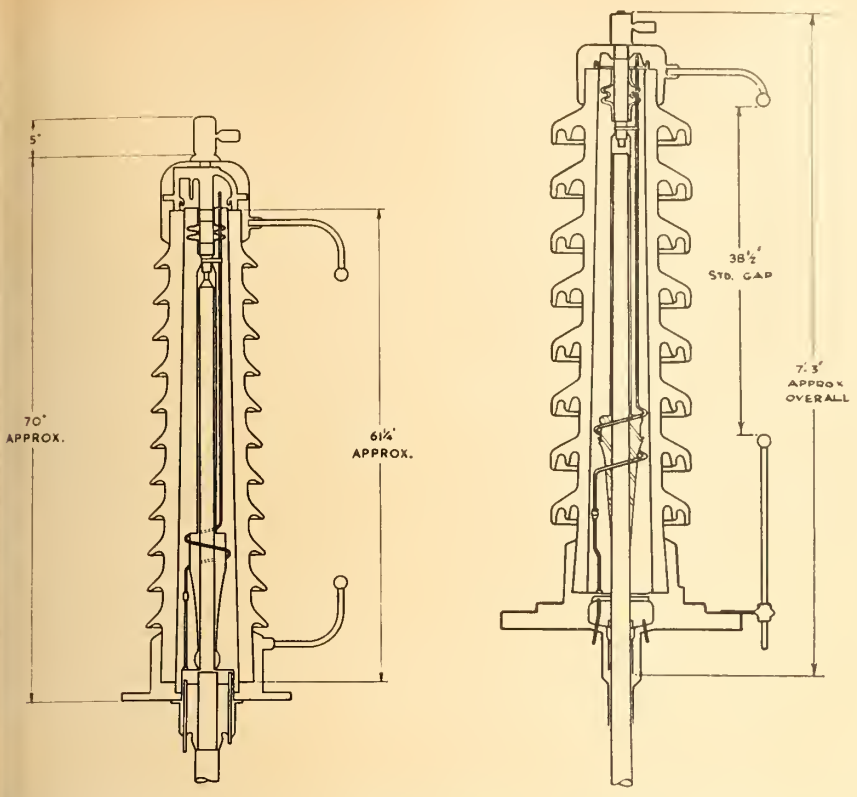


Fig. 6. Comparison of 132 kv. terminations, with and without semi-conducting glaze porcelain.

which heat developed, mainly due to the electrical resistance of the conductor, may be dissipated through the cable and surrounding medium. In Britain the least onerous condition specified is that for cables either laid direct in the ground or in air, the most onerous for unarmoured cables laid in ducts. The specified maximum conductor temperature decreases with increase in working voltage and number of laid-up cores.

Despite the fact that the majority of cables in America are laid in ducts and unarmoured, and that the thermal constants of cable and possibly ground are more exacting than in Britain, higher temperature levels (for solid types) are in general use in America than in Britain. (Table 1)

For oil-filled installations, all British cables are specified at 85° C. maximum conductor temperature, whereas the American figure varies from 81° C. for 15 kv. cables to 70° C. for cables working at system voltages over 76 kv. However, in many cases the carrying capacity of American cables is determined by the emergency load when one or more lines fail, and for such cases an increase to 90° C. for 100 hours in 12 months is typical.

Even higher ratings are permissible for emergency operation if extra oil capacity in the reservoirs is provided. The use of emergency ratings has found little favour in Britain, perhaps due to the difficulty of getting agreement on the method of calculation.

Electric Stress. In solid types of cable, the maximum operating stress for both British and American installations is approximately 45 kv. per cm., indicating that the desire to save duct space in American systems has not led to any drastic reduction in insulation thickness. A difference in conception of the role played by electric stress in the breakdown mechanism of insulating materials exists between the two countries.

The "cylindrical" distribution of stress in the dielectric wall gives, of course, a maximum value of stress adjoining the conductor. The view in Britain is that it is the value of this maximum stress which determines breakdown in the dielectric, and hence it is this figure which is quoted in Britain as the operating stress.

While support for this assumption is rather complex in paper-oil insulation, ample confirmation is available from dielectric materials, such as rubber, which may be tested in both flat sheet and cylindrical form. In America, however, it is held that the ratio of operating voltage to wall thickness, i.e. the mean stress, is the controlling factor, and mean stresses are quoted as operating stresses.

It follows that, in British designs where the maximum stress is held constant, there is a reduction of wall thickness (and an increase of mean stress) as the size of the conductor is increased. This difference in practice must be kept constantly in mind. The design practices in the two countries can be compared by calculating the mean stresses for British designs. (Table 2)

Specification Tests

British and American cable specifications reveal a curiously different approach to the function of the purchasing specification and the relationship between the manufacturer and customer. The specifications of the Association of Edison Illuminating Companies (9) which cover the whole range of cables, lay down not only the performance tests with which the cable must comply, but also the materials and methods of manufacture in very great detail.

British specifications on the other hand, broadly speaking lay down only the performance tests, and it is left to the enterprise and ingenuity of the manufacturer to find the best arrangement of materials and methods which will comply with the tests with the maximum efficiency and economy. It follows that the British cable manufacturer, however the financial clauses of a contract may run, bears a heavy share of the technical responsibility for the success of a contract.

The specifications of the British Standards Institution (10) only cover solid type cable up to 33 kv. The Canadian Standards Association has a close working contact with the B.S.I., but it has not yet extended its specifications to the fields of mains and super-tension cable. Presumably a substantial use is made in Canada of A.E.I.C. specifications.

Higher voltage cables are covered by performance specifications laid down by the British Electricity Authority after full consultation with the manufacturers. The tests called for in these specifications fall into three classes:

Type Approval Tests, which are carried out once only for each design of cable and all its asso-

Table 3. Comparison of Routine Test Voltage Levels for Solid-Type Cables.

Britain		N. America	
System Voltage (kv.)	A-c. Test (Phase-to-earth) Test Voltage (kv.)	System Voltage (kv.)	A-c. Test (Phase-to-earth) Test Voltage (kv).
1.1	3.5	1	8 – 15.6
3.3	6	3	12 – 18
6.6	10	6	18 – 20.4
11	15	11	27.6
22	35	22	50.4
33	53	33	72

ciated accessories. Cables having minimum and maximum conductor sizes must be submitted to the tests. A design which satisfies the tests qualifies for use on a field trial basis, to be followed later by recognition as an accepted standard.

Sample Tests, which, when the cable is an accepted standard, are destructive tests carried out on a small proportion (say 1 in 50) of manufactured lengths.

Routine Tests, which are non-destructive and are carried out on all manufactured lengths.

The proper level for a-c tests has long been a controversial issue between the two countries. In Britain excessively high voltage a-c routine tests are deprecated on the grounds not only that they may do damage to production lengths which is undetected, but which may result in their service performance being impaired, but also that they have no relevance to operating conditions. The high level of American a-c tests on solid cable is shown in Table 3.

For super-tension cables the position is anomalous, since for oil-filled cable the British tests are more severe while for oilostatic the American tests are remarkably severe. (Tables 4 and 5.)

In Britain there is an increasing reliance on the surge test, which is not mentioned in the A.E.I.C. specifications. This is partly because the surge test gives a definite result quickly. Also unlike the over voltage a-c test, the surge test either breaks a cable down or leaves it virtually undamaged. Moreover it corresponds exactly to a condition which may arise in practice.

Nevertheless the level of surge tests which is laid down by the British Electricity Authority is severe. The withstand surge voltage to earth is calculated from the formula $4.5\ (E + 10)$ where E is the phase to phase voltage. Actual figures are given in Table 6. It will be seen that for 33 kv. cable the surge voltage is 7 times the peak operating voltage.

The surge test is carried out on all type tests. The specification calls for 20 repeated surges, 10 positive followed by 10 negative, with $1/50\mu$-second waveform. The latest requirement is for the surge test to be carried out with the cable at its maximum operating temperature. The surge test is severe and in most cases is the controlling design consideration.

Table 4. Comparison of Routine Test Voltage Levels for Oil-Filled Cables.

Britain		N. America	
System Voltage (kv.)	A-c. Test (Phase-to-earth) Test Voltage (kv.)	System Voltage (kv.)	A-c. Test (Phase-to-earth) Test Voltage (kv.)
33	53	33	49.5
66	106	66	82.5
132	175	125	139.5

Table 5. Comparison of Routine Test Levels (Without Pressure) for Pressure Cables.

Britain		N. America		
System Voltage (kv.)	A-c. Test (Phase-to-earth) Test Voltage (kv.)	System Voltage (kv.)	A-c. Test (Phase-to-earth) Test Voltage (kv.)	
			oil	gas
33	19	33	37.9	24.7
66	38	66	63.2	41.2
132	76	135	113.8	74.2

Cable Performance

The most valuable information on performance available to the cable-maker comes from the operating experience of his customers. American figures are derived from the annual reports of the Edison Electric Institute, (11) and the Association of Edison Illuminating Companies, (12) for duct-lay cable 7.5 kv. and over, with a total cable network of about 16,000 cable miles.

Unfortunately, comparable figures for the British Electricity Authority network as a whole are not available. The only published figures on British cable performance relate to the Eastern Electricity Board. (13) This is one of the fourteen Area Boards comprised within the British Electricity Authority, with a cable network from 2.5 kv. to 33 kv. of approximately 5,000 circuit miles; and to this extent the basis of the comparison is limited.

The British figures relate to circuit miles, whereas the American figures relate to cable miles. This is a factor adverse to the British statistics. Both statistics include "removals" i.e. faults removed before actual breakdown. American statistics extend over a period of five years, and do not show any great change for cable trouble rate (i.e. failures plus removals) from year to year. Taking the figures for 1952 the comparison is set out in Table 7.

When the failures are analysed by cause of breakdown both countries show a maximum due to mechanical damage indicating rather surprisingly that the duct system does not afford any additional protection over the laid

direct cables. Also surprising is the high proportion of failures due to corrosion in the American figures. The analysis is given in Table 8.

Joint Failure

The total joint trouble rate per 100 miles for the networks and conditions described above are given in Table 9. The American joint trouble rate is noted as "the highest rate experienced since 1936".

Statistics notoriously may easily be misleading, and in this particular field it is practically impossible to ensure that the figures are strictly comparable. While it does appear on these figures that British cable performance is somewhat better than American, largely due to the incidence of corrosion troubles in America, yet taken as a whole the figures cannot but be interpreted as indicating a reasonably satisfactory performance.

Submarine Cables

The laying of the world's first submarine telegraph cable under the English Channel in 1851 was followed by a half-century of enterprise in submarine telegraph work. During that time this type of cable was laid over great distances, notably in many crossings of the Atlantic Ocean.

It was not until after 1900 that

Table 6. Withstand Surge Test Requirements of the British Electricity Authority.

System Voltage (kv.)	Surge Voltage kv. (peak)
33	194
66	342
132	640

power cables were laid under water, and among the first recorded submarine installations were the Harlem river crossing (14) with 3-core 6.6 kv. paper insulated cables, and the St. Lawrence river crossing (15) with 4-core 2.3 kv. rubber insulated cable, both prior to 1910.

The ideal cable for a submarine installation is one which may be manufactured in one continuous length in the factory, transferred to the hold of the laying ship, and laid in one operation. In cables insulated with paper this is difficult where the cores are lapped with dry paper tapes and impregnated after lapping, since the size

Fig. 7. Gamma radiographic lead-sheath thickness measuring apparatus.

of the impregnation vessel imposes a limit on the length of cable.

A super-tension cable using pre-impregnated paper tape as the dielectric was developed by Beaver and Davey, (16) and has been made in England for many years. For voltages above 33 kv., the dielectric performance is boosted by gas pressure of about 15 atmospheres.

This cable does not require tank impregnation, and therefore offers an unique possibility of continuous manufacture without limitation of length, following the methods developed during the war and used on both sides of the Atlantic for the manufacture of long lengths of Pluto—the submarine high pressure oil pipe line.

A factory has been built in England to produce this type of cable for voltages up to 200 kv. in lengths of 30 miles. The conductor is coiled on to a turntable 25 ft. in diameter with a capacity of 110 tons. From this stage the paper taping and the lead sheathing are carried out as a tandem operation. The leaded cable is coiled down on to a large turntable 47 ft. in diameter with a capacity of 460 tons of cable.

A large accumulator between the paper taping machine and the lead press has sufficient capacity to take up the cable during recharging of the lead press, when a single ram lead press is being used. The remaining processes of manufacture — reinforcement, protection, protection curing, armouring and transferring out of the factory into the coiling down sheds—are carried out as a tandem operation.

The extrusion of the sheath is carried out with a Glover Press, (17) in which the container is automatically re-charged under vacuum as the ram is withdrawn. This is widely used in Britain, since it has been established that it produces sheaths of exceptionally high quality. The sheathing of this length of cable involves the continuous operation of the lead press for 40 days, and special radiographic methods are used to provide a control of lead thickness and concentricity.

Gamma ray photographs are regularly taken along the sheath. The radio isotope cobalt 60 is used as a source of gamma rays. The exposure time is 2 minutes, and a complete assembly of two sources directed at right angles and two photographic film holders is locked to the cable for this period. (Fig. 7)

Even when the cable is made in a continuous length it is necessary to have submarine joints available to provide for various contingencies. A joint design has been developed with the same diameter and flexibility as the cable. A rigid type of joint has also been developed which is suitable for jointing work on board ship, when it may be necessary for the jointing time to be reduced to a bare minimum.

This design incorporates adequate arrangements for transferring the heavy mechanical forces in the armouring wire from one side of the joint to the other. The whole assembly is supported in a cradle, with bending restrictors at the point of entry of the cable into the joint. Thus the joint can be handled over the side of the

cable ship and paid out without risk of mechanical damage to the joint or the adjoining cable.

Joints on long lengths of mass-impregnated cable usually require re-impregnation. This can be accomplished by freezing the cable on either side of the joint. An advantage of the pre-impregnated pressure cable is that re-impregnation of the joints is unnecessary.

The jointing of high voltage cables on board ship is a lengthy procedure demanding fair weather. The time required must be correlated with the meteorological statistics of the district, to determine the probability of a successful operation.

An interesting installation scheduled for the early summer of 1956 is the crossing from Vancouver Island to the mainland. This installation is composed of two runs, one from Vancouver Island to Galiano Island of approximately 5,000 yd., the other from Galiano Island to the mainland, a distance of about 30,000 yd.

The maximum depth of the route is 100 fathoms, with a water pressure of approximately 280 lb. per sq. in. Four single-core cables will be laid, one 3-phase circuit and a spare, individual cables being spaced 500 yd. from each other and converging at the landing points. The shore ends at the mainland run over a long beach, and may be armoured with cast-iron articulated protectors.

The cable is an 0.35 sq. in. hollow core copper conductor lapped with pre-impregnated paper tapes to a wall thickness of 0.56 in., and operating at a maximum stress of 85 kv. per cm. The installation will transmit 120 Mva. at 138 kv., and the cables will operate under a gas pressure of 300 lb. per sq. in.

The preparations and preliminary trials have exposed many new and important problems. Submarine telegraph cables have been successfully laid at great depths for approximately one hundred years. The behaviour of a heavy submarine power cable being laid at great depths is, however, very different from that of a telegraph cable, and the power cable is far more susceptible to damage by mechanical deformations. However, detailed studies under actual laying conditions have enabled satisfactory solutions to these problems to be worked out.

Table 7. American and British Cable Trouble Rate.

Both countries show a maximum failure rate in the voltage range 7 kv. to 15 kv.

	Trouble rate per 100 miles
American:	
Duct-lay cable above 7.5 kv	7 5
British:	
2.5 kv to 33 kv	3 9

Table 8. Analysis of Cable Failures by Cause of Failure.

	Proportion of total failures	
	British (EEB) %	American %
Mechanical damage	59	43
Corrosion	5	25
Inherent	36	20
Other causes and "unknown"	—	12
	100	100

Table 9. Joint Trouble Rate per 100 miles.

American	4 8
British	0 5

Future Developments

The world demands ever larger and larger supplies of electricity. The availability of the necessary energy resources is not established with absolute certainty. Known reserves of solid, liquid and gaseous fuel have their utilization pretty well mapped out. The potential hydro power of the world is already earmarked with one exception. The only continen with a clear surplus of hydro power is Africa with the enormou potential hydro power located in Central Africa.

France is likely to be one of the first countries to be desperately short of energy. It is an interesting speculation whether the engineers of the future will be able to devise means of transmitting the energy of Central Africa, to say Metropolitan France. Probably atomic power will intervene and it will be found expedient to use the hydro power for the production of plutonium to be sent where required as packaged energy.

Nevertheless, transmission lines are likely to increase in length for some time. As the transmission length approaches the quarter wave length, say from 400 to 900 miles, the regulation difficulties increase. There will, therefore, be an increasing demand for the development of high voltage d-c transmission.

Submarine power links will be increasingly required in various parts of the world because of local shortages of energy. Unfortunately, at a length of say 50 miles high voltage a-c cables become self-loading; that is to say the capacitance current taken by the dielectric absorbs the whole carrying capacity of the cable. Cable links above or even approaching this length are therefore only practicable with d-c transmission.

The adoption of direct current transmission will raise a whole set of new problems for the cable maker. The distribution of electric stress in the dielectric of a cable operating under a-c conditions, although non-uniform, is well determined, due to the fact that the permittivity of the dielectric does not vary appreciably over the range of working temperatures or with time.

However, in the d-c case, the distribution of stress is dependent not on the permittivity, but on the insulation resistance of the dielectric, which property varies with both temperature and stress for most dielectric materials. Hence the phenomenon of different portions of a dielectric being subjected to varying stress during heating and cooling cycles of the cable will have to be taken into account. *(Continued on page 950)*

Fuel Transportation by Pipe Line

by

Dr. G. S. Hume,

Director General, Scientific Services,
Department of Mines and Technical Surveys,
Ottawa

A paper presented before the Montreal Branch of the Engineering Institute of Canada, February 24, 1955.

Arrangements now made and under way ensure that natural gas pipeline projects of great magnitude will soon be undertaken in Canada. This has come about because large reserves of natural gas have been found in Alberta and British Columbia, and because there is need in central Canada and on the west coast for fuel and energy above that already available.

For many years a national fuel policy has been under discussion, because in eastern Canada and in the western prairie provinces there are coal supplies which the central part of Canada lacks. Only to a limited extent, however, has it been possible to supply this market with Canadian coal, mainly because of transportation costs. But it has been recognized that coal still fills the largest part of our energy requirements, and that the continued existence of coal mines is essential for national security. Moreover, except where coal movements to central Canada have been aided by Federal freight subventions, all the coal used has come from sources outside of Canada, principally from the United States.

The discovery of large oil supplies in the prairie provinces and the building of pipeline outlet facilities to Ontario and to Vancouver, has brought to the central as well as the west coast area of Canada a new source of Canadian energy now to be supplemented by a further supply of energy in the form of natural gas. Perhaps the significance of this is not yet fully appreciated and, whereas formerly the national fuel policy was always discussed in terms of coal, the new developments should be assessed in terms of the beginning of a national energy policy now being put into effect.

In Alberta for many years there has been a natural gas supply for the larger consumer markets, and gas has been sold at a relatively cheap price. When Turner Valley was found in 1924 the developments that followed gave rise to an excess of gas in the recovery of distillate and crude oil far beyond the needs of available markets.

Some of the gas thus produced was stored in the nearly depleted Bow Island field in Southern Alberta, but much was flared and the wastage was more than a trillion cubic feet, equal in energy to about 40 million tons of good grade coal. When it is considered that in 1952 Canadian production of coal amounted to 17.5 million tons and that 26 million tons of coal, coke and briquettes were imported for a total of 43.5 million tons, the extent of this vast wastage becomes apparent.

Thus when oil was discovered at Leduc in 1947 and the lower productive zone contained a gas cap, the hope was expressed (1) that larger gas markets might eventually be available in order to avoid future wastage as new oil fields developed. It was foreseen at that time that there were sufficient prospects in the Peace River area of British Columbia and Alberta to justify developments for a gas pipeline to Vancouver. It was not too much to hope that developments in southern Alberta would eventually justify a pipe line to eastern Canada to serve Ontario and western Quebec.

These views were shared by a number of people, as was soon evident from the applications received by the Parliament of Canada for Gas Transmission Company incorporations. These applications were introduced as private bills into the House of Commons and Senate. The discussions that followed did much, not only to focus public attention on projects of great national concern, but provided information on routes, markets and the difficulties and advantages of developing Canadian markets with Canadian gas, as contrasted with supplying gas to markets in United States.

Dr. Hume's many years of practical experience with oil and gas development, and his thorough knowledge of Canadian geology, are well known. The following paper combines two of his addresses presented earlier this year. In it he emphasizes the great advantages, in designing the Trans-Canada natural gas pipe line, of following customary practice with oil pipe lines — cheapest in the long run, — by using a pipe larger than required initially with smaller pumping capacity. This, coupled with provisions for "spill-over" into New York State, he contends, would lower costs to the consumer and shorten the difficult period of market build-up.

The views here expressed, favouring a 34-inch diameter pipe throughout its length are his own and, stated at the time of his original presentation last March, do not necessarily represent government policy.

Reserves Up Fourfold Since 1948

Meantime in Alberta reserves of gas were increasing at an unprecedented rate, due mainly to the search for oil. The first appraisal (2) made by the Department of Mines and Resources, Ottawa, in April 1948, placed the natural gas *in situ* in the various fields as then known, at almost 4 trillion cubic feet or 3.6 trillion to an abandonment pressure of

100 pounds. The amount in Saskatchewan was relatively insignificant and none was then available in British Columbia. These volumes of gas should not be confused with marketable supplies, which would be of the order of 75 to 80 per cent of the gas *in situ* in most fields.

A further report as of June 1950, showed the Alberta reserves *in situ* were almost 7 trillion cubic feet. In March 1952, the Alberta Petroleum and Natural Gas Conservation Board, after lengthy public hearings, reported gas reserves originally *in situ* at 8.5 trillion cubic feet and the disposable reserves at 6.8 trillion cubic feet. In the last report issued, the Conservation Board, again after lengthy hearings, has placed the disposable reserves at 11.5 trillion cubic feet as of June 1953. Since that time the reserves have continued to increase and for western Canada they are now conservatively estimated at 16 trillion and more optimistically at 20 trillion cubic feet.

It is known that 5 trillion cubic feet would be sufficient to dedicate to a 36-inch all-Canadian pipe line. Hence it appears sufficient gas is being found to justify a major gas pipe line every two or three years. As yet no major project has started building. No real incentive is positively assured for drilling for gas alone, although considerable has been done, in the expectation that markets will be made available. Thus, pipelines will undoubtedly stimulate the rate of discovery of new gas reserves.

Rapid Growth in Oil Reserves

Meantime, though measures have been taken to utilize gas produced with oil insofar as economically feasible, in 1953 wastage amounted to over 25 billion cubic feet and in 1954 it was somewhat larger. All of this would not be saved and used even if pipe lines to distant markets were now in operation, but the operation of some of the wet gas fields which produce gas in high volume with oil or distillate would become possible.

Some of these fields, like Pincher Creek, have been awaiting a market for several years. If they are to provide the incentive in the search for others of a similar kind, the investment return is an important consideration. Thus, markets for natural gas are an urgent requirement for Alberta and northeastern British Columbia.

In 1954 Alberta's production was about 88.3 million barrels. Saskatchewan's about 5.1 million barrels and Manitoba's slightly in excess of 2.1 million barrels, or a total of 95.5 million barrels, an average of a little more than 260,000 bbls./d. Reserves, which increased more than half a billion barrels in 1954, are now considered to be about 2.5 billion barrels. More than three-quarters of the new oil found in 1954 was in Alberta.

The growth in natural gas reserves has been mainly due to the search for oil, but recently there has been some drilling to prove up gas fields. The recent expansion in gas markets in Alberta has been mainly in the petrochemical and extractive metallurgy fields. Although these developments encouraged the local search for gas, principally in the Edmonton area, the outlet to larger markets which could provide the incentive for a widespread search has been largely lacking.

Pipe Lines and Expanded Markets For Oil

Many areas have gas wells long shut in awaiting a market. In contrast, the growth in the use of Canadian oil to supply the needs of this country within economic reach of the oil fields has been spectacular. Excess potential production is now available and new markets are being sought. In 1947 the production of oil in Canada was 10 per cent of our consumption. It is now 54 per cent, in spite of a very rapid growth in use.

This changed situation has resulted from a combination of events, among which is recognition of the excellent prospects in Western Canada and the advances made in pipeline construction within recent years which allowed the oil to be transported cheaply to distant markets. The enlarged markets stimulated exploration and development. The success in finding more oil led in turn to the building of more pipe lines, until now the economic market is the limiting factor. A steady future growth is to be expected but the oil has now reached the economic fringe areas where stiff competition is expected from foreign oil.

Eastern Canada

Previous to the construction of oil pipe lines from Alberta, products made from imported oil at Sarnia were shipped by tankers up the Great Lakes to compete successfully in the eastern Manitoba market with products made by Prairie refineries from Canadian and imported crude oil. Not only has the whole Prairie market been captured by Western Canadian refineries but the Interprovincial and Lakehead pipe lines are bringing oil in ever-increasing volume to the Sarnia and Toronto areas.

It may be that, ultimately, the Montreal refining centre with a capacity about a third of all Canada or 200,000 barrels a day, will be reached. Some reductions in price at the well-head have become effective to allow more distant competition, but already the price of crude oil in Alberta is below that of a similar grade in United States.

Hence, with high exploration costs there is much doubt about the advisability of trying to further extend the market into a still more competitive fringe area like Montreal, where prices must meet those of oil by tanker to the east coast from Venezuela and the Middle East, and largely by pipe line from Portland, Maine to Montreal.

Western Canada

On the west coast, since completion of the Trans-Mountain Pipe Line, Alberta oil has mainly displaced imported oil in the Fraser Valley. The 24-inch pipe line has a potential capacity, with adequate pumping stations, of 300,000 bbls./d. but is presently equipped to handle 120,000 barrels. At first there was much disappointment that the throughput was relatively small in relation to the capacity. There was some doubt, too, due to cheap tanker rates, if oil through this line could supply two new refineries to be built at Ferndale and Anacortes.

The Ferndale refinery uses about 30,000 bbls./d. The refinery at Anacortes, when completed late this summer, will have a capacity of 50,000 bbls./d. It has been announced Canadian oil will be used. Thus the Trans-Mountain Pipe Line, now carrying more than 75,000 bbls./d compared to less than 50,000 bbls./d. in February 1954, has

prospects for further expanded throughput this year. Such a flow will partly relieve the prorated production in Alberta. Thus the vision shown in building a larger pipe line than originally required has been justified by the build-up in requirements.

Design For Estimated Markets

Experience in United States has shown (3) that new oil pipe lines are commonly sized to initially move two-thirds of their ultimate anticipated demand. An example, as given, illustrates this.

"If the initial capacity required is 100,000 bbls./d. of crude with a foreseeable ultimate of 150,000 bbls./d., and a 16-inch line with 14 stations were constructed initially, it would then require an additional 14 stations or a total of 28 to move the 150,000 barrels when such demands developed, with excessive operating costs.

However, if a 20-inch line were constructed with 5 stations for initial operation at 100,000 bbls./d., then by constructing 5 additional stations throughput could be increased to 150,000 bbls./d. Thus the 150,000 barrels could be moved through a 20-inch line at approximately one-third the power costs, and with one-third the operating personnel required for the movement through a 16-inch line, and the difference in capital outlay between the 20-inch and 16-inch quickly amortized."

This is an exceedingly important principle in the construction of any pipe line for either oil or natural gas. It was illustrated by the fact that in the engineering studies connected with the Lakehead pipe line from Superior, Wisconsin to Sarnia it was found cheaper to build a 30-inch oil line than a 26-inch line, even though 300,000 barrels of ultimate capacity of the 30-inch line is much in excess of present use.

Proposed Pacific States Gas Line

Out of a succession of applications two large projects for piping natural gas are under preparation. Both have encountered difficulties far beyond what might have been anticipated. The proposed Westcoast Transmission line from Peace River area through central British Columbia to Vancouver, thence to United States Pacific Northwest markets, met with protracted hearings before the Federal Power Commission for permission to import gas into United States. It was ultimately denied this privilege.

However, a deal has now been made with opposing interests, and there seems little doubt this project will proceed on a scale much larger than originally planned. This should prove advantageous both for an expanded consuming market and from the standpoint of an outlet for reserves of gas in the Peace River area. These have grown at an astonishing rate, in view of market uncertainties, and are now several trillion cubic feet. Plans now call for joining this supply with the proposed supply from the San Juan basin of New Mexico for the States of Washington, Oregon and Idaho, and extending the market to San Francisco.

It may not be too optimistic to think that in a few years not one but two parallel lines may be operating out of the Peace River area, and that reserves and markets will justify an output of a billion cubic feet a day. Although permission to import the gas into United States has not yet been received, the difficulties and objections appear to have been removed. It will be advantageous to both countries to have this gas available for common use on the west coast and there is every expectation this will soon be achieved.

Proposed Gas Line To Central Provinces

In regard to the other project, Trans-Canada Pipe Lines, there are still obstacles to be overcome. In making a policy pronouncement in the House of Commons on the question of gas for Central Canada on March 13, 1953, the Rt. Hon. C. D. Howe stated "the policy of the government of Canada is to refuse permits for moving natural gas by pipeline across an international boundary until such time as we are convinced there can be no economic use, present or future, for that natural gas within Canada".

This statement has been reiterated by Mr. Howe, by other members of the Cabinet and by the Prime Minister and is now taken as established policy accepted by Parliament. Also Mr. Howe made it clear that Government policy includes a Canadian route for the line when he stated "I am convinced, after thorough study of the matter, that the only reliable supply of natural gas for the provinces of Ontario and Quebec must be from Western Canada by means of an all-Canadian line".

The route through Northern Ontario has been criticized in preference to one south of the Great Lakes through United States. Any gas pipe line to Ontario through United States, as pointed out by Hon. George Drew (4) in the House of Commons on April 7, 1953, would be subject to withdrawal of gas by United States consumers, leaving Ontario and Quebec in a precarious position at the end of the line. For a fuel-deficient area like central Canada this would detract from the national value of the pipe line.

Northern Resources

Proponents of a pipe line route south of the Great Lakes refer to the barren waste of Northern Ontario. Anyone familiar with the rich resources of this area both in mineral and forest products recognizes the value of developments there and the need for fuel. Northern Ontario may well become one of the richest parts of Canada. It has enormous developed and potential resources, and already holds a strategic position in Canada's economy. Fortunately, as far as is known, no plan for a southern pipe line route has ever been seriously considered by Trans-Canada officials, and no such proposal has had to be considered by the Board of Transport Commissioners.

There have also been discussions concerning the route eastward from Winnipeg, and it has been decided to go from Nipigon to Hearst to Cochrane, thence south to North Bay, with a spur line back to Sudbury, rather than try to follow the C.P.R. from Nipigon direct to Sudbury. The more northerly line is some 80 miles longer. However, in addition to having an access road already built and kept open in winter, there is the advantage of much easier and cheaper construction per mile through the clay belt.

An access road is imperative in order that breaks can be quickly repaired. Service must be maintained without protracted delays when customers depend on de-

livery of gas for fuel. A few hours break, during repairs need not ordinarily inconvenience domestic users, but a few days interruption might be disastrous. Storage facilities in Ontario, together with ready access to the line at all times, render it comparatively safe. Mining engineers who know northern Ontario highly commend the route chosen.

Size Of Pipe in Relation To Markets and Price

It is understood that Trans-Canada Pipe Lines Ltd. now proposes to build a 34-inch line from Alberta to Winnipeg and a 30-inch line from Winnipeg to Toronto. Admittedly, a 30-inch line is not small, but if the markets justified a larger line gas could be transported at a cheaper rate, both to the advantage of the Alberta producer and to the eastern consumer.

Each cent reduction in transportation costs per thousand cubic feet on a 500 million cubic feet per day throughput amounts to $5,000. The lessons learned in building oil pipe lines in the United States, where the design is for an initial movement of two-thirds of the ultimate anticipated demand, should not be overlooked. It is the demand, therefore, that is the critical consideration in fixing the size of the pipe line. This, of course, depends on the price for which gas can be sold by the distributing utilities.

At present, the demand the utilities are willing to concede is disappointing, in spite of the fact that the proposed selling price to utilities is right in line with what was anticipated from studies made when the project was first suggested. There can be no doubt of the potential market. This is known in relation to price from sources beyond dispute.

It would be unfortunate indeed if, with such a market available, a smaller pipe than would best serve the national interest were constructed, because the market was limited by high distribution costs. Under these conditions the producer would be penalized by a lower price than a larger pipe line would provide, and the consumer would pay more than he might otherwise have to, with the result that expansion in the use of Canadian fuel would be restricted.

In the operation of the pipe line, to get as high a load factor in both winter and summer periods of unequal consumption, storage is essential. Storage in the former gas fields of south-western Ontario will be used to great advantage. However, storage is not the answer in relation to the size of the pipe, as only projected sales can be used to determine this.

Thus, it would seem that, if the distributing utilities in central Canada cannot foresee a market to justify the larger line, and thus reduce transportation costs, the spill-over into New York State on an interruptible basis, as proposed in the Bechtel report of October 1953, should be given serious consideration. At the time this report was written the Tennessee Gas Company would have been willing to take a minimum of 50 billion cubic feet of gas a year on a 20-year basis. This gas would be on a storage interruptible basis, taken during periods of low consumption as on holidays and week ends, particularly in the summer.

Spill-over To New York

However, the yearly amount would be firm, in that new customers on the Tennessee system would use it from storage available in New York State and elsewhere on the Tennessee Transmission system. A large volume in addition to that used in central Canada could be provided to ensure a large diameter pipe line, hence lowering transportation costs by spill-over into storage in New York State, thus reversing the present flow through the Niagara pipe line without further building of new lines.

According to the Bechtel report, gas could be brought to Toronto for 45 cents on a 100 per cent load factor. This would be equivalent to coal, where preference for use of fuel is not a consideration, at a price of $12.15 a ton (13,500 B.t.u. per pound) and where equal efficiency is achieved in burning, a condition never achieved in a domestic furnace in a climate such as ours. Obviously the objective of gas sales is to the high-priced domestic market, but to achieve volume, industrial sales on an interruptible basis at a lower price is essential. Considerable initial sales below 45 cents a thousand might be warranted on a large volume throughput of a large line. It is certain that the lower the selling price, the faster will be the mar ket build-up and hence the dif ficult period of the first few year can be shortened appreciably by line design and throughput.

Costs For Transporting Oil and Ga By Pipe vs. Coal By Rail

A market for any large volum of western Canadian oil woul have been impossible without pip lines. The pipe line transporta tion charge per barrel from Ed monton to Sarnia, a distance o 1,740 miles, is 64 cents, and fron Edmonton to Vancouver, 45 cents A barrel of Redwater crude de livered at Sarnia contains some 5.8 billion B.t.u., hence the transportation cost from Edmon ton to Sarnia is 11.03 cents per million B.t.u. and from Edmon ton to Vancouver about 7.7 cents.

This gives Alberta oil a highly advantageous position in com petition with Alberta coal in the same markets. For example, the rail rate for coal for subsidy pur poses from Alberta to Toronto i $11.35 a ton, although very little coal moves this far. If coal i considered as having 13,500 B.t.u per pound, a good grade, then the rate is equivalent to 42.04 cent per million B.t.u. or 3.8 times the rate of moving Redwater crud oil from Edmonton to Sarnia.

However, Redwater crude is re fined in Sarnia and only the en products come into competitio with coal for fuel. Thus oil fo fuel has a much greater transpor tation advantage than the 3.8 times mentioned, and it may b as much as six times. It is easily understood if prices for coal an oil are such that these compet at the point of origin, namely in Alberta, coal and oil from that Province would be far from com petitive in Ontario.

The changeover from coal t oil and natural gas in Alberta shows that, even there, coal is no holding its place either in the domestic or commercial markets This is shown by the fact that a gas turbine to make electric powe was recently put into operatio at Vermilion in east central Al berta, and a new thermal electric plant to be erected at Wabamun west of Edmonton where coa can be strip-mined, and where some flat-lying coal seams are 2 feet thick, is being equipped t burn natural gas with coal as a alternative.

In regard to transportation costs per unit of energy there is less disparity between coal and natural gas than between coal and oil, although from a domestic standpoint there would be a decided preference for natural gas even at the same cost per unit of energy. As far as can be learned, the cost of transporting natural gas from wells in Alberta to Toronto has not been decided, and will not be known until complete engineering costs of any pipe line project are available.

However, it can be assumed for comparative purposes that it will be something of the order of 40 to 45 cents per thousand cubic feet. Natural gas is sold on the basis of 1,000 B.t.u. per cubic foot, so that 40 to 45 cents would be the assumed transportation costs of one million B.t.u. of energy. This is at about the same rate as for coal by rail. Hence it becomes obvious if natural gas is to compete in the fuel markets in central Canada its competition will be with oil and with coal from other sources since imported coal is cheaper in this market than coal produced from Canadian mines.

This means that if natural gas is to find extensive use in the large potential market in central Canada, it must be brought there at the lowest possible transportation cost so that the producer can receive a price consistent with the incentive to search for new supplies, and so that the consumer can benefit by paying the lowest possible price consistent with the creation of market demand. It cannot, therefore, be too strongly emphasized that the volume transported in the largest possible line is of paramount importance in relation to the national interest.

Importance of Large Pipe

The original Trans-Canada Pipeline Co. proposal for a 30-inch line was to start at a delivery rate of about 96 billion cubic feet a year and, by an increase in the number of compressor stations, to raise this to 155 billion in the fifth year and ultimately to about 500 million a day. For the 36-inch line Bechtel suggested starting at a delivery of 500 million a day with a spill-over to New York State of about 200 million, increasing the pipeline capacity as the eastern Canada market expanded to 650 million cubic feet a day. It is said also that the amount that could be delivered at Winnipeg might be increased to 800 million a day.

Obviously the larger amounts have price advantages if all or most of the gas can be sold. Stated in terms of the pipeline this means a high load factor. It is in the first few years of any pipeline's operation that there are difficulties, since markets must be developed and this takes time, perhaps five or more years. These difficulties in the first five or six years would be considerably increased by building a 36-inch line if there should be no spill-over into New York, in comparison with what they would be with a 30-inch line.

On the other hand, gas from the 36-inch line could be sold on an interruptible basis to reach industries which could not afford to use gas from the 30-inch line because of the higher cost. This would seem to be a reasonable objective for any pipe line if it is to fill the need for additional energy in a fuel deficient area like central Canada. Particularly is this so when such a large surplus of gas is available and the pipe line is being considered in terms of national welfare.

Advantages Of Natural Gas As A Fuel

From the national standpoint the availability of natural gas for central Canada is most important. Climatic conditions in this country make fuel a prime necessity for physical existence. It is also true that our industrial development and living standards depend on our capacity to use the energy available to us in the most efficient manner and so keep costs to a minimum.

Fuel oil has to a considerable extent replaced coal for domestic heating and for other purposes because of its obvious advantages. There is no doubt that in areas where natural gas is available at comparable prices it is preferred to fuel oil. In fact, of all the fuels in use today, natural gas most nearly approaches the ideal. It is clean, providing fast heat, and in heat value it is more than double manufactured gas made from coal.

Perhaps at a time when strategic considerations are important it has another advantage over oil. An oil furnace depends on electricity for blower operation, whereas a natural gas supply is dependent only on a pressure of a few ounces as delivered to the burner. Gas mains, of course, can be broken and gas is explosive when confined, but gas mains can be relatively quickly repaired. This is in contrast to prolonged and serious difficulties that could arise from the disruption of electric power.

Gas Can Replace Electric Power For Heating

Natural gas would not replace electricity for light, but in Ontario it will replace electricity for water and space heating. In Ontario where there now are coal burning plants at Toronto and Windsor with capacities of 400,000 and 240,000 kw. hr. respectively, it is probably true that electricity from this source is not economically profitable for domestic water heating. Since Ontario has reached the stage where further power sites in proximity to industry are limited, it is important that electricity be relieved of the load which natural gas can best supply

It is doubtful, however, to what extent natural gas can or will replace fuel oil for domestic heating. The two fuels should be regarded as complementary rather than as rivals. Undoubtedly the price of each must be competitive with the other. It is considered unlikely that any householder would scrap his oil furnace when a supply of natural gas becomes available, but if and when the furnace needs to be replaced, natural gas at a comparable price will undoubtedly be the choice.

Markets For Gas in Central Provinces

Natural gas is sold to three main groups of consumers, that is, household, commercial and industrial users. The home consumer pays the highest price and the commercial consumer somewhat less. The industrial consumer may pay only about 1/3 the amount paid by the first two groups. Sales at the highest price are obviously most advantageous to the utility distributor, and tend to reduce the overall price if these are sufficiently large. Thus the utility prefers to obtain as large domestic sales as possible.

However, in a climate such as ours space heating requirements are subject to wide seasonal variations, with a high demand in the winter and a low demand in the summer. In order to provide base load for the distributing utility

company, water heating (best done by using natural gas) is usually considered essential, where space heating is provided. Even so, the seasonal load is very unequal, and unless this can be evened up in some way the pipeline will have a low load factor, which is the relation of load to capacity.

Sales to the commercial consumer are much more stable. Since he desires gas for continuous use he contracts for it at a firm amount for a fixed delivered price. However, as he usually buys in considerable quantity the price to him is less than to the domestic consumer. The commercial consumption and that of the domestic consumer is likely, however, to be only a minor part of the early pipeline supply, and even in established distribution systems may be only 25 per cent of the whole, dependent on abundant supplies being available. Thus the largest consumers are the industrial users.

The industrial consumer buys gas on an interruptible or dump basis during periods of low consumption. In order to do this he must provide a stand-by or alternative fuel, with the necessary equipment to use it. The advantage to the pipeline in having such customers is that the load factor of the pipeline can be maintained at a relatively steady and high rate, even though the price paid by the industrial consumer may be quite low. The tendency as markets are built up is to decrease if possible the amount of industrial gas sold and increase sales to commercial and domestic consumers. There never will be a point, however, where a long gas pipeline in Canada would not have need for industrial sales.

Double The Heat Value Of Manufactured Gas

In that part of Ontario and Quebec accessible by the Trans-Canada pipeline there are a number of cities such as Toronto, Montreal, Hamilton, and Ottawa now supplied by manufactured gas. This gas has a heat value of the order of 460 to 470 B.t.u., whereas natural gas as that will replace it has a value of approximately 1,000 B.t.u. Manufactured gas is in general quite expensive and not widely in use, hence distribution systems in such various cities will have to be greatly extended and a vigorous sales campaign conducted to build the market for natural gas as quickly as possible consistent with safety and efficiency.

There is however, one favourable aspect. In the natural gas fields of southwestern Ontario there is presently a reserve of 160 billion cubic feet. This can be used by certain cities and towns during the construction period of the Trans-Canada line to establish and build up the markets. This reserve is sufficiently large that it can be put into use at the earliest possible date, but first the timing on the arrival of the pipeline gas must be fixed.

Thus the use of this gas can serve two purposes, namely (a) to build up the market pending the arrival of the Trans-Canada pipeline (b) make storage available to balance the load on the Trans-Canada pipeline by using gas now in the prospective storage fields. It has been stated that ultimately 50 or 60 billion cubic feet of storage may be made available from fields now owned by the Union Gas Company and Imperial Oil Ltd.

This storage is one of the keys for the successful operation of the Trans-Canada line. It will receive gas during the off-peak periods, in summer, and make additional gas available for peak consumption in the winter above the pipeline's capacity to supply the full load. It will also provide a valuable asset against pipeline breaks which otherwise might cause interruption of service.

New Developments in Gas Transportation

Recently technical literature (5) has contained references to the transportation of refrigerated liquid methane in insulated barges or tankers. A proposal has been made by W. L. Morrison and Associates to transport gas in refrigerated barges up the Mississippi River from the Gulf states to sell in midwest cities. Refrigeration will be carried out at as low a temperature as —260° F. without subjecting the gas to pressure. This reduces the gas to one six-hundredth of its normal volume.

The liquid gas will then be stored in refrigerated insulated barges, two of which, each with about 35,000 barrels capacity, would meet the daily requirements of 18 million cubic feet a day for the Chicago stock yards, at a cost about half or less than half that of transportation by pipe line. To bring this venture into operation eight barges are being equipped with insulated tanks, to be put into service in the near future.

A similar proposal has been made to transport liquid refrigerated methane by tanker from the oil fields of the Middle East to Europe. Studies (6) of this were undertaken by the National Research Council and the National Academy of Sciences at the request of the Foreign Operation Administration of the United States Government. In the Middle East the wastage of natural gas from the production of oil is now estimated at a billion cubic feet a day, of which perhaps 300 million cubic feet a day is available in Saudi Arabia.

Could Supply Britain

Estimates based on the availability of 500 million cubic feet a day, of which 20 per cent or 100 million cu. ft. a day would be used in refrigeration, are for $180 million to build 20 tankers of 15,000 net tons each at $9 million a ship, $95 million for the refrigeration plant, $75 million for gas gathering lines, or a total of $350 million. Charges for delivery of 400 million cubic feet a day, or a volume greater than ordinarily would be put through a 26-inch line, are placed at $39.9 million.

On this basis the delivered cost of gas at a tanker terminal at London, England, would be 45 cents, or 37 pence per Mcf. This includes 4 cents net value for the gas and 7 cents gathering costs. The calorific value of 400 million cubic feet a day of natural gas is equivalent to a yearly consumption of approximately 28 million barrels of fuel oil or over 5½ million tons of coal. The current price of manufactured gas in England is about 48 pence or 30 per cent higher than the estimated delivered price of methane with twice the heat value.

Considering the authoritative source of these estimates the project must be seriously considered as being not only feasible but economically advantageous. No doubt such a radical change in fuel sources for any country would be carefully reviewed from the national safety and strategic viewpoints.

Could Even Supply Central Canada

What is the impact the prospects for marketing Middle East

gas could have in Canada? If tankers can move liquid methane to England at such prices then it also can be delivered cheaply to eastern Canadian ports where it might successfully compete with other fuels. The Montreal market is within easy reach of the eastern seaboard, but it certainly would be the irony of fate, with such surplus volumes of gas available in Alberta, if this gas is not used to supply the Montreal market.

Atomic power will be available in a few years, probably at a high price at first, but ultimately at a price that will compete with other forms of energy. It may be advantageous therefore, to have large gas markets well established in central Canada before this happens, which would necessitate the construction of pipe lines of the largest possible diameter.

The Trans-Canada project for bringing natural gas to central Canada has been looked upon by many as a national project, even though carried out by private enterprise. It should be viewed in the light of potential rather than short-term requirements. Thus natural gas should be made available at as low a price as possible by cheap transportation of large volumes in as large diameter pipe lines as can be justified, so sales will be encouraged and the Alberta producer can have a price which fully justifies the incentive to develop presently known fields and search for new ones.

Develop Before Atomic Power

The possibilities of the use of atomic power should not be underestimated in relation to replacing other energy source materials. Canada has much to gain by using the extensive reserves of gas available in Alberta now lacking a market. Already, delay may prove costly if the ultimate market is restricted by competition with atomic power, before the usual period of 20 or 25 years for amortization of the pipe line is ended. The reserves of gas in Alberta are huge, the desire to have a pipe line built is great, the potential consuming market in central Canada is enormous. The benefits to be achieved by such a Canadian pipe line from west to east cannot fail to be national in their effects. Vision to think of the line in terms of Canadian developments both in the west and east has not been lacking and it is hoped achievement will soon be possible.

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Discussion of Technical Papers

Gas Turbines

by E. Bernhardt, President, Brown Boveri (Canada) Ltd., Montreal.
The Engineering Journal, June 1955, Page 753

S. W. Fraser-Underhill[1]

Mr. Fraser-Underhill said that he would like to join in offering hearty congratulations to Mr. Bernhardt on his excellent paper. Whilst he had not had time to study it in detail, rapid perusal showed the very wide and interesting scope of the paper.

Mr. Fraser-Underhill had two questions to ask the author.

First, could the author enlarge on the subject of turbine blade washing and say what medium is used?

Second, in view of the interest in work being carried out in Canada and Great Britain on the burning of solid fuel in gas turbines, could the author say a few words about his firm's and/or his own experiences and views on this subject.

The Author

Turbine blade washing is only necessary where liquid fuels are used. The time between two consecutive washings is variable and depends very much on the quality of fuel used. To be more specific, the following information might be of interest:

The 1650 kw. gas turbines installed at Pertigalete—which now have been converted to gas fuel—originally ran on a mixture of 60 per cent Bunker "C" oil and 40 per cent Diesel oil. Under those conditions, washing took place every 900-1000 hours. Perhaps even more interesting are the results with the Beznau sets—and there the conditions for the fuels are such as to necessitate washing after a period of approximately 300-400 hours full load operation. It must however be remembered that in Beznau Bunker "C" is used exclusively.

For the purpose of washing, spray nozzles are built into the inlet side of the gas turbine and the washing is carried out when the turbine has cooled down to a temperature of about 200-250°F. The washing, itself, is carried out while the rotor is rotated by the starting motor. Steam is used from an electric boiler which first dissolves and loosens the slag. After the steam treatment, water is squirted in—under pressure—still with the rotor turning. Slag is washed out of the turbine to the exhaust duct where it is carried away. For the Beznau sets, two hours are required for the washing operation—naturally without taking into account the cooling-off period of the machine.

No research is carried out at Brown Boveri for the time being in regard to coal-fired gas turbines. In the 30's, considerable time and money were spent by Brown Boveri to develop a coal-fired Velox boiler and at that time already the problem was to ensure that the supercharging gas turbine which was connected to the exhaust gas of the Velox boiler withstood the ash and abrasive particles from the fuel combustion. These efforts were later on abandoned because at that time at least we did not see any suitable solution of the problem.

[1] Ewbank and Partners (Canada) Limited, Toronto.

Power Transmission by Insulated Cable

by Dr. L. G. Brazier

(*Continued from page 942*)

New Dielectrics

Sixty years after Ferranti first introduced impregnated paper as a cable dieleetrie, it is still difficult to find an alternative which will eompete with it on performanee or priee. Where the eost is not a determining factor rubber has been used in Ameriea particularly for submarine power links but because of its poor long time ageing characteristic the designs have been held down to a stress of about 25 kv. per cm.

Reeent researehes indicate that methods ean be devised to enable rubber to operate at mueh higher stress—perhaps 100 kv. per cm. If this is eonfirmed it will radieally alter the potential usefulness of high voltage rubber cable for submarine and other special purposes.

Of the large range of plasties now available to the cable maker, polythene at first sight appears the most attractive. It has high impulse strength (2,500 kv. per cm. or higher) and its permittivity and power faetor are mueh superior to impregnated paper.

Unfortunately it has a large volume contraetion on solidifieation (about 15%) and it has at present been found impossible to extrude thiek walls of polythene without the formation of voids even with the help of vaeuum or pressure controlled eooling teehniques. These voids tend to be worst adjacent to a metallie eonductor.

This is serious enough, but in addition polythene happens to be a material which is peeuliarly susceptible to discharges in voids, erosion taking place to a tremendous extent. Hence the a-c strength of this plastie falls rapidly with inerease in thiekness, a sheet of 2 mils thickness giving a short-time valne of over 1,200 kv. per em., whereas a 50 mils sheet will fail at only 400 kv. per cm.

Other polymers, sueh as polystyrene for example, have elcctrical properties comparable or even superior to those of polythene, but the plastic range is so limited that they cannot be extruded. These polymers are therefore useless for cable manufacture.

The new discovery that the natural or synthetie plasties molecule can be modified by radiation —by electron or neutron bombardment—opens up or seems to open up a new field of endeavour with almost limitless possibilities and potentialities. Rubber can be "vuleanized" without sulphur. The softening temperature of polythene can be raised by perhaps 50°C. It offers a real method of molecular manipulation to produce materials with arbitrarily selected properties.

It is however a subjeet for the future. Little ean yet be said how much or how little it is going to help the cable maker. It would however be singularly appropriate if atomie power whieh will be called upon to meet the irresistible demand for more and more electrical energy in the world, also proves to be the instrument for improving and eheapening its dissemination.

Acknowledgements

The author's aeknowledgements are thankfully offered to many eolleagnes for their invaluable help in the preparation of the paper, and to the British Insulated Callender's Cable Co. Ltd. for permission to prepare and publish the paper.

Dr. L. G. Brazier, delivering his paper at the annual meeting in Toronto.

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Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

PRIDE IS FOR PEOPLE

Canadian Metals, v. 17, n. 8, July, 1954, p. 5.

It sometimes seems to us that many who laud Canada for her rich sources of mineral wealth are often like sycophants who praise a rich friend only in order to share selfishly in the wealth. To a wealthy person of high honour and sharp brains summer friends must be as much nuisance as flies. Flies, however, make no secret of their intent and need no schizophrenic masks to hide their feelings.

Birthday time, which we have now just passed, is often considered a suitable time to make proclamation of patriotism or admiration. The almost shopworn statistics of our wealth are trotted out for show.

True, we are proud and happy about our great mineral resources. We are also proud of our people and what they have done over these many years to make us a power of note. Actually we should be more proud of our men and women than of our vast raw wealth, for the former are developed by our Canadian environment, while nature alone created the latter.

Canadian Inventions

Let us then hear more about our inventions and plans, completed and otherwise. Let us hear of Lord Rutherford, who in 1902 in Montreal, stated the theory of atomic disintegration. Let us know more of our present day Shawinigan Power scientists who are developing in Canada a new and cheaper process for making titanium.

Let us know more about Dr. Abraham Gesner, who, a century ago in Halifax, extracted oil from coal beds. The new oil replaced animal and vegetable lighting oils. Gesner called it Kerosene. Alexander Graham Bell started his inventions in Canada. Marine fog horns were first developed in this country.

There is no limit to these illustrations if we take the trouble to really examine our history. But more than inventions are involved. The creation of Canada in 1867 was a master work, so was our transcontinental railway (assailed as fantastic in its day).

We will stop here, but we could extend this list for a long time. The point for pride is not what we have, but how we use it. Our wealth is a blessing, and we have used much of it with intelligent aggressiveness. Let that be remembered and made known, and true Canadians celebrate our birthdays to come with tales of our cultural, political and technical knowhow.

To merely cite the facts of our natural endowment is vain boasting; to be only swayed by them when recited by true or false friends is to invite flattery—and eventual downfall.

CAN WE AFFORD TO DE-SALT SEA WATER?

Power Engineering, v. 58, n. 8, August, 1954, pp. 86-87.

Recent years have marked a decided increase in engineers' preoccupation with the problems of extracting fresh water from the sea. Unfortunately, the subject is of such interest that its complexity is often minimized for popular consumption, and this has led to much befuddled thinking and some interesting if fantastic schemes.

On the other hand, it may be fortunate that the public is so interested. Present thinking indicates that plants for the desalting of sea water will be extremely large and expensive—if significant amounts of fresh water are to be produced—and that the public will have to foot the bill.

Not only will the plants be expensive to build, but they will be very expensive to run. While it is not an iron-clad general rule, it is usually true that less expensive plants cost more to run because of less effective recovery of wasted power. This assumes, of course, plants of equal capacity.

No "Perfect" Solution

Despite the many workable techniques conceived to extract fresh water from sea water, no one technique offers a "perfect" solution to all the requirements of public water supply. These requirements are: (1) Fresh water production in terms of millions of gallons per day, (2) at less than $0.40 per 1,000 gal. for cities, (3) at less than $0.06 per 1,000 gal. for irrigation, and (4) with a minimum effect on fuel resources.

Even theoretically, a plant extracting fresh water from sea water (35,000 p.p.m. impurity) must expend 2.6 k.w.h. unrecoverable energy for each 1,000 gal. of fresh water. Add another 10.4 k.w.h. per p.s.i. head for every million gallons pumped to estimate induction and distribution costs. Since most water supplies, municipal or agricultural, are consumed well above sea level, the pumping costs cannot be ignored.

Some engineers believe the lowest purification costs are promised at this time by a new process called electrodialysis. This process employs unlike plastic membranes in pairs which screen out anions or cations respectively. Migration of the ions to their respective opposite poles is induced by positive and negative electrodes on opposite sides of the pairs of membranes. Migration is interrupted when the ions encounter a membrane which refuses passage to particles with their electrical characteristic. When sea water (or other solution) is introduced between two membranes with opposite permeability characteristics, the anions will flow through one membrane while the cations flow in the opposite direction through the other membrane. This leaves purified water between the unlike membranes, the purity depending on electrical charge at the electrodes, the residence time in the field of influence, and the condition of the membranes.

Electrodialysis

Both power and equipment costs for electrodialysis promise to be lower than for other methods of purification, at least partly because of the following characteristics:

1. The water is not heated or vaporized, thereby eliminating thermodynamic losses.
2. Action is taken against the im-

will undoubtedly have a brilliant future. In fact, not only will the scientists from all over the world be brought much closer to each other (their chances of survival being, incidentally, considerably enhanced by the food served in the proposed ceremonies), but likewise many promising intelligences which are today diverted to more remunerative activities, such as gambling and smuggling, will be lured back to a field which offers both a congenial atmosphere of spiritual communion and also a large amount of epicurean prosperity.

ARCTIC REGIONS POSE TOUGH METALLURGICAL PROBLEMS

Maj. F. W. Myers, Jr., U.S. Army, Arlington, Va. *The Iron Age,* v. 175, n. 3, January 20th, 1955, pp. 79-82.

Arctic Regions have assumed great military importance in recent years. To operate in such areas, equipment must be built to withstand extremely rugged conditions without metallurgical failure. It must endure temperatures ranging from 70° to —70° F., deep snow, marshland, ice-filled harbors and rivers, rough terrain and steep slopes.

One of the most outstanding examples of low-temperature metal failures is the more than 100 Liberty-type vessels and about 30 T-2 tankers which have been listed as casualties. The striking feature about these metallurgical failures is that these fractures occurred at about 30° F. —a rather high temperature considering Arctic conditions.

The problem is not unique to military equipment. The Canadian railroads, which have had considerable operating experience in extremely cold regions, have found it necessary to develop special steels to prevent undue breakage of locomotive frames, tracks and bridges.

Metallurgical failures occurring in Arctic regions are complicated in analysis by an intangible "windchill" factor. It is defined as the rate at which an object loses heat if placed outdoors under given conditions. The unit used to measure windchill is the quantity of heat in kilogram calories per degree Centigrade which the atmosphere absorbs per hour from an exposed surface one meter square. The highest windchill recorded in North America is about 2370 units.

The low-temperature problem is believed to be compounded substantially by this windchill effect. When the windchill sweeps in, on, or over a piece of equipment, it results in a quenching effect on the exposed surface, lowering the temperature of the material on the exposed surface below that of the unexposed side. Therefore, the material will have a temperature gradient through its cross-section.

This temperature differential sets up high multiaxial stresses, which together with load stress, results in early fracture of a strength member. If relatively good quality low-carbon steels fail at temperatures about 30° F., a steel having a much lower transition temperature will be required for equipment subjected to the additive destructive effects of windchill.

Transition Range Effects

Research to date on metallurgical failures occurring at near zero or subzero temperatures indicates that these steels have had relatively high transition temperatures. This, coupled with inadequate design for welded construction, has been the major factor in ship failures. Even with good design, it has been the prime reason for structural failures in low-temperature areas.

Studies show that the transition range is raised by an increase in ferritic grain-size, an increase in plate thickness, and by slow cooling after normalizing. Also, the transition range in mild steel plate can be reduced by higher manganese content. Other studies show that increasing the manganese — carbon ratio lowers the range of transition from tough to brittle fracture, increases the impact values at all temperatures, and tends to result in finer McQuaid-Ehn and ferritic grain sizes. Still other tests show that chemical influence has a definite effect on transition temperature, and that metallurgical structure influences physical properties.

Impact Values Drop

Some plates from ships which fractured were so lacking in toughness and so brittle at —40° F. that they broke when dropped on a concrete floor. Normalizing heat treatment about doubled the mechanical properties.

The many investigations show that most low-carbon hot-rolled structural steels have relatively high transition temperatures and are extremely notch sensitive at low temperatures. Changing structural design, combining riveted and welded construction, or other means of improvising will not alter this condition.

In many cases, failures have occurred at points of geometric discontinuity, which are structural notches, thereby setting up concentrations of stresses in or near a welded joint. Studies show that the weld was probably not the primary cause of failure. However, defective welds can set up stress concentrations resulting in fracture more readily in cold regions than in mild climates.

Many lightweight alloys can be considered for use in Arctic regions. Aluminum, for example, not only greatly increases the payload of a vehicle, particularly where ground pressure is important, but gives a much higher safety factor to certain types of equipment. Aluminum alloys are superior to ferrous metals where notch-sensitivity is important. Another advantage of aluminum is that its tensile strength increases with lower temperature while impact properties hardly change.

Magnesium has been used experimentally at temperatures as low as —320° F. without difficulty. The modulus of elasticity of these lightweight metals is lower than that of steel, making it necessary to use deeper sections to maintain the same deflection characteristics. Conversely, this can be an asset because the lower the modulus the greater the ability to absorb energy without permanent set.

High Tensile Steels

Among the low-alloy steels, there are a number of high-tensile types which may be used successfully in relatively cold climates. These steels have a Charpy impact value of about 40 ft.-lb. and a tensile strength of about 70,000 psi. However, they do not have the toughness required at extremely low temperatures.

Use of the low-alloy high-tensile steels in ship construction may have definite advantages. Their higher cost would be offset by their higher physical values which would reduce the amount of steel required. It would also increase the payload of the vessel. Its greater corrosion resistance would be another factor in considering cost.

Low-carbon steels made by using fine-grain practice have also given results superior to those of ordinary steels.

High-manganese, high-tensile steel with small amounts of vanadium is another possibility for low-temperature service. Also, a fully-killed, hot-topped 0.90 manganese steel which has an energy absorption value of about 50 ft.-lb. at —50° F. and a yield strength of about 50,000 psi. may give satisfactory low-temperature service.

Steels such as NE 8640 and SAE 4140 develop excellent low-temperature characteristics when given special heat treatments. After proper heat treatment, these steels exhibit yield strength of 105,000 psi. and Charpy impact values of 50 to 60 ft.-lb. at —70° F. Microscopic segregation of alloying elements which tends to cause cracking in these high-strength steels can be greatly reduced by heating the steel to 2250° F.

All studies and reports indicate that the vast majority of materials used in structures for Arctic use are inadequate for the job. The problems are such that they cannot be treated as failures of specific items or materials, but must be treated as a general metallurgical problem.

WELDED TV TOWER

Robert A. Vaughan, *The Welding Journal,* v. 33, n. 12, December 1954; pp. 1175/78, pp. 1187.

Design and execution of a 660-ton triangular section "steel needle," extending nearly one-third of a mile straight up into the pleasant Oklahoma air, called for highly specialized talents on the part of engineers, fabricators and erection crews. Claimed to be the tallest man-made structure on earth, it is a 1,572-ft. guyed TV tower for mounting two television antennas.

Thanks to the unique combination of high-speed manual shop arc welding in precision jigs and a novel design of 100-ft. electric gin pole for hoisting partially assembled sections into place for bolting together, it has been possible to maintain a steady flow of steel through the fabricating shop on to the tower site and up into position.

A specialist in the design of radio and television towers had no qualms over undertaking the design of this grandaddy of them all. Previous towers have been in the 800-1000 ft. height range, but the desire for maximum television coverage—and perhaps a native pride in having the nation's biggest—led KWTV planners to invest close to

$500,000 for the ultimate in towers and transmission equipment. Line-of-sight distance to the horizon from the tower top is 60 miles. This is the normal effective signal range in all directions, although atmospheric conditions may push it well beyond that.

To understand the specialized fabricating problems involved, it is necessary to have in mind the general physical characteristics of the tower structure. It is straight-sided with 12 ft. face and three vertical legs forming the triangular section. The legs are made in sections, most of them 30 ft. in length and are tied together by horizontal girts of steel angles and diagonal bracing of steel rounds, bolted to drilled gusset or wing plates which have been welded to the leg members. The latter are joined together vertically in the field by means of circular flanges welded to each end and drilled to receive eight bolts each.

The tower structure itself extends upwards some 1420 ft., and at its peak is additional structural steel framing to support the lower antenna, 79 ft. in height. Above that is the second antenna, 73 ft. in height. The entire assembly rests on a reinforced concrete base surmounted by a 36-in. diam. porcelain insulator capped by three 5½-in. thick slabs carrying the tower's base.

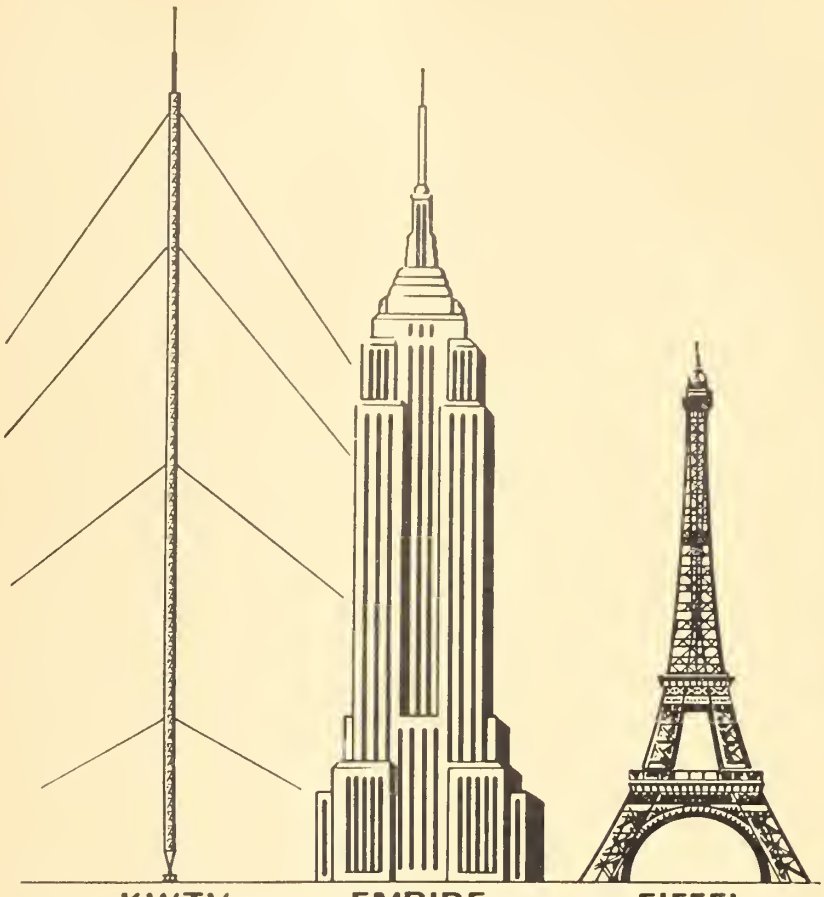
There is a total of 54 individual sections stacked up for the complete tower. All structural members are machined, welded, galvanized and painted in shop and then shipped knocked-down to Oklahoma and bolted together, piece by piece, on the ground and in the air.

The most spectacular features of the design are the size and weight of the leg sections. The lower 30 ft. comprises three 10½-in. solid forged steel rounds, tapering together at the base to form the pivot support. The next 270 ft. are made up of nine sections, each 30 ft. long with legs of 14-in. wide flange H-beams weighing 314 lbs. to the foot. They are tied together by girts and diagonals plus the end flanges, the same as are the round legs.

Next come two sections of 9½-in. rounds, designed to carry the attachments for the lowest set of guy cables. Then there are 35 sections, each 30 ft. long, with 8-in. round legs, stepping down to 6-in. rounds toward the top. Finally there are three 20-ft. "bays" having 4-5 in. rounds and above them the antenna support framework built up of 8- x 8- x 1⅛-in. angles, these of high-tensile steel. The 35 intermediate sections also are of this higher strength steel while all other members are of mild steel, either SAE 1020 or ASTM A-7 specification. All bolts are alloy steel.

At the 290-, 650-, 1040- and 1340-ft. levels welded steel collars carrying guy cables are fitted in place. At each level there are three pairs of guy cables 120 deg. apart to anchorages on the ground. The latter are positioned 950 ft. from the tower base for the upper three sets of cables, 520 ft. for the lower set. Each pair of cables is attached to the two tower legs on that face, running parallel down to the anchoring point.

Reinforcing steel in tower and guy anchor bases is embedded into 1200 cu. yd. of concrete sunk into the ground. The 24 guy cables have a total length of 27,000 ft. They are all prestressed galvanized bridge strand cable. The top six are 2 in. diam. with rated breaking strength of 490,000 lb. At the 1040-ft. level the cables are 1⅞ in. diam. At the 650-ft. level the cables are 1⅝ in. and at the lowest level 1½ in. diam. with two insulators.



Prestressing of the cable is done by the manufacturer. The cable is stretched to just under the yield point, thus eliminating locked-up stresses and insuring a minimum of "give" when installed.

Construction of Heavy Insulator

The heavy insulator supporting the tower is of unusual construction. It has 21 individual porcelain elements, each 6½ in. diam. with an I.D. of 3½ in. A steel cap 36 in. diam. and 5½ in. thick is placed on the head of the insulator, with a lead gasket between the head and the cap. The latter is held to the insulator by six 1¾-in. bolts. Temporary tierods join the cap to the steel base, permitting preloading of the insulators to 300,000 lb. to avoid danger of transverse load affecting the insulator during erection. Once the weight of the tower is taken up by the insulator, the tierods can be removed. Each of the cylindrical insulator sleeves is filled with oil.

At maximum working load, each porcelain sleeve carries 134,000 lb., equivalent to 5700 psi, exceptionally low for radio insulators. Total tower weight on the insulator is 1,323,392 lb. or over 660 tons. Actually, it is designed to withstand a crushing load of 5600 tons with a maximum working load of 1400 tons.

In case of breakage or other difficulty with the insulator platform once the tower is in service, it is possible actually to "lift" the weight of the tower off the insulator through manipulation of three hydraulic jackposts. They are positioned under the three tower legs at the point 30 ft. up where the main legs begin to converge to join at the insulator base. These posts are triangular in section, with three legs of 4-in. steel rounds and having a face spacing of about 14 in. They are tied together with a lattice of diagonal round bars and plates, all prefabricated by welding before erection. The three posts are spaced 12 ft. apart and meet the main tower legs at the point where the H-section columning starts.

Specifications call for meeting wind loads of 60 psf. of projected area on the upper 792 ft. of the tower, and of 40 psf. of area on the lower 780 ft. These loads are tempered somewhat by the use of round leg sections and diagonals, which means that they can be reduced in effect, by one-third.

At numerous points in most towers, particularly in those which are not guyed at the top, the welds and the tower members are liable to a reversal of stresses as the wind changes direction.

Lower tower sections, because of the high axial compression induced by the "pull-down" effect of the guy cables and the weight of sections above, are not deflected to any important extent by wind and, hence, are loaded probably 90% in axial compression.

In the upper bays where there may be stress reversal, the end flanges are reinforced by gusset plates welded to them and to the legs. In lower sections under high axial compression loading, precautions are taken to prevent the legs from punching through the flanges.

Table 1—Physical Properties

Temperature, °F—	+80	0	−100	−200
Yield point, psi	63,200	81,700	90,000	109,200
Tensile strength, psi	76,000	92,400	100,600	111,500
Elongation (% of 2 in.)	27.9	25.85	25.50	27.13
Reduction in area, %	69.4	69.90	61.30	57.90
Impact * West-ing-arc, ft-lb	100.0	80.0	22.0	. . .
Impact * E-6020 manual, ft.-lb	58	25	21.0	. . .

*V-notch Charpy impact test.

Inside the structure and supported therein are four 6⅛-in. coaxial cables leading to the antennas. They have a total combined length of 6,500 ft. plus another 2,000 ft. on the ground from the transmitters to the tower. Further, the tower structure will incorporate ten intermediate inside platforms to provide rest and work areas for service and maintenance crews and one outside platform at the 650-ft. level for special electrical equipment. At each platform level will be mounted signal lights, including nine 1,000-w. flashing beacons and 18 obstruction lights. Additional service facilities number full height access ladders and a two-man electric elevator running to the 1,340-ft. level.

All tower sections are hot dip galvanized and primed with paint after fabrication and before shipment. After erection, the tower will be painted orange and white to conform with CAA regulations on such structures.

Extensive welding was essential in prefabrication of the 200 odd leg members, each carrying two end flanges and one wing plate plus the 900 or so diagonals to which flat bolting plates were welded at each end. All welding was done manually, and it marked the first used by the shop of the Jetweld 1 electrode, in conjunction with 400-amp, a-c welding generators. This type of electrode provides physical properties equivalent to AWS E-7020 and has been designed for extra high-speed, deep-groove welding with a-c current. Because of its high deposition rate and easy slag removal, it produces weld metal at low cost per lineal foot in addition to having good wash-in properties and exceptionally little spatter or arc blow.

Jetweld is a coated electrode with a refractory coating containing a substantial percentage of powdered iron. This permits higher current settings and provides self-cleaning action making it ideal for cover pass work.

Flange joints on the heavier tower legs called for as many as 40 or 50 passes to build up the desired fillets inside and out. Using 3/16-in. rod at a current setting of 275 amp or ¼-in. rod at 350 amp, it was possible to maintain a welding speed of 14-15 ipm. On the heavier flange joints of the counterbored type, as much as 40 lb. of electrode went into a single joint. Flanges were flame cut from heavy plate or slab stock, some being up to 3½ in. thick and requiring 1-in. fillet welds on the outside.

Briefly, the procedure for assembling a leg member was to place it in a jig and locate the flanges and wing plates for tack welding. The round leg section is held firmly by end plates on the jig with fixtures locating the plates at the exact 60-deg. angle required. It was possible to tack weld the two flanges and fix wing plates in as little time as 11 min.

A crane then transferred the assembly to other jigs for completing the flange welds and for finishing the continuous ¼-in. fillet welds on the wing plate joints. By turning the work in the jig through motor and chain drive all welding could be made downhand.

A high rate of production was maintained on welding the bolting plates to the ends of diagonal bracing members with the aid of a special jig equipped with locating pins at either end over which the short bolting plates could be slipped. The round connecting member then was placed in slots flame cut into the plates, and the joint welded all the way around on both sides. Rigid spotting of the end plates compensated for any slight variation in length of the connecting round bar.

New Welding Process Cuts Costs and Welding Times

Higher welding speeds, better quality welds, and lower operating costs are the main advantages of a new consumable-electrode, inert-gas arc-welding process. It is claimed that field tests on the new process disclose a 15 to 20% faster welding speed at a 25 to 50% reduction in costs over other manual and semi-automatic inert gas methods.

Key to the new process, which uses ordinary welding grade argon to shield the arc, is a new coated wire. This wire produces best results when used with a newly designed welding gun, wire control and a new constant potential power source.

The new process produces welds that can be painted without cleaning. There is virtually no spraying or spatter. Nor is there any slag-covering on the weld. The new process may be used on mild steels, with or without normal mill scale on thicknesses from 1/16-in. up. It can be used as either a semi-automatic process—where an operator holds the gun or in automatic processes—where the gun is clamped into position and the work moved or where the wire is fed through an automatic head. Primarily intended for horizontal and flat position welding, the new process is not yet developed for vertical or overhead welding.

The new process, in contrast to most other processes of this type, uses straight polarity. The special coating on the wire makes it possible to take advantage of some of the higher burn-off rates because it stabilizes the arc, eliminates spatter, and provides good penetration. The end result is a high quality weld at greatly increased speeds.

Table 1 gives typical values of various physical properties at temperatures from 80°F to a −200°F. The excellent physical properties at low temperatures mean a weld low in contaminating oxygen and nitrogen.

Because of greater arc stability, this process uses about 33% less gas.

TANKER FOR CHEMICALS

The Institute of Marine Engineers, v. LXVII, n. 2, February 1955, pp. 24, 25

The *Marine Dow-Chem* is the first ocean-going tankship especially designed and built to transport a diversity of high-density liquid chemicals in bulk. The hull form and machinery chosen was that of an 18,000-deadweight-ton Bethlehem tanker, a number of which are in operation for several different owners. This unusual vessel, which has a capacity of 3,500,000 U.S. gal., unlike any tanker ever built, was designed, built and equipped for one role—the economical maker-to-user movement of large tonnages of liquid chemicals. To accomplish this, many structural features representing first-time engineering by both the chemical and shipbuilding industries were incorporated in the vessel. One principal difference between the *Marine Dow-Chem* and other tankers is in the protective arrangement of cargo tanks. In movement of chemicals great care must be taken to prevent contamination since quality of these commodities is measured in "parts per million". It further was required that the cargo tanks be isolated entirely from sea water—that through which the ship moved and also that used for ballasting purposes. The desired isolation was accomplished by double bulkheads, which put two thicknesses of steel between any two cargo tanks and between cargo tanks and the sea. Other notable features include cathodic protection of the hull, and extensive use of nickel and rubber linings in the cargo systems. The vessel is of the three-island type with flared stem and cruiser stern. The hull, in general, is framed longitudinally and of welded construction. Special consideration was given to the structure in way of the independent cargo tanks and to take care of the unusual loading conditions. Propulsion is by a single 19¾-ft. diameter propeller driven by Bethlehem 7,000-s.h.p. steam turbines with Falk double-reduction gearing. The high-pressure turbine is of the impulse-reaction type with a two-row impulse wheel followed by several expansions of reaction blading totalling twenty-two moving rows. The low-pressure ahead turbine is of the all-reaction type, with a hollow, conical rotor carrying twenty-five moving rows. The astern turbine in the low-pressure turbine casing is of the impulse type with one three-row wheel and one two-row wheel, separated by a diaphragm. The two Foster Wheeler boilers are designed to deliver steam at 725 deg. F. at 425 lb. per sq. in. gauge throttle pressure. They are water-tube units with water walls, economizers, super-heaters and internal desuperheaters in the steam drums for handling the auxiliary steam. The *Marine Dow-Chem* has the distinction of being the first American-built vessel to have cathodic protection installed when the vessel was on the building ways. One hundred and eighty anodes of Dow DX-8 magnesium weighing 60 lb. each were attached to the hull by steel studs. The anodes were arranged in groups of thirty located forward, amidships and aft, on both sides of the ship. They were placed along flow lines to minimize resistance to the vessel's movement through the water. The specific cargoes which the *Marine Dow-Chem* is designed to handle are as follows: Hy-

hydrochloric acid, a widely used chemical; perchloroethylene, a cleaning agent; methylene chloride, used in the manufacture of photographic film and paint removers; chloroform, a widely used raw material and solvent; carbon tetrachloride, a familiar solvent and raw material; ethylene dichloride, a widely used solvent and raw material; styrene, an ingredient of many plastics and other synthetic materials; glycols, the ingredient of many commercial products; 73 per cent caustic soda, one of the most widely used basic chemicals. Of the foregoing materials, hydrochloric acid and caustic soda presented the greatest design problem since both chemicals attack steel and both are made unacceptable for most commercial uses by even small amounts of iron-salt contamination. Each of the six huge (15 ft. diam. by 41 ft. deep) tanks, located in the No. 1 hold were designed for interchangeable transport of hydrochloric acid or caustic solution. These tanks were fitted with special rubber linings supplied by the Goodyear Tyre and Rubber Company. After installing the linings, steam under pressure was introduced to vulcanize the rubber. Over 35,000 lb. of rubber were used in lining the tanks and connecting piping.

AN IMAGINATIVE SOLUTION TO FUEL SHORTAGES

Combustion, v. 26, n. 8, February 1955, p. 39

One of our British contemporaries, *Power and Works Engineering,* in its December editorial, recalled to our mind the project of transporting natural gas from oil fields by barges in refrigerated containers at atmospheric pressure. This project scheduled for introduction on the Mississippi River, is intriguing in its possibilities. As our English cousins see it this project, if successful economically, could make available the natural gas released in the oil fields of the world to all markets no matter where they be.

Briefly the project as originally envisioned would entail liquefying natural gas, principally methane, in the Gulf Coast area, loading it in insulated tanks set on barges and moving the cargo at atmospheric pressure up the Mississippi and Illinois Rivers to the Union stockyards at Chicago. There the gas would be vaporized and used for fuel purposes. Further the tremendous amounts of refrigerating energy released in this vaporization process would be employed in chilling and cold storage of meats.

The project's initial construction costs are held to be less than half those for major gas-transmission lines delivering the same volume of gas. Power for barge transportation, it is hoped, will be relatively inexpensive, since the tow-boats could be operated largely off the small amount of natural gas evaporating from the storage tanks, with some liquid kept in the tanks at Chicago for fuel for the return trip. Actually, though, operating costs must await the grim findings of experience. Therein lies the answer to whether a new form of fuel transportation is with us or not.

We shall follow developments as closely as possible as will, of course, the gas supply industry and the very rich market it serves. The existence of a liquefied gas barge system would truly make it possible to bring the natural gas supplies of oil fields all over the world to any market. Further, as new supplies came in or old fields became depleted there would be no problems of disposal of old or capitalization of new gas transmission lines.

TEST HOUSE FOR PROTEUS ENGINES

The Press Office, The Bristol Aeroplane Co. Ltd., Filton House, Bristol

To speed the flow of engines a new test house has been built by the Bristol Aeroplane Co. Ltd., where production engines will be check-run before delivery. The test house combines two identical test beds and one central control room.

The beds are capable of testing engines of up to 6,000 shaft horsepower. This exceeds by some 40 per cent the shaft horsepower output of the Proteus 755 engine. There is thus an ample reserve of capacity for the testing of all types of turboprop engines likely to be developed in the foreseeable future.

The main services to the test house are housed in a central basement beneath the control room and fuel is supplied from a tank which holds up to 12,000 gallons. An unusual feature is water tanks in front of the building which supply water for the cooling system and, incidentally, ensure that the air drawn in is free of grit.

The length of the building is 146½ feet. Of this, 60 feet is taken up by the engine rooms and the remainder by the extensive system of "splitter" type silencing baffles installed at the intake and exhaust ends of the beds.

The engine rooms are 24 feet square in cross section, and the engine platforms are centrally mounted on floating concrete blocks separated from the surrounding floor by isolation pads. This ensures that no vibration is transmitted to the main structure. As an additional precaution, the control room floor is similarly isolated from the main wall structure.

Engines Moved by Crane

To enable engines to be mounted rapidly on the test platform and to permit quick delivery to and from the shops, large soundproof doors are fitted in each of the side walls and an overhead crane of 2½ tons lifting capacity is installed over each bed. The engine to be tested is brought in through the doors by truck, hoisted into position, and secured to a tubular test mounting. At the end of the eight hours' test schedule, the propeller is removed and temporarily supported on a vertical stanchion, while the engine is removed from its platform and lowered to the truck which takes it away to await installation.

The engine can be reached for servicing from an hydraulically operated elevator which rises from floor level to a height of a little over eight feet. A fool-proof system of controls ensures that it is impossible to raise this ramp while an engine is actually running.

There are two control panels, one overlooking each bed, with instrumentation laid out in three principal groups so that the supervision and observation of an engine on test can be handled by only two men. The central panel, which is directly below the observation window, covers throttle lever, propeller pitch control, dials recording compressor and propeller speeds and an electronic r.p.m. calibrator. On the right are instruments recording oil temperatures and pressures and fuel flow, and those at left cover services supplied to the station. Here are the controls for the automatic CO_2 fire-fighting system and the electrically operated steel shutters which blanket off the air intake and the rear outlet when the beds are not in use.

To ensure clear vision, the observation windows are tilted at an angle and the lighting above the control panel is carefully diffused, to avoid throwing reflections on the glass. In addition, there are two portholes set obliquely in the wall of each bed to enable observers to watch the exhaust and the behaviour of the propeller.

The building construction is unusual in that the large areas of brick-work do not, in fact, constitute the basic structure. Rather, they form a system of panelling within a framework of reinforced concrete to allow the building to move as a result of expansion caused by solar heat. Thus the side

Front view of the test house showing the intake splitters of one of the beds. The steel shutter of the second bed is in the closed position.

walls of the building form a number of brick panels separated by expansion joints; the building can also expand vertically because of horizontal joints extending throughout the length of each panel, the entire wall structure being mounted on a concrete beam which is part of the main framework and is pin-jointed to the concrete foundation.

The exhaust splitters extend to a depth four feet below the ground level of the intake splitters, so providing an area of egress substantially larger than the intake area. This is designed to prevent the recirculation of warm air which might result from the creation of a depression at the front of the building and an area of compression at the rear.

A FORCE FOR PEACE

Excerpts from an address by H. C. McClellan, Chairman of the Board of the National Association of Manufacturers, before the Council for International Progress in Management. A. M. Lederer, Morris and Van Wormer partner, is Chairman of the Board of C.I.P.M.

Industry Tomorrow, February 15, 1955.

During the past few years, numerous teams of American industrialists selected by the Council for International Progress in Management and sponsored by the Foreign Operations Administration have been sent to friendly foreign countries to assist those countries in affairs of business and industry.

These teams have not gone as Washington bureaucrats, attempting to impose our government policies upon other governments. They have supposedly been sent as free enterprise missionaries — men from private business selected because of competence in specialized fields in industrial activity.

Troubling Questions

Regardless of the logical arguments which can be advanced in favor of these American projects on foreign cooperation, this team-sending venture raises serious questions in the minds of many Americans. Why should we, admittedly the most successful nation in production and marketing of all kinds, share our know-how with any other country? Are we not merely inviting stronger competition, depleting our own markets or potential markets abroad?

We are living today in one of the most critical periods of world history. It is an era during which the foundation can be laid for lasting peace and economic progress around the world. But it is also an era which could mark the decline or even the fall of civilization everywhere. Which of these two alternatives will be chosen is not yet clear but this we know: when the decision is made, we Americans will have helped to make it.

Methods That Have Failed

This calls for sober consideration by every thinking American. During my lifetime and the lifetime of many others in this audience, the United States and her Allies have fought and won World War I to make the world safe for democracy. This nation, together with other nations, has fought and won World War II to defend peaceful nations from aggression. We and our Allies have fought the Korean War to a stalemate to stop the spread of Communism by forceful and illegal means. And yet, in spite of those wars and those victories, with their tremendous cost in the lives of young men from many nations, the challenge has not been met. Aggression by belligerent nations against peaceful ones has not ceased and the spread of communism by forceful and illegal means continues. Today, we are living in an armed camp, each nation competing to match or exceed the military or tactical strength of other nations.

Every citizen among us is dismayed to find that the great sacrifices in blood and treasure which we have made in the recent past have resulted only in a switch of international partners and have achieved so little toward establishing solid peace.

It should be recognized, I believe, that during our time at least, wars have occurred only after gross misunderstandings between the peoples of nations have wilfully been developed. These wars were not caused by any lack of understanding between the nations' leaders; the government spokesmen have understood each other all too well. Each of the wars in our time was preceded by a great black cloud of confused mass thinking and opinion; foggy, fuzzy combinations of half-truths, falsities, misconceptions and prejudices instilled in the minds of millions of people, then whipped into hatred by selfish, power-seeking men who themselves knew full well the evil of their work.

A New Approach to Peace

Fortunately for all concerned about peace, our Administration in Washington has adopted a new approach to peace. That approach is the development of a better understanding between the peoples of free nations. Technical cooperation constitutes an important part of that approach and in that effort, our team plan projects carry a front line role.

Even though this technical cooperation effort should result, as some presently fear, in new competition and in heavy losses by American industry in markets for our goods both at home and abroad, is it possible that those losses by the broadest stretch of the imagination could cost more than a fraction of what we have been paying in human lives, in tax dollars and in national security? During recent years alone, our nation has suffered more than 1,500,000 human casualties and has spent more than 677 billions of dollars fighting one war after another, only to be confronted each time with the threat of a worse war. Who can estimate how great will be the cost of one more war?

Cooperation Even With Risks

Speaking as a practical hard-headed businessman and not as a do-gooder or social reformer, I sincerely believe our best course is clear. We should willingly accept whatever risk may possibly accrue in business cost to America in adopting the course of cooperation with other nations. We should work vigorously toward the economic advancement of less fortunate nations everywhere.

The New "Balance of Power"

It is also my conviction that as a force for permanent peace the old theory of balance of power is as obsolete as the last war's weapons. Today, one bomb dropped from a single plane can exceed the combined explosive power of all bombs dropped from all of the planes in all of the theatres of combat throughout World War II. Who knows what weapons will be available ten years hence? What security can there be against attack from a well-prepared aggressor? The only balance of power that soon will remain will rest with the first to attack.

The black cloud of misunderstanding and misconception has been built up just as before, not merely around our cold war enemies, but even among our friends. Think of this. Millions of people today behind the Iron and Bamboo curtains and other millions who are citizens of free nations friendly with us sincerely believe that America is by purposes and intent an aggressor nation. This we cannot afford, if peace is to be attained.

Communications Between Peoples

We must somehow manage to develop understanding of people everywhere that only peace means progress and that peace can be established fairly. Means must be found to create understanding of the utter necessity for peace in the light of today's potentials for destruction.

This suggests surely that in whatever long-range programs we undertake as a nation toward the peace objective, communications between people outside of government, even though in part provided by government, must obtain high priority and increasing emphasis. From all of the evidence and experience I have been able to accumulate, these are the activities which cost the least and produce the most in the development of true understanding between peoples of nations.

Any interested American who knows anything about efforts made thus far in this direction is fully aware of the tremendous difficulties which must be overcome. To those who would refuse such undertakings because of these difficulties or because of the cost, I can only say that we can always fight, but fighting should be the last resort and should never be our sole means of defending freedom while other means hold promise. Furthermore, I believe that everyone of us should realize that unless we achieve understanding of the order I have described, all of the arms, all of the military might, all of the bombs and all of the men that free nations together can build and muster, will in the end result only in another war, just as such efforts have done in the past.

Highlights of the 1955 Annual Meeting

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Head Table at the Banquet

Top two rows, l. to r.: C. D. Carruthers, chairman, Annual Meeting Committee; M. L. Baker, president, Association of Professional Engineers of Nova Scotia; Mrs. G. Lorne Wiggs; M. W. Huggins, chairman of the Toronto Branch, E.I.C.; Mrs. E. H. Webb; J. Hoogstraten, president, Association of Professional Engineers of Manitoba; Mrs. J. R. Montagne; R. E. Jamieson, president, Canadian Standards Association; Mrs. C. T. Bissell; A. Turner Bone, national vice-president, Canadian Construction Association; Mrs. F. V. C. Hewett; Captain J. Dean, R.C.N.; Mrs. Nathan Phillips; E. R. Rowzee, president, Chemical Institute of Canada; Mrs. D. M. Stephens; F. Kenneth Hare, head of geography department, McGill University; and D. M. Stephens, outgoing president, E.I.C.

Centre three rows, l. to r.: William Roy Glidden, president, American Society of Civil Engineers; Nathan Phillips, His Worship the Mayor of Toronto; Mrs. R. R. McLaughlin; Thompson Chandler, vice-president, American Society of Mechanical Engineers; Mrs. M. W. Huggins; C. T. Bissell, vice-president, University of Toronto; Mrs. C. D. Carruthers; F. V. C. Hewett, member of Executive Committee, Canadian Institute of Mining and Metallurgy; Mrs. R. E. Heartz; I. P. Macnab, past-president, E.I.C.; Colonel E. H. Webb, Canadian Army; Miss Margaret Turner Bone; and A. J. C. Paine, president, Royal Architectural Institute of Canada.

Lower row, l. to r.: Mrs. J. Hoogstraten; E. A. Cross, president, Association of Consulting Engineers of Canada; Mrs. R. E. Jamieson; J. R. Montague, president, Association of Professional Engineers of Ontario; Group-Captain C. L. Ingles, R.C.A.F.; Mrs. R. C. Dickson; G. Lorne Wiggs, president, Corporation of Professional Engineers of Quebec; and R. E. Heartz, president elect, E.I.C.

Missing from photographs: Mrs. Thompson Chandler; L. F. Grant, president, Engineers' Council for Professional Development; Mrs. Wm. Roy Glidden; and R. R. McLaughlin, dean of the faculty of applied science and engineering, University of Toronto.

Above, at the first meeting of the new Council.

Personalities and Authors

Right (above), joint authors R. L. Clinch and H. J. Saaltink; (below), W. B. Lewis and W. H. D. Hanchet. ➤

Left (top), Sqn. Ldr. H. D. Monteith, J. B. Bryce (centre), G. E. Hall and A. E. Berry; (bottom) A. G. McNamara and R. S. Sproule. ➤

Below, joint authors J. P. Skillen and D. H. McKeough ➤

Retiring president, D. M. Stephens, right, talks to M. W. Huggins, chairman of the Toronto branch, E.I.C.

Address of the retiring president, D. M. Stephens, at the 69th Annual Meeting of the Engineering Institute of Canada, Toronto, May, 1955.

Change is Inevitable

There are so many things I should like to say this evening and so many things I should say if I tried to say them all, I am afraid this talk might outlast our convention.

One of the first things I should like to do, Mr. Chairman, is to pay my tribute to you, and to extend to you and your colleagues of the Toronto Branch and to the members of your various committees, my warmest congratulations upon the magnificent arrangements that have been made for this annual meeting. I know something of how formidable are the tasks associated with a convention of this sort and of the organization and the teamwork that are required to accomplish what you have done. I am sure I speak for all visitors when I extend to you and your committee our warmest thanks for the wonderful arrangements you have made for us.

This past year has been a most delightful one for me and I wish I could find words that would adequately describe to you something of the solid and lasting enjoyment which I have derived from it. If I had been able to find just those right words, it would have been easier for me to tell you also, on my wife's behalf, something of the extent to which she has shared this enjoyment and these solid satisfactions with me. It has been for both of us a most enriching year.

While I have not been able to visit all of the Institute branches I have been able to meet with engineers from almost every part of Canada. Through their eyes I have been able to glimpse something of the vast developments that are taking place in this nation. Through these meetings and visits I have been able to sense something of the gigantic commercial, technical, developmental, and, yes, the military and strategic forces that are pushing our northern frontiers ever northward and at a tremendous pace across the whole broad sweep of Canada. Through other visits with research people I have sensed something of that parallel drama in which Canadian engineers and Canadian scientists are playing praiseworthy parts and which are associated with the rolling back of scientific frontiers.

During this past year I have been able to visit, in company with the General Secretary and other officers of the Institute, a large number of the Canadian universities and degree-granting colleges where engineering subjects are taught. We have talked with the Presidents and Principals, Rectors and Deans, Members of Faculties, and very large numbers of the students from these wonderful institutions and we have been inspired and uplifted by all of them.

Through our discussions with engineers from all parts of the Commonwealth whom we met in London, through various discussions with representative engineers from various parts of the United States, through reports which we have had from Mr. James A. Vance and Mr. Verne King on their Pan American contacts, and from Dr. Wright on his recent wider travels in Europe I have formed some impression of the intense world-wide interest which this nation is attracting and of the high status which the engineering profession of Canada is coming to occupy in international engineering circles.

It is through his visits to the various branches of the Institute that your President will always, I think, find his most inspiring experiences. It is within the branches that much of the real work of the Institute goes forward and it is through the branch organizations and their various technical sections that many of our members are making noteworthy contributions not only to our profession but to their local communities and often to much wider communities also.

If I were to attempt to summarize the state of the health of the Institute as I assess it from my year in the presidency I could quite honestly use the one word "excellent". Our standards of admission are in general irreproachable. We have a large and growing membership. It contains a fine cross-section of age groups. A very large proportion of the outstanding men of our profession are outstanding in our Institute too. We have the finest relationships with similar technical and professional bodies from many other countries and particularly helpful relationships with the founder societies of United States, with the British institutions and corresponding institutions and societies of the Commonwealth. In our own country, as far as I can ascertain, our Institute is well regarded as an organization that is keenly alive to its responsibilities to the public and the nation.

This healthy and encouraging state of affairs is in itself a tribute

to a large number of people. It is a credit to the sort of people who comprise our membership. It is a tribute to the men who have served on Council and on Branch Executives over these many years. It is a special tribute, I suggest, to our General Secretary, to his close associates, Dr. Grant and Colonel Thompson, and to the devoted group of men and women at Headquarters and in the Toronto Office who have been inspired by and an inspiration to Dr. Wright, Colonel Thompson and Dr. Grant. But, I suggest, this fine state of affairs is in a special way a tribute to a group of farsighted pioneers of our profession who did some pretty solid thinking back about 1886 and about whom I shall say a further word in a moment.

Yes, I can report to you that in my judgment the state of health of our Institute is excellent.

But when I say this I do not mean it in the sense that a physician might if he were reporting upon the health of an elderly man who has earned his retirement. Rather I mean that the health of the Institute is excellent in exactly the same sense that our physician might report upon the health of a robust youth who had most of his life before him and a whole series of challenging and demanding tasks to perform.

We are a young Institute—a young profession—and we have a whole series of demanding and challenging tasks before us.

We are a young Institute notwithstanding the fact that we were founded in 1887, just two years after our first transcontinental railway had been completed.

The building of this railway had been one of the many early challenging and demanding tasks to confront some of the pioneers of our profession in Canada. Through its accomplishment the profession of engineering made one of its great contributions to the physical structure of this nation. So important was this accomplishment that we can claim the mere physical fact of Canada to be of itself an engineering triumph.

Founding of the Institute

Just two years after this triumph had been scored—just two years after some of the pioneers of our profession had made this outstanding contribution to the physical structure of this new nation—just two years after this particular "last spike" had been driven, a group of men, which included many of these same pioneers, founded a learned Society which was later to become an Institute but which was always dedicated to a pretty important group of principles.

It might be appropriate if we were to examine two or three of these principles in relation to a few of the problems which will demand and challenge the attention of our Institute. It is upon that theme that I should like to speak for the few remaining minutes that have been allotted to me this evening.

A few moments ago I referred to the extent to which Dr. Wright, other officers of the Institute and I had been inspired and uplifted by our visits to a large number of our universities and teaching institutions and by the men and women who comprise their faculties. This, I suggest, is wholly in the tradition of the universities and their teaching staffs. They have been providing inspiration to our Institute from the very beginning. When we peer into the history of our Institute we find one chronicler says of the early 1880's:

> "About this time the authorities of Toronto and McGill universities realized the importance of having educational facilities for training engineers, and the advantages of having an association with which to cooperate if one could be formed."

As we go on into this history we find underscored again and again the fact that our founders considered the assistance which they could render to the universities in the training of engineers to be one of the important purposes of their new Society.

To just as great an extent today as was true in the 1880's our universities and those who comprise their faculties hold in trust for society much of the cumulative culture and learning of all of our long history. To an even greater extent than in the 1880's (and this because entry into our profession

Authors of Papers

Left, D. T. Wright, and F. J. Horgan speaking for L. B. Allan.

Below, I. W. Smith, J. M. Vickers, E. Bernhardt, J. P. J. Dubuc and Clayton Glenn (on opposite page).

Above, l. to r., O. E. Johnson, R. R. Jackson, R. L. Hearn, chairman A. W. F. McQueen with author W. M. Walkinshaw, H. R. Rice, F. C. Hooper, M. Eaton, and D. C. R. Miller. Reading top to bottom.

is now almost exclusively from the universities) the teachers and professors in the engineering subjects and the students that surround them hold the key to the future of our profession. And when we consider this in relation to the immense problems with which our Canadian universities will be faced if they are to play their full role even for this next decade, and when we consider the veritable tidal wave of new students who have just finished elementary schools and who are about to enter high schools and will sweep on toward universities, we must conclude that these institutions will require all of the help that can possibly be given to them.

As engineers who have derived so much from the universities, as members of a profession whose future lies so largely with the universities, as members of a profession which must carry particularly heavy responsibilities for the development of this nation, and as members of an Institute that was founded in part to assist the universities, I suggest to you that it is incumbent upon us, as individuals, as a profession, and as an Institute to conform with this early Institute purpose and to assist the universities where and when we can.

I suggest that another fundamental concept upon which our founders were agreed (and which perhaps requires renewed emphasis today) was that "engineering" was then and always would be a living, growing, dynamic body of knowledge and practice. Also, that this body of knowledge and practice could have cohesion and homogeneity only if the members of the engineering profession maintained contact with one another, only if they communicated their problems, their methods, their successes and their failures to one another; and further, that only by the frankest, fullest, yes, even the most rugged interchanges could we develop, maintain, and keep abreast of an adequate body of knowledge and practice in the many dynamic fields with which engineers were and always would be concerned.

No Mental Isolation

If I were to phrase this concept in a short but clumsy way I should say that our founders were dedicated to the principle that no man could become a real member of the engineering profession by taking the most advanced college training and then going off to live in an intellectual igloo where he would be isolated from his fellow engineers.

It was because our founders placed such great importance upon this concept that they stated one of the chief objects of their new society to be:

> "To facilitate the acquirement and interchange of professional knowledge among its members".

It is because succeeding generations of members have agreed so thoroughly with this concept that our Institute and its branches have always given such a high place to technical papers and sessions; and that we have developed and maintained the leading engineering journal in the country.

It is because our members place so much emphasis upon this "interchange" concept that our many technical sections came into being. It is for this same reason (and

here I make a prophecy) that we shall see established more and more of these technical sections—and subsections—and that we shall see closer and closer relationships and linkages between them.

The Universities

If I were to make one further comment upon this "interchange" concept, and if at the same time I were to ask a favour of our engineering friends at the universities in return for the help that I hope our Institute might be to them, it would be to suggest that they find as many fruitful occasions as possible upon which to impress upon their students:

First: That many engineering sciences are dynamic;

Second: That the body of knowledge and practice in our profession is an especially fluid one and is being constantly re-shaped and refined;

Third: That this re-shaping and refining takes place through the application of this "interchange" concept;

Fourth: That full professional status requires participation in this re-shaping and refining, in part because through this participation we keep ourselves informed of practice as it develops; and

Fifth: That early affiliation with an Institute (and if they are to work in Canada, with a Canadian Institute) dedicated to this principle and these concepts is highly to be commended.

In some such manner as this, it seems to me, a rather rich concept from our professional past may be transmitted through us to our professional progeny.

There is one other concept upon which our founders laid great emphasis and which, I suggest, is well worth contemplating now.

On March 4th, 1886, a group of pioneer Canadian engineers met formally together for the purpose of organizing a new learned society. A resolution was passed at that meeting which was subsequently acted upon and which resulted in an Act being passed in 1887 by the Parliament of Canada, incorporating the "Canadian Society of Civil Engineers". This resolution, which is generally regarded to be one of our foundation documents, resolved that:

> "A Society of Engineers in Canada be formed comprising *all branches of engineers* . . . "

In 1886 the term "civil engineering" had, of course, a very broad connotation which comprised all aspects of civilian engineering as distinguished from military engineering.

By 1918 the term "civil engineering" had taken on a narrower meaning and was frequently taken to exclude several of the specialized branches of civilian engineering. In order to conform with the views of its founders and in order to make it clear that all branches of Engineering could be contained in a single organization a further Act of Parliament was passed which changed the name of the Society to The Engineering Institute of Canada.

And so this concept, first proclaimed in 1886, that all branches of engineering should be included in a single Canadian organization was reaffirmed in 1918.

My own view would be that this concept of a single professional home adequate to accommodate all branches of engineering is as important today as it was in 1886 or in 1918. I suggest to you that when Mr. Herbert Smith, of this city, took his long forward look and then made his highly constructive speech a little more than a year ago, he struck a chord that drew an immediate harmonious response from a tremendous majority of the engineers of Canada. And Mr. Smith's primary point, as I understood and understand him, can be taken as a 1954 and 1955 advocacy of the "one professional home" principle that had been sought after in 1886 and again in 1918.

I have always been impressed by the analogous or parallel developments in our country and in our Institute.

Stimulus of Incorporation

While I do not minimize the importance of developments which took place prior to the period 1885-86, I suggest that our real development as a *nation* was made possible when that thin line of steel was finally laid from Atlantic to Pacific. No more do I minimize the importance of engineers and engineering in this country in the period prior to 1886-87. Some extremely important work was done. But I suggest to you that the real development of a Canadian engineering profession was greatly aided and stimulated by the incorporation in 1887 of a professional engineering society. It was most fortunate that this was so. Some solid foundations were laid for Canada's rather young engineering profession just about the time it was to play an immensely important role in the amazing physical development of this country that took place between 1890 and the first world war.

Change and Development

During the first world war and partly because of it our economic and industrial patterns changed very greatly. And from 1918 to 1930 our country went through another dynamic stage of development. In 1918, also just as the nation was about to move forward at an accelerated pace and with increasingly diverse developments, we went through a reorganization which was most timely and which took account of the increasing diversity of Canada's industrial and developmental pattern and of the increasing degree of specialization within our profession.

And now, in 1955, with still greater changes in our country, with a rate of development that is and will be a particular challenge to the engineers of Canada, we in the Institute, along with even greater numbers of engineers of the professional associations in Canada, are setting about to do whatever must be done to change the organizational structure of our profession and to bring this structure into fullest harmony with the needs of our nation and of our times.

There are people who find merit in a course of action for no other reason than that it constitutes a *change*. I suggest to you, Mr. Chairman, that engineers are not, as a rule, greatly inspired by *change* just for the sake of *change*. On the other hand, engineers are accustomed to working in fields that are dynamic and fluid and we are unafraid of change when it is needed or when change means improvement. One reason that engineers in their work are unafraid of change is perhaps that in any particular instance they know just what is fundamental and cannot be changed, and what is incidental and can be changed.

Some engineers of Canada brought about a great change in the Canadian engineering profession in 1886. Others made a very

substantial change in 1918. But each time there was very close adherence to certain fundamentals.

We now face what I think is the need for another structural change. But, even when this particular change is completed, and because engineering, like life itself, is dynamic, there will be needs and times for other changes in the future also, changes that take adequate account of the nuclear, electronic, petro-chemical and aeronautical fields, for example. But so long as we know or strongly believe we know our fundamentals and our verities, I suggest we have no more need to fear this coming change or still other changes in our organizational structure than we have need to fear change in our professional practice or our professional work. So long as we cling to these verities we can hail *change* as Tennyson does and say with him.

"Forward, forward, let us range,
Let the Great World swing forever
Down the ringing grooves of *change*."

Right, retiring president D. M. Stephens receives a copy of "Half-hours with Great Scientists" from James A. Vance, a past-president.

Above, upper left, T. E. Wright, joint author, Plummer Medal; lower, l. to r., A. M. Lount, John Galbraith Prize; J. L. de Stein, Duggan Medal and Prize; R. L. Hearn, Julian C. Smith Medal.

Presentation of Awards and Prizes

Above, left, Frank A. Forward, Leonard Medal; W. G. Swan, Julian C. Smith Medal; below, retiring president D. M. Stephens presents honorary membership to I. P. Macnab; J. B. Stirling, Sir John Kennedy Medal; A. G. Lester, Ross Medal; and F. P. Shearwood, Gzowski Medal.

Minutes of the 69th Annual General Meeting

The Sixty-Ninth Annual General Meeting of The Engineering Institute of Canada was convened in the Concert Hall of the Royal York Hotel, Toronto, Ontario, on Wednesday, May 11, 1955, at ten twenty a.m., with president D. M. Stephens in the chair.

The minutes of the Sixty-Eighth Annual General Meeting, as published on pages 835 to 838 of the July, 1954 *Journal* were taken as read and approved.

Nominating Committee

The membership of the Nominating Committee of the Institute for the year 1955 is as follows:

Chairman—E. R. Eaton, Sudbury, Ont.

Branch	*Representative*
Amherst	L. F. Kirkpatrick
Belleville	O. H. Scott
Border Cities	C. G. R. Armstrong
Brockville	T. W. Brackinreid
Calgary	T. D. Stanley
Cape Breton	C. N. Murray
Cent. Br. Columbia	M. L. Zirul
Corner Brook	H. B. Carter
Cornwall	H. W. Nickerson
Eastern Townships	J. Lemieux
Edmonton	E. L. Smith
Fredericton	H. G. Hughson
Halifax	W. H. Chisholm
Hamilton	N. Metcalf
Huronia	B. C. Lamble
Kingston	J. W. Brooks
Kitchener	A. J. Girdwood
Kootenay	E. B. Broadhurst
Lakehead	S. Flook
Lethbridge	N. H. Bradley
London	I. D. Patterson
Lower St. Lawrence	R. Thomas
Moncton	R. F. Weir
Montreal	L. A. Duchastel
Newfoundland	William Watson
North Nova Scotia	Clyde F. Cameron
Niagara Peninsula	C. G. Cline
Nipissing & Up. Ot.	J. S. Cooper
North-East. Ontario	I. M. Foster
Northern N.B.	A. R. Bonnell
Ottawa	T. Foulkes
Peterborough	B. Ottewell
Port Hope	E. M. Wynn
P.E.I.	C. H. Stewart
Quebec	J. St. Jacques
Saguenay	A. B. Sinclair
Saint John	H. S. McCleave
St. Maurice Valley	J. F. Wickenden
Sarnia	J. W. Graeb
Saskatchewan	A. H. Douglas
Sault Ste. Marie	R. A. Campbell
Sudbury	P. R. McAdam
Toronto	E. R. Graydon
Vancouver	E. L. Hartley
Vancouver Island	J. Alton
Winnipeg	T. E. Storey
Yukon	H. W. Love

Honorary Memberships

The general secretary reported that the following had been elected to honorary membership in the Institute and that certificates would be presented at the annual banquet or on some appropriate later occasion:

John Edwin Armstrong, C.E., formerly Chief Engineer, Canadian Pacific Railway Company, Montreal.

de Gaspe Beaubien, C.B.E., D.SC., B.SC., Consulting Engineer, Montreal.

Edward Phillips Fetherstonhaugh, LL.D., D.SC., B.SC., formerly Dean of Engineering and Architecture, University of Manitoba.

Ira Percy Macnab, LL.D., D.SC., B.SC., General Manager, Public Service Commission of Halifax, N.S.

Awards of Medals and Prizes

The general secretary announced the various awards of the Institute as follows stating that the formal presentation of these would be made at the annual banquet of the Institute on May 13th.

Sir John Kennedy Medal — "As a recognition of outstanding merit in the profession or of noteworthy contributions to the science of engineering or to the benefit of the Institute"; to John Bertram Stirling, M.E.I.C., President, E. G. M. Cape & Company, Montreal, Que.

Julian C. Smith Medals—"For achievement in the development of Canada"; to Richard Lankaster Hearn, M.E.I.C., Chairman, Hydro-Electric Commission of Ontario, Toronto, Ont.; and to William George Swan, Consulting Engineer, Vancouver, B.C.

Gzowski Medal—"For the best paper of the medal year on a civil engineering subject, 'civil' being used in the limited sense to indicate structural, surveying and construction work generally"; to Frederick Perry Shearwood, HON. M.E.I.C., formerly chief engineer, Dominion Bridge Company Limited, Montreal, Que.; for his paper "The Stabilization of Suspension Bridges."

Duggan Medal and Prize—"For papers dealing with the use of metals for structural or mechanical purposes"; to Joseph Louis deStein, M.E.I.C., Department of Civil Engineering, McGill University, Montreal; for his paper "Rational Design for Building Frames with Semi-Rigid Connections."

Leonard Medal—"For papers on mining subjects"; to Frank A. Forward, Head of Department of Mining and Metallurgy, University of British Columbia, Vancouver, B.C.; for his paper "Ammonia Pressure Leach Process for Recovering Nickel, Copper, and Cobalt from Sherritt Gordon Nickel Sulphite Concentrate."

Plummer Medal — "For papers on chemical and metallurgical subjects"; to joint authors T. E. Wright, Chemical Division; Hugh P. Godard, Chemical Division, and I. H. Jenks, Publication Division, Aluminum Laboratories Limited, Kingston, Ontario; for their paper "The Resistance of Aluminum to some Alkaline Building Materials."

Ross Medal—"For papers on electrical engineering subjects"; to Alexander George Lester, M.E.I.C., General Manager, Special Contract Department, Bell Telephone Company of Canada, Montreal, Que.; for his paper "Telecommunications in Canada."

John Galbraith Prize—"For best paper by a Junior in the province of Ontario"; to Albert Murray Lount, M.E.I.C., Partner, T. O. Lazarides, Lount & Partners, Structural Engineers, Toronto, Ontario; for his paper "Prestressed Concrete Applied to Roof Joists."

Phelps Johnson Prize — "For best paper by an English Junior in the province of Quebec"; to Joseph Lawrence Abram Carey, JR.E.I.C., Resident Engineer, Montreal Engineering Company, (at present in India); for his paper "Labrador Menihek Power Development."

Ernest Marceau Prize—"For the best paper by a French junior in the province of Quebec"; to Gaston Galibois, JR.E.I.C., Quebec Power Company, Quebec, Que.; for his paper "Etudes des conditions de puissance reactive sur le reseau de 66K de la Compagnie Quebec Power."

Report of Council, Report of Finance Committee, Financial Statement and Treasurer's Report

On the motion of G. H. Rogers, seconded by R. E. Hayes, it was resolved that the report of Council, the report of the Finance Committee, the financial statement and the treasurer's report be accepted and approved.

Harry F. Bennett Education Fund

Mr. E. V. Buchanan, one of the trustees of the fund, suggested that it would be of interest to the members if a report on the activities of the fund were added to the annual report of Council. At Mr. Buchanan's request the general secretary made a brief oral report somewhat as follows:

The fund is audited annually by the Institute's auditors. At the present time there is almost $10,000.00 out on loan. Payments are being made quite satisfactorily although there are a few which require some follow-up.

The capital sum at the present time is approximately $32,000.00. There are now about forty-seven students and graduates who have loans still outstanding. The fund is becoming better known and the request for assistance is increasing slightly.

Referring to Mr. Buchanan's suggestion that the fund should be reported in the annual report of Council, the general secretary said that it was a good idea and that subsequent reports would contain up-to-date information about it.

Report of Committees

On the motion of R. H. Findlay, seconded by H. R. Fee, it was resolved that the reports of the following committees be taken as read and accepted: Admissions, Legislation, Library and House, Papers, Publication, Membership, Professional Interests, Board of Examiners, Prairie Water Problems, The Young Engineer, Employment Service, Library Report, Life Members' Com-

mittee, Canadian Chamber of Commerce, and the Canadian Standards Association.

Branch Reports

On the motion of Norman A. Eager, seconded by William Sharples, it was resolved that the reports of the various branches be taken as read and approved.

Committee on Confederation

The president stated that at the meeting of Council held the previous day the report of the Committee on Confederation had been discussed in detail. At the meeting, as well as the continuing, outgoing, and incoming councillors, there were present by invitation all those attending the branch officers conference.

Dr. Stephens explained that as Dr. R. E. Heartz, the original chairman of the committee, was to take over the presidency of the Institute at this annual meeting, it had been necessary for him to resign the chairmanship. At the time Council accepted his resignation it appointed Dr. I. R. Tait to replace him. It was Dr. Tait who had presented the final report to the previous day's meeting of Council.

The president called attention to the fact that the report itself had asked that, with the acceptance of the report, the committee be dismissed and a new one appointed in its place. Therefore, upon the acceptance of the report, Council had asked Dr. Tait to accept the chairmanship of the new committee. At the same time Council proposed that Messrs. Heartz and Stephens collaborate with Dr. Tait in selecting the personnel for the new committee.

Dr. Tait reviewed briefly the history of the activity of the committee. He stated that since the proposal which had been brought forward by Mr. Herbert Smith had been received, the idea of confederation had spread rapidly across the country.

Dr. Tait outlined the committee's activities which had culminated in the report presented to the annual meeting of Council. In his opinion real progress had been made. It would be the idea of the new committee to meet with the Dominion Council committee in an endeavour to arrive at a common understanding and a proposal for confederation between the provincial professional associations and the Engineering Institute.

Relations With Industry

Colonel Grant reported that at the students conference held the previous day, there had been some discussion as to the influence of the Institute on engineering education. He went on to explain that the American Society for Engineering Education had a "Relations with Industry Committee." The students conference had thought that such a committee set up by the Institute might be very useful. No action was taken at this meeting inasmuch as it was understood that a proposal from the students conference dealing with the subject was to be sent to Headquarters for Council's consideration.

Election of Officers

The general secretary presented the list of the newly elected officers of the Institute as follows:

G. W. Rayner, of Toronto, a member of the Engineering Institute for 35 years, greets the president-elect, R. E. Heartz of Montreal.

President

R. E. Heartz, Montreal Que.

Vice-Presidents

Western Provinces	R. M. Hardy, Edmonton, Alta.
Province of Ontario	M. A. Montgomery, Kitchener, Ont.
Province of Quebec	R. L. Dunsmore, Montreal, Que.

Councillors

Newfoundland Branch	G. R. Jack
Corner Brook Branch	H. B. Carter
Prince Edward Island Branch	E. K. MacNutt
Halifax Branch	G. F. Bennett
Amherst Branch	L. E. Burrill
Saint John Branch	A. G. Watt
Fredericton Branch	P. C. Levesque
Saguenay Branch	B. L. Davis
St. Maurice Valley Branch	E. T. Buchanan
Lower St. Lawrence Branch	L. P. Dancose
Eastern Townships Branch	G. J. Cote
Montreal Branch	W. H. Gauvin C. G. Kingsmill
Ottawa Branch	R. E. Hayes
Brockville Branch	H. B. Brewer
Kingston Branch	H. G. Conn
Belleville Branch	S. Sillitoe
Port Hope Branch	G. T. Hunter, Jr.
Toronto Branch	M. McMurray
London Branch	D. D. C. McGeachy
Border Cities Branch	W. R. Mitchell
Nipissing & Upper Ottawa Branch	G. L. Hood
Sudbury Branch	R. H. Moore
Lakehead Branch	G. S. Halter
Winnipeg Branch	C. V. Antenbring
Saskatchewan Branch	J. J. Schaeffer
Edmonton Branch	E. K. Cumming
Kootenay Branch	H. P. Hamilton
Central British Columbia Branch	M. L. Wade
Vancouver Branch	H. T. Libby
Vancouver Island Branch	W. A. Bowman
Yukon Branch	M. C. Sutherland-Brown

Dr. Stephens said that he derived a great deal of satisfaction, as did those in the audience, from the fine slate of officers that have been elected.

In referring to the incoming president he observed that there is work ahead of the Institute right now that compares in significance with that which was done in 1886 and 1887 in the organizing of the old Society, or as that done in 1918 when the name of the society was changed. He was very pleased that the man who was going to be in charge of Institute affairs for the coming year, with all these great responsibilities and opportunities ahead, was the man who had headed up the Committee on Confederation. He thought it was a good omen that the person who had done so much good work for the committee was now going to take over the increasing responsibilities of the presidency.

Dr. Stephens stated that not only was Dr. Heartz qualified by reason of the work which he had done on the Committee on Confederation but also by the years of service which he had rendered to the branch and the Institute through a great variety of posts. All these things qualify him eminently for the high office to which he had been elected.

Vote of Thanks to Retiring Officers

On the motion of J. B. Stirling, seconded by James A. Vance, it was unanimously resolved that a vote of thanks be extended to the retiring president and members of Council in appreciation of the work which they have done for the Institute during the past year.

Dr. Stirling said that beyond the words of the resolution he would like to refer particularly to the outstanding work done by the retiring president, Dr. Stephens. In his opinion only a past-president could appreciate the amount of work involved in the presidency. In spite of the fact that Dr. Stephens had taken on the presidency just at the time when the work of his employers was in great need of his attention, he had carried out his duties fully and to everyone's satisfaction.

Dr. Stirling said that also he would like to comment on the service to the Institute which had been given by the retiring vice-president, Dr. I. R. Tait. He observed that Dr. Tait's services had been most unusual and helpful. He served extra time as vice-president inasmuch as he was asked to finish out the second year of office for his predecessor who had taken on the presidency. Also he had given generously of his own time in all the affairs of the Institute.

Mr. Vance, as another past-president, supported fully everything that Dr. Stirling had said and he seconded the motion.

Dr. Heartz, in acknowledgment of the introduction from Dr. Stephens, expressed his appreciation of the honour which had been done him in selecting him for the presidency. He hoped to meet each person at the meeting and those who were not here he looked forward to seeing in his travels across the country.

The meeting adjourned at 11.30 a.m.

Branch Officers' and Students' Conferences

The Branch Officers' Conference for 1955 was held on Tuesday, May 10. Professor M. W. Huggins, chairman of the Toronto branch, acted as chairman of the conference, supported by L. F. Bresolin, secretary-treasurer of the Toronto branch, as secretary. In addition to the headquarters representation, thirty-seven members attended on behalf of twenty-four branches. The members of the conference form the subject of the cover illustration of the June *Journal*.

Among subjects discussed was that of the admission of science graduates to membership in the Institute. Opinion was sharply divided on this, and discussions were to continue.

It was moved, and carried, that $100.00 be sent by headquarters to an E.I.C. representative at each University, the use of the money to be left to the representative. A further motion, also carried, called for establishment of a headquarters' fund from which individual branches may apply for reimbursement of expense in the development of student activities, this to be available at all Universities giving engineering training.

There was considerable discussion on the subject of junior membership and the reasons for resignations. A motion recommending that there should be no time limit on junior membership was defeated.

Arising from discussion on how to interest more members in Institute affairs, it was agreed that a chart should be published annually showing, for all branch meetings, the speaker, subject, attendance, and whether refreshments were served; this would assist programme committees.

It was felt that many good papers given at branch meetings never reached the *Journal*. It was desirable that as many of these papers as possible be submitted to headquarters.

Students' Conference

The student conference met in the Royal York Hotel, Toronto, on May 10th, 1955, under the chairmanship of D. C. MacCallum; P. B. Walters, University of Toronto, acted as conference secretary. (A photograph of the conference including the representatives of the Federal civil service and the armed forces, appears on page 797 of the June *Journal*.)

Current conditions of employment were outlined by the representatives of the government and the Services. Government requirements for two hundred engineers, mainly in civil, electrical, mechanical and aeronautical engineering, and in engineering physics, had not yet been fully met. The Royal Canadian Navy needed marine engineers, who could be mechanical, civil or other engineers with additional special training; the building of new ships and other all-Canadian engineering developments were possible fields.

Electrical, mechanical, and civil engineers were still needed to complete the requirements for three hundred posts in the design and field branches of the Army's two corps of engineers. There was a great demand by the R.C.A.F. to fill positions in aeronautical and other engineering fields.

Dr. I. P. Macnab and R. L. Dunsmore, speaking of the requirements for engineers in industry, stressed that serious consideration was necessary before finally deciding on a job and that advancement depended on hard work.

Later discussion pointed out that the reputation of the engineering profession demands certain ethics of conduct, such as prompt replies by the graduate to all offers of employment; neither industry nor the graduate should think in terms of having the other at an advantage.

Resolutions

Resolutions called for the Institute to publish student news for six months of the academic year; to list available Institute sponsored grants and scholarships; and to make available to student branches a list of local practising engineers who could act as guidance councillors.

Other resolutions covered publication of pamphlets and application forms in both French and English; the possibility of the Institute helping students to get summer employment in sparsely-industrialized areas; the investigation of industry's opinion about university engineering council curricula; and the proposal that a student member be allowed to sit on all local branch executives.

Finally, a further effort should be made to have university students' fees made deductible from taxable incomes.

Delegates to the conference included the following:

Eskil Johnson, *University of British Columbia*
H. D. Atkins, *University of Alberta*
John Campbell, *University of Saskatchewan.*
D. W. Craik, *University of Manitoba*
Paul Walters, *University of Toronto*
B. R. Carter, *Royal Military College*
Andrew Blair, *Queen's University*
Michael Orlander, *McGill University*
Jean Roquet, *Ecole Polytechnique*
Jean Villeneuve, *Laval University*
George Keith, *University of New Brunswick*
Don J. Kawaja, *Nova Scotia Technical College*
R. B. Gair. *University of Manitoba (observer)*
Lt. Col. Henselwood, *Representing the Army*
Wg. Cmdr. Grant, *Representing the R.C.A.F.*
Cmdr. Sims, *Representing the R.C.N.*
V. M. Clarkson, *Personnel Selection Branch, Civil Service*

The complete minutes of the students' conference will be available for distribution, at a later date, through the university engineering societies.

At the President's Dinner, l. to r., Colonel H. G. Thompson, executive assistant to the general secretary, E.I.C.; R. L. Dobbin, past-president; Colonel L. F. Grant, past-president; T. H. Hogg, past-president; D. M. Stephens, president; C. R. Young, past-president; J. A. Vance, past-president; I. P. Macnab, past-president; and R. E. Heartz, president-elect.

Month To Month

JAN. FEB. MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Engineering Services for Export

On May 26 a meeting was held in the Sheraton-Mount Royal Hotel, Montreal, to discuss the possibilities of Canadian consulting engineers getting some share of the work that is required by foreign governments who will receive assistance through the International Bank for Reconstruction and Development.

The meeting was made to coincide with the annual meeting of the Canadian Manufacturers Association and was presided over by J. D. Ferguson, the immediate past-president of the C.M.A. The other organizations represented were the Engineering Institute of Canada, the Canadian Construction Association, the Federal Government and the International Bank.

Brian H. Colquhoun, M.E.I.C., the engineering adviser to the bank, was present to explain how the bank functions and how consulting engineering services are retained. The Federal Government departments were represented by Denis Harvey, director, Commodities Branch of the Department of Trade and Commerce; L. Rasminsky, deputy governor, Bank of Canada; R. C. Johnson, president, Defence Construction (1951) Limited.

Representing the Engineering Institute of Canada there were R. E. Heartz, the president, and L. Austin Wright, the general secretary. As well there were several heads of consulting engineering firms from different parts of Canada.

The result of the meeting was that it was agreed generally that many consulting engineering firms in Canada were fully competent to do work of the kind required in the countries that were working through the Colombo Plan and certain other countries in different parts of the world. There is a substantial volume of work of this kind and up to the present the Canadian firms have done very little of it.

The long process through which such work is secured was outlined by Mr. Colquhoun. Also it was stressed that there was a great variety of work required and that therefore there might well be opportunities for firms who specialize in different fields.

It was agreed that the Canadian Manufacturers Association, the Canadian Construction Association, and the Engineering Institute of Canada should set up an informal organization whereby information regarding these projects might be pooled and activities of the Canadian consulting engineers and manufacturers co-ordinated.

The meeting was arranged by the Canadian Manufacturers Association. It is hoped that their interest in these matters coupled with the interest of the engineers and the contractors will lead to some substantial development of business for Canadians.

Victory for the Engineers

The now famous case of Architects vs Engineers, in the City of Toronto, has been heard again, this time in the appeal court. Again the decision is in favour of the defendant, Messrs. A. D. Margison & Associates Limited, consulting professional engineers.

This case was referred to in an earlier issue of the *Journal* and has been given wide publicity in the press throughout Canada. It was a case of the Ontario Association of Architects accusing the engineering firm of "holding itself out as an architect". In the first trial the decision was favourable to the engineers but the architects appealed it.

On the 31st day of May, Judge I. M. Macdonell in the county court handed down his judgment. It is very clear, concise and comprehensive. Let us hope that it will settle this issue once and for all, at least as far as Ontario is concerned.

The exhibition of architects calling engineers in to the courts is not likely to enhance the reputation of either. This case has shown, as did

Cover Picture

The cover picture is a view of Ontario Hydro's J. Clark Keith Generating Station, Windsor, Ont., which was officially opened November 1951. This installation has a capacity of 354,000 h.p. and is typical of the equipment discussed in the article "Metallurgical Problems of Modern Steam Turbines and Alternators," Page 919 of this issue.

Ontario Hydro Photograph

a previous case in the Province of Quebec, that such charges are not effective in any way in denying to the engineer the privilege of competing for work for which he is particularly competent. And it should be kept in mind that, so far, there is no indication of an engineering association bringing an architect into court for infringement of their rights.

In the Quebec case, the architects were given the favourable decision, but it was so prescribed that it settled nothing for the future. The courts maintained that the decision settled only that one case, and that every other case would have to be tried separately on its merits. It is doubtful if there will be any more such cases in the Province of Quebec.

And now, this Ontario case has ended just as fruitlessly. The architects have won nothing and the engineers have lost nothing, except it may be that the architects, and perhaps the engineers as well, have lost some prestige in the eyes of the public. It is regrettable that one profession should put another profession in such an awkward position before the public. Let us hope it does not occur again. There is certainly nothing of any value to be gained.

Knowing that this case will be of wide interest, the *Journal* publishes herewith the full judgment of Judge I. M. Macdonell.

In the County Court of the County of York

Between:

REGINA EX REL.
JOHN DOUGLAS MILLER
—and—
A. D. MARGISON AND
ASSOCIATES, LIMITED.

Before

HIS HONOUR JUDGE I. M. MACDONELL

A. L. Fleming, Q.C.
— for the Complainant

J. J. Robinette, Q.C.
— for the Accused.

Reasons for Judgment

Macdonell J.

This is an appeal by the Complainant, who is Secretary of the Ontario Association of Architects, from the dismissal by Magistrate Elmore of the following charge:

> "A. D. Margison and Associates, Limited, of 30 Eglinton Avenue East, Toronto, a corporation, is charged that they did within a period of six months ending on the 11th day of January, in the year 1955, hold itself out as an architect, contrary to the provisions of Section 18 of the Architects Act, (1950) R.S.C. Chapter 21, as amended by Statutes of Ontario, (1953) Chapter 5".

At the outset I may say that I entirely concur with the Reasons for Judgment given by the learned Magistrate in the court below. However, in view of the fact that this is admittedly a test case having wide implications, I think it might be helpful if I express my reasons in somewhat greater detail.

The relevant provisions of the Architects Act, R.S.O. (1950) Chapter 21, as amended by the Architects Act (1953) Chapter 5, are as follows:

Section 18.

(1a) "Every corporation that applies to itself the term 'architect or 'architects' alone or in combination with any other other item or that holds itself out as an architect or as architects shall be guilty of an offence and the corporation or any director thereof, on summary conviction, shall be liable to a penalty of not less than $100 and not more than $500 for a first offence and to a penalty of not less than $200 and not more than $1,000, or to imprisonment for a term of not more than three months, or both, for any subsequent offence.

Subsection (2)

(2) Without restricting the generalty of subsections (1) and (1a), any person who or corporation that prepared or offers to prepare for a fee, commission or other remuneration any sketch, drawing or specification for any proposed building structure or for any structural alteration of or addition to an existing building structure, when such proposed work is to cost more than $10,000, shall be deemed to hold himself or itself out as an architect.

Subsection (3) Nothing in this Act shall prevent or be deemed to prevent,

(bb) any partnership, association of persons or corporation that is entitled to practise in its own name under THE PROFESSIONAL ENGINEERS ACT in accordance with the conditions therein prescribed, from performing architectural services in the course of any work undertaken or proposed to be undertaken by such partnership, association or corporation pursuant to such entitlement."

There is little dispute about the facts. It is admitted that the following advertisement was published in papers widely circulated in Ontario during October and November 1954, with the authority of the accused:—

PROFESSIONAL ENGINEERING
AND
ARCHITECTURAL SERVICES
for the complete design and supervision of
INDUSTRIAL AND COMMERCIAL
PROJECTS.
ARCHITECTURAL DESIGN—building layout, elevations, co-ordinated with:
ENGINEERING DESIGN—site investigations; site services and facilities; plant operational studies and layout; manufacturing processes; structural design; plumbing; drainage and fire protection; heating, ventilating and air conditioning; steam and electrical power, commmunications and illumination.

A. D. MARGISON
and ASSOCIATES
Limited.
30 Eglinton Avenue East
Toronto

CONSULTING PROFESSIONAL ENGINEERS
INVESTIGATIONS, REPORTS, DESIGN, SUPERVISION.

In addition, an investigator, in November, 1954, went to the offices of the accused and interviewed one Keith with regard to the employment of the accused in connection with the erection of an office building to cost between $750,000 and $1,000,000 — "something like the Federal Building." It is conceded that such a building would have to be constructed of steel or reinforced concrete. Keith assured the investigator that all services in connection with the building would be performed by the accused and that it would not be necessary to employ an Architect, and he stated that he himself was an Architect. But he made clear that while the accused had Architects in its employ, they were primarily Consulting Engineers.

It is established that the accused and its predecessors are registered under the Professional Engineers Act, and have been practicing as at present for over a quarter of a century; a senior associate is one of the outstanding structural engineers in Canada. They have an architectural department consisting of Keith and three others all qualified

to practice under the Architects Act.

Evidence was also given by experts which made it clear that while the two professions of Architect and Professional Engineer overlap to a great extent, there are services which each is particularly qualified to perform. For example, an Architect's training in architectural design, involving pleasing appearance both inside and outside a building, is peculiar to his profession. The overlapping is demonstrated by the fact that it is usual for firms of Professional Enginers, such as the accused, to employ Architects, and conversely for firms of Architects to employ Professional Engineers qualified to practice.

I find the evidence discloses that the accused held itself out as Consulting Professional Engineers, willing and able to do architectural work in the construction of an office building. I have no doubt that this involves an offence under Subsection (1a) and (2) quoted above. It is, however, more difficult to decide whether the actions of the accused were an exception permitted by Subsection (3) (bb).

On behalf of the Appellant it was argued most persuasively that the Architect was "the owner's man who took full responsibility for planning." While it was conceded that an Engineer could look after the construction of some factories or similar structures, it was contended that the right to deal with the client and solve his problems should be restricted to Architects, and that this was what the accused had held itself out as able and willing to do.

Mr. Robinette, on the other hand, argued that all the accused had done was to hold itself out as able to do architectural work in connection with an engineering undertaking, and that this is covered by the exception.

I think it is significant that there is no definition of "architecture" in the Act, whereas the definition of "professional engineering" contained in the Professional Engineers Act, R.S.O. (1950), Chapter 292, is wide indeed and covers "steel, concrete and reinforced concrete structures." Also, it should be pointed out that there is an exception simliar to Subsections 3 (bb) above in the Professional Engineers Act, which allows Architects to perform engineering work in connection with their undertakings, which reads as follows:

"2. Nothing in this Act shall prevent or be deemed to prevent,

(a) . . . . .

(b) any member or licensee of the Ontario Association of Architects under The Architects Act or any employee of such member or licensee acting under the direction and responsibility of such member or licensee from performing professional engineering services in the course of any work undertaken or proposed to be undertaken by such member or licensee as an architect."

I cannot but think that it was the intention of the legislation to give reciprocal privileges, at least to the extent necessary to cover the facts disclosed, and that it is up to a client to weigh the qualifications of firms of Architects and Enginers and decide which he wishes to employ, or indeed if he wishes to employ both, which is a common practice. Mr. Flemming contended that it is possible to decide whether a job is essentially one for an Architect or one for an Engineer. I can find nothing in the words of the legislation which enables the court to draw such a line between the two professions, and I do not think that the court should endeavour to do so until the Legislature passes appropriate provisions.

For these reasons, I conclude that the accused held itself out as able to perform architectural services in the course of a work undertaken by it as an engineering firm, and that this is authorized by Section 18 (3) (bb) above.

The appeal should therefore be dismissed, with costs if demanded.

DATED AT TORONTO THIS 31st DAY OF MAY, 1955.

Signed

I. M. MACDONELL.

Who Said Civil?

Even after all these years, one occasionally hears the remark that the Engineering Institute is a civil organization. Persons who say this are never able to prove the statement and in fact are never able to quote anything even to support it. At times they say the same thing about *The Engineering Journal* suggesting that it is a civil publication.

Fortunately, not too many people think this way. However in case any members of the Institute are faced with a statement of this kind, here is some information that may be of help to them. (a) As near as can be figured, the civil engineers within the Institute membership constitute twenty-five percent of the total. (b) Papers published in *The Engineering Journal* in 1954 were classified as follows: Chemical 4 — Civil 19 — Mechanical 19 — Electrical 12 — Miscellaneous 16. In other words, twenty-seven percent of the papers which appeared last year in *The Engineering Journal* were of a civil nature.

There was a time when this organization was known as The Canadian Society of Civil Engineers. At that time the word "civil" meant all engineers other than military, and therefore quite rightly the organization was known as a civil engineering society. When the word "civil" acquired a more specialized meaning the society changed its name to the Engineering Institute of Canada.

There can be no doubt but that in a new country like Canada it is essential that the engineers band themselves together in one organization rather than divide themselves into groups representing their specialization. Even in those countries where the specialized societies have great support, it is suggested by many of them that they would be better off if they had one overall organization that could represent them all, with technical divisions to represent the branches or specialties. There is no doubt that in Canada we are very fortunate in having one organization which works for all members of the profession regardless of their specialized interests.

It may come as a surprise to many to realize that Canada is not alone in such matters. Similar types of organizations are set up in Australia, New Zealand, India and Rhodesia. They function there with the same success that the Engineering Institute of Canada functions in Canada.

The Engineering Institute is not a civil engineering society and never has been, within the modern meaning of that word. It is a constant objective to balance the interests and activities between all the branches of the profession. The record of *The Engineering Journal* is clear proof of the realization of the objective.

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

Progress by Ontario Hydro

The final steel cell was driven into place to seal off the north channel of the St. Lawrence near Cornwall, on May 18th, Ontario Hydro has announced. A 4,200-foot long steel cell cofferdam now completely spans the river from Barnhart Island to the Canadian mainland.

These steel cells for the cofferdam were built out into the river from both the Canadian shore and the Barnhart Island side by Mannix-Raymond of Montreal, and met almost in the centre of the channel. This temporary dam blocks off the downstream channel area, which, together with an upstream cofferdam, built last winter, will seal off the north channel and permit de-watering in this sector. A start will be made late in June on pumping the 650 million gallons of water from the area within the cofferdam, using four electrically driven pumps, each with a capacity of 20 thousand gallons per minute, and 36 inch discharge pipes. This will enable excavation in the river bed to commence for the new powerhouse. Tender bids for the Canadian half of the powerhouse structure are now in, and awarding of the contract will be announced soon.

Some 1,250,000 tons of crushed rock and 700,000 tons of manufactured sand will be removed during the next three years from a large quarry northwest of Cornwall. This material will be used as concrete aggregate for the Ontario Hydro half of the international powerhouse, headworks and complementary works.

The contractor has commenced erecting buildings and crusher machinery, and stripping of over-burden has started to enable quarrying operations to begin. Delivery of the first aggregate is scheduled for September.

Work has started on the erection of the new St. Lawrence Transformer Station, which will eventually distribute power from the Canadian half of the powerhouse, replacing the present Cornwall T.S. Located two miles north of the Power site it is scheduled to be in service by April, 1956, and fully completed in 1958. It will have an initial capacity of 230,000 kva.

By June of 1956 the Commission will start feeding power into the new St. Lawrence T.S. from Toronto, to meet increased demands in eastern Ontario. When St. Lawrence power is available, this link will help to integrate power from the new generating station into Hydro's system.

The station will be composed of ten permanent buildings of steel, concrete and brick on the site, including a control building, relay, oil, compressed air, and service buildings; 36 circuits will feed in and out of the station. There will be four banks of 230/115 kv. transformers, each with a capacity of 115,000 kva., and eight banks of 115/44 kv. transformers, each with a capacity of 25,000 kva. The station will also have thirty 230 kv. circuit-breakers, thirty-five 115 kv. circuit-breakers, and twenty 44 kv. circuit-breakers.

A new 30-bed hospital will be opened in June by the Commission to provide "on the job" medical and surgical treatment for construction workers and staff members. Located about two miles west of Cornwall, the two-storey frame building with single-storey wings will be staffed and equipped to handle most accidental injuries and illness cases. The Hydro Hospital will help to relieve the load on the local facilities imposed by the influx into the area of a large number of workers.

Brown Boveri (Canada) Ltd., has been awarded a contract for switchgear for switching and control of power from the 16 generators in the Canadian Powerhouse, at a price of $345,000, the lowest of four tenders, while the Canadian Westinghouse Company has been awarded a contract for thirteen 60 cycle power transformers at a price of approximately $1,250,000.

Contracts have been awarded for subgrade, structures and other work associated with the relocation of 40 miles of CNR double track main line between Cornwall and Cardinal, to Sir Robert McAlpine Canada Ltd., C. A. Pitts General Contractor Ltd., and Iroquois Constructors Limited, all of Toronto. The total value amounts to $3,100,000 and each firm will build some 13 miles of roadbed.

Award of the contract for the Cornwall Dykes went to Atlas Construction Co. of Montreal at a price of $3,330,000, bringing to more than $39 million the total value of contracts let to date by Ontario Hydro.

Progress by Canada's Seaway Authority

A contract for excavation and dykes in the Lachine Section between the Jacques Cartier Bridge and the entrance to Montreal Harbour, has been awarded to Miron & Frères Limited, the second lowest of seven bidders, at $1,769,000. The work involves some 2 million cubic yards of material, 500,000 of which are rock, over a distance of one mile. Completion is called for November 30, 1957.

A. Janin & Compagnie Ltée., have been awarded a contract for a temporary water supply system for the municipalities of Longueuil and Jacques Cartier. This work, costing some $60,000, will provide clear water and prevent service interruptions during channel construction.

Tenders for some seven miles of channel construction in the Lachine Section above the Victoria Bridge and opposite Laprairie, involving some 3 million yards of rock and over 7 million yards of earth, were opened on June 21st. An award has not yet been made. Completion is called for December 1957.

Tenders will be invited in June for a seven-storey building (illus.) to serve as permanent headquarters of the St. Lawrence Seaway Authority. It will be erected at the corner of Pitt and Second Streets in Cornwall.

The Canada-United States Committees, set up during the meeting of Seaway Authority officials in Washington last March to discuss shipping toll rates, convened in Montreal on June 16th for their

first meeting. Following this, they continued discussions in Ottawa. This meeting consisted mainly of exchanges of information and ideas, with discussions of considerations affecting determination of the rate base for tolls, and procedure for future meetings. No date was fixed for future meetings.

Progress by USSDC

Up to the end of May, the United States Seaway Development Corporation had awarded contracts as follow:

For excavation of 3.8 million yards of earth at the upstream end of the Long Sault Canal, to the Badgett Mine Stripping Corp., at $1,372,800.

For 2.6 million yards of earth excavation at Robinson Bay Lock to Jack and Jim Maser Corp., at $990,900.

For 3.1 million yards of earth excavation and one dyke at the Grass River Lock on Long Sault Canal to Dutcher Construction Corp. at $2,197,843.

For excavation of 12 million yards of earth for the Long Sault Canal and 3 million yards of embankments, to Morrison Knudsen-Peter Kiewit Sons Co., at $6,276,-535.

With the awards of further contracts for 60,000 yards of rock dredging in the Thousand Island Section, and for dredging and Canal excavation in the Cornwall Island South Channel comprising some three million yards of earth excavation, for which tenders will be advertised in June and September respectively, more than 85 per cent of the excavation authorized by the USSDC will have been awarded.

Progress by NYSPA

The contract for construction of the United States portion of the Iroquois Dam has been awarded to Jones Construction Co. of Charlotte and C. H. Tompkins of Washington, D.C., at $18,019,600, the lowest of three tenders, highest of which was $20,139,100.

On May 27th the New York State Power Authority approved a contract for the sale of power to the Aluminum Company of America. It will be transmitted to the Governor, who has sixty days in which to act. The Authority also adopted a resolution providing for continued use of the river front by upland property owners, where reasonable settlement can be made and where public lands are not involved.

Seaway Part of Vast Inland Waterway Network

Lewis G. Castle, Administrator, U.S. St. Lawrence Seaway Development Corporation, in an address on May 5th to the St. Lawrence Valley Association of Chambers of Commerce at Watertown, N.Y., drew attention to the Seaway's place within the vast network of waterways, which included the Calumet Sag Channel to be commenced next year, connecting it with the Illinois River Waterway, thence with the entire Mississippi Valley System, which in turn connects with the 1100-mile Gulf Intracoastal Waterway. Thus a great trunk line of water navigation from the Mexican border and Florida would reach up through the centre of the continent as far as the Appalachians and up the Missouri almost to the Rockies.

He foresaw a major reorientation of the nations' business geography. In place of the main currents of commerce following east-west rail lines, northern states hitherto left in the backwaters of trade would find themselves squarely in the main current. Since prewar, he said, the proportion of ton mileage traffic carried by water had risen from 2 per cent, to 17 per cent in 1953, and was still accelerating.

But, he cautioned, the investment of nearly a billion dollars in construction in the St. Lawrence Valley was bound to cause some kind of a business boom and distortion. Unless at the end of the construction period new industries were ready to take up the payrolls in equivalent amount, a business let-down might follow. But these adjustments would be short range. He expressed no doubt that in the long run the permanant build-up of the region would far outreach the temporary boom of the construction period.

Seaway Authority President Speaks at Copenhagen

The Hon. Lionel Chevrier, President of Canada's Seaway Authority, addressing the Baltic and International Maritime Conference at Copenhagen on May 20th, 1955, predicted the Seaway would not only expedite the whole shipping process, but would also decrease the total shipping cost at Montreal or other ocean ports. Shipments of Labrador ore without transhipment would assist substantially in developing a market for the minimum basic production of 10 million tons annually.

"It is anticipated that grain, iron ore, coal and coke, petroleum

Headquarters of Seaway Authority (Architects Drawing).

and forestry products—possibly 85 per cent of the immediate Seaway tonnage potential—will continue to be carried by North America's inland fleet, augmented as required throughout the Seaway itself," he said. Both Canada and the United States place restrictions upon internal coastal trade which limits the scope of foreign carriers."

"A second limiting feature is that much of the traffic is carried in captive fleets, a policy that may be extended to the movement of ore. Finally, there is the fact that the laker fleet, built to carry maximum bulk cargoes in inland waters, provides such services with a high degree of efficiency."

"Even where large bulk cargoes are directly consigned to overseas markets," said Mr. Chevrier, "it appears these cargoes are more likely to utilize laker capacity to Montreal and other down-river ports and then trans-ship for ocean movement. It is further expected that ample back-haul capacity will be available in the laker grain and iron ore fleets, to permit effective competition for local bulk traffic."

In contrast to this type of traffic, there would be the movement of cargoes of both a bulk and general merchandise nature primarily associated with trade between the industrial districts surrounding the Seaway system and overseas areas, Mr. Chevrier explained. While initial volumes of such cargoes may be small relative to internal bulk movements, "there is reason to believe the present volume of this traffic will more than treble in the years immediately following completion of the Seaway," he said.

Pioneered in 1933 and re-established in 1945, this Great Lakes-Overseas trade has since expanded at a phenomenal rate. By 1954 the total volume exceeded 780,000 tons and involved fourteen shipping lines and 120 vessels. "It is worth noting," said Mr. Chevrier, "that the number of shipping lines involved doubled between 1952 and 1954, despite the handicaps of the existing fourteen-foot canals". This trade could be expanded some 25 times its current level without exceeding the tonnage of similar traffic now handled by ports in comparable coastal districts.

Whether this traffic is to be transhipped at the principal ports of the St. Lawrence, or to move directly by ocean vessels, depends upon the relative costs of transportation at the time the movement takes place, said Mr. Chevrier. This trade, however, "appears to offer the most attractive future for ocean going vessels."

While Canadian and American participation in this traffic is currently small and may be expected to increase with the completion of the Seaway, subject to trade conditions, traffic patterns, and the like, he pointed out, there appeared to be ample scope for other world-wide shipping interests of all types.

Opportunity Knocks for Seaway Ports

Speaking again at Hamilton, Ontario, on June 10, at the formal opening of the Hamilton Harbor Commission Administration Building, Mr. Chevrier pointed out that all ports on the Seaway must look for an expansion of all classes of trade, which offered tremendous opportunities for expansion.

"Our ports will not want to neglect these internal trade movements. The Great Lakes Overseas trade is relatively new and deserves more than passing attention because of its potentials." Discontinued during World War II, it was re-established in 1945 and has since expanded at a phenomenal rate. By 1954, the total volume exceeded 780,000 tons and involved fourteen shipping lines and 120 vessels.

"It has been estimated that this trade could be expanded 25 times its current level. It is one of the most interesting facets of the Seaway traffic potential. Ports located on the Seaway route should take a good look at this trade," he stated.

Free Port Status for Montreal?

Last winter R. P. Jellett, Chairman of the Montreal Economic Council, told the Montreal Board of Trade that a centre "island" or wharf just below St. Helen's Island in Montreal Harbor should be established to provide modern harbour facilities for a "free port." At such a free port, manufacturing industries would receive raw materials duty-free from abroad for conversion into finished goods, which would again not be subject to duty on reshipment to destinations outside of Canada.

Eight years ago the idea of a free port for Montreal was submitted to Ottawa authorities, but was turned down at Cabinet level. Refusal was on the grounds that Canada's existing bonded warehous facilities already provided many o the advantages of a free port, an offered importers and exporter advantages comparable to thos offered by a foreign trade zone.

Mayor Jean Drapeau of Mont real, has recently given support fo the idea. "The Port is the City' number one economic problem", h said, "and first consideratio should be given to the harbour. A free port would assure that cargoe would be unloaded, left in bond and later reloaded. This would en sure a large measure of employ ment that the city would lose i shipping were to by-pass Montrea and proceed to Toronto or eve further west." But, he added, suc a project would probably be im possible without the full suppor of the National Harbours Board.

Other Matters Relating to Seaway

The province of Manitoba ha engaged Dr. Harold Mayer an Dr. Ezra Solomon, of the Univers ity of Chicago, to make a thorough study of how the Seaway will af fect the province. Dr. Mayer is a authority on Great Lakes Shipping and played an important part i development of the Chicago por plan. Dr. Solomon is associate pro fessor of the School of Economics where he specializes in busines economics. The consultants wil initially assist in preparation o Manitoba's Brief to the Roya Commission on Coastal Trade.

A Bill has been introduced i Congress asking the President t have the International Joint Com mission make a study of the feasi bility of extending the Seaway t the Hudson river by way of the Richelieu River and Lake Cham plain. This route, it is claimed would lessen the water distance between the Great Lakes and the Port of New York by 1500 miles The New York and Vermont Legis latures have endorsed the idea.

A suggestion recently appeare in the Windsor Star (Ontario) that, before flooding of areas abov Cornwall occurs in 1958, the top soil should be scraped off an saved from the many farms to b flooded. In a similar smaller pro ject in Austria, this had been suc cessfully done. A few inches adde to the shallow soil farms not fa from the St. Lawrence could thu be saved at reasonable cost an used to great advantage.

L. F. Grant Honoured by A.S.M.E.

The American Society of Mechanical Engineers, having selected Lt.-Col. L. F. Grant, Hon. M.E.I.C., as the recipient of a special medal marking the Society's 75th Anniversary, took the occasion of the E.I.C. annual banquet to make the presentation. Thompson Chandler, vice-president, expressed the appreciation of A.S.M.E. to Colonel Grant, the field secretary and a past president of the Institute, and president of the Engineer's Council for Professional Development. Mr. Chandler spoke as follows:

President Morgan of The American Society of Mechanical Engineers has asked me to express his regret that an extended Society trip to the Pacific Coast, made it impossible to be present this evening and perform this pleasant duty. It is a privilege for me to be here to enjoy your good fellowship and an honour to serve for President Morgan on this occasion.

This year, The American Society of Mechanical Engineers is celebrating its 75th Anniversary in a series of events designed to dramatize the "Engineer in Our World." Our celebration is extending throughout the year, throughout U.S.A., in Copenhagen, in Brazil and here tonight in Toronto. The Engineering Institute of Canada has honored our Society by permitting this important element of our celebration to be carried on here. For that courtesy we are grateful.

During our year of celebration, we deem it our duty to recognize the great services rendered to the Society and the profession by leaders from outside our borders particularly those who have successfully headed joint engineering agencies. Tonight, it is my pleasure to bring a special tribute to one who has worked valiantly for the engineering profession on our continent.

I refer to Colonel Leroy Fraser Grant, your representative for six years on Engineers Council for Professional Development and now serving his third year as President of that body. In his work on ECPD his qualities of intelligent devotion and farseeing leadership have endeared him to all who have worked with him. He headed with distinction two ECPD delegations to educational conferences in Europe.

You know of Colonel Grant's successful career in engineering, in education and in the military service. Your Society, the Engineering Institute of Canada, recognized his qualities by selecting him as president and by making him an honorary member. The Institute with wisdom and forethought selected him as one able to make a great contribution to the work of ECPD and further provided the opportunity for him to participate. It is fitting therefore, that this recognition be given to him here.

One of the unique characteristics of the relations between our two nations is the manner in which we share our feelings for great leaders in both nations. We want you to know that we share your affection and respect for Colonel Grant.

Accordingly it is a great honor and a distinct pleasure on behalf of the Council and members of The American Society of Mechanical Engineers to bestow a special 75th Anniversary Medal and Certificate on Leroy Fraser Grant "in appreciation of his friendly co-operation and in recognition of his devoted service and outstanding leadership in the Engineers' Council for Professional Development and as its President".

Lt.-Col. L. F. Grant, Hon. M.E.I.C.

Athlone Fellowships—1955

Thirty-eight Canadian engineering graduates will go to Britain soon to carry on their studies under the Athlone Fellowship program.

Twenty-eight of these young men (Group A) are graduates of this year's engineering classes across Canada, and ten are recent graduates (Group B) who have spent some time in Canadian industry.

The coveted Athlone Fellowships provide two years' training in British universities and in industry, with emphasis on work in special fields of interest selected by the trainee. The experience and training sought by this year's Fellows is impressive in its scope, and will surely be of value in turn to Canada when these men resume or find their places in our industries and universities. But more important is the opportunity to live and work among the British people and to assimilate impressions and exchange ideas. The program has from the beginning been successful in promoting good relations between the two countries.

This year, as always, the list of Fellows contains student or junior members of the Institute, and to these the Institute offers special congratulations. A complete list of the winners and of their universities is as follows:

Group A

R. A. Bennett, S.E.I.C., mechanical engineering, Nova Scotia Technical College; J. E. Campbell, S.E.I.C., civil engineering, Nova Scotia Technical College, J. R. Dean, S.E.I.C., mechanical engineering, University of New Brunswick; G. T. Small, S.E.I.C., civil engineering, University of New Brunswick; A. H. Marquis, engineering metallurgy, Laval University; J. J. Pare, S.E.I.C., civil engineering, Laval University; L. Amyot, mechanical-electrical engineering, Ecole Polytechnique; R. LaBonte, S.E.I.C., civil engineering, Ecole Polytechnique; W. F. Hayes, S.E.I.C., mechanical engineering (design), McGill University; G. McK. Ross, S.E.I.C., electrical engineering (communications), McGill University; P. P. Webb, S.E.I.C., engineering (physics), McGill University; E. R. Cornell, S.E.I.C., mechanical engi-

neering, Queen's University; P. W. McLellan, chemical engineering, Queen's University; H. E. Tuisku, S.E.I.C., mechanical engineering (science), Queen's University.

J. B. French, chemical engineering, University of Toronto; R. K. Ham, engineering physics, physical metallurgy, University of Toronto; J. V. Hanson, electrical engineering (communications), University of Toronto; J. R. Weir, S.E.I.C., engineering and business, University of Toronto; R. W. Simpson, aeronautical engineering, University of Toronto; K. Peaker, S.E.I.C., civil engineering, University of Manitoba; G. E. Sims, S.E.I.C., mechanical engineering, University of Manitoba; P. Langeman, S.E.I.C., civil engineering, University of Saskatchewan; D. H. Shields, S.E.I.C., civil engineering, University of Saskatchewan; D. J. Marsden, S.E.I.C., engineering, physics, University of Alberta; R. R. Affleck, chemical engineering, applied science, University of British Columbia; W. Dietiker, S.E.I.C., electrical engineering, University of British Columbia; D. A. Guthrie, chemical engineering, University of British Columbia, Vancouver; A. E. Wright, civil engineering, University of British Columbia.

Group B

F. H. Sutcliffe, JR.E.I.C., civil engineering, B.ENG., McGill University, 1953; J. Vilagos, S.E.I.C., mechanical engineering, B.ENG., McGill University, 1954; P. D. Burke, engineering and business, B.A.SC., University of Toronto, 1952; S. G. Harris, engineering metallurgy, M.A.SC., University of Toronto, 1954; D. C. Lowe, S.E.I.C., engineering and business, B.A.SC., University of Toronto, 1954; A. B. Bjornsson, S.E.I.C., civil engineering, B.SC., (Eng.) (Civil), University of Manitoba, 1954; L. G. Soderman, civil engineering, soil mechanics, B.SC., C.E., University of Manitoba; R. M. Fraser, electrical engineering, University of British Columbia, Vancouver, 1953; H. N. Halton, JR.E.I.C., mechanical engineering, B.A.SC., University of British Columbia, 1951; P. Price, mechanical engineering, aeronautical engineering, B.SC., M.SC., AE.E., California Institute of Technology, Stanford University.

Aviation Writers Meet in Canada

For the first time in its history the Aviation Writers Association met in Canada from May 30 to June 4. The King Edward Hotel at Toronto was the headquarters but the activities were spread all the way from there to Montreal.

The program included many interesting technical sessions, visits to industry, and demonstration flights. It finished with a great flourish with the International Air Show on Saturday afternoon and the dinner tendered by the City of Toronto on Saturday evening.

Each morning the program opened with an eight o'clock breakfast, after which there was a speaker, a technical discussion or a business meeting. During the mornings and afternoons there were several panel discussions or as they were called in this instance "forums".

The one exception to the eight o'clock breakfast routine was on Wednesday, June 1, when the entire party were flown from Toronto to the St. Hubert Airport at Montreal, where they witnessed a flying display, and the tour of the air defence command headquarters which included an exhibition of Arctic survival equipment. The program concluded with an address from Air Marshal C. R. Slemon, Chief of the Air Staff. The planes left St. Hubert at four fifteen and the party arrived in Toronto in time for a reception and buffet supper at the Toronto Flying Club, Malton Airport, sponsored by Canadian Pacific Airlines. This day's program was known as "Air Defence Day".

Thursday, June 2, was "Trade Fair and Northern Flying Day". This involved a bus trip to the Trade Fair and a tour of aircraft exhibits.

At noon the party drove to the Downsview Airport where luncheon was served in the de Haviland cafeteria. The program here included an inspection of special displays, an airshow put on by de Haviland and the Ontario Lands and Forest planes and a cocktail hour in the cafeteria before departure for the hotel. The day finished up with dinner at the hotel. This was the occasion on which AVM Plant made his now famous speech. It was unfortunate that so many people who did not hear the speech should have misinterpreted it, and that as a consequence he should have been censured so drastically. It was a good speech—perhaps the best of the meeting.

Friday, June 3 was "Air Transportation Day", and for this portion of the program the A.W.A. were joined by journalists from fifteen member countries of NATO. After breakfast, Jack Dyment, M.E.I.C., director of engineering, T.C.A., spoke for about fifteen minutes explaining why T.C.A. had gone in for Viscounts. This was followed by a most interesting question period. (More about this later.)

The business meeting of the Association followed this question and answer period. It turned out to be a most interesting affair with wide differences of opinion with regard to certain proposals to change the by-laws.

After the business meeting, buses drove the party to the Malton Airport where demonstration flights were given by the T.C.A. on the Viscount. Several parties were taken over and around Niagara Falls and back over the City of Toronto returning to the airport in about one hour's time. It gave an excellent demonstration of the merits of the new type of plane. Canadians are fortunate to have this class of equipment made available to them before it goes to any other country this side of the water.

After the flight demonstration alternatives were offered to everyone. Some chose to see more of the Toronto made planes such as the Chipmunk and the Beaver. Other groups went through the A. V. Roe plant and still others took in the plant of Orenda Engines Limited. All in all these alternatives made a very busy afternoon and the group did not get back to the hotel until almost dinner time.

The speaker for the dinner was the Honorable Mr. Campney, Minister of National Defence. His talk dealt largely with his own experiences as a flyer during the first war and Canada's development of an air force and an aircraft industry. Unfortunately the speech was slanted towards a Canadian audience. Apparently Mr. Campney had not been informed that the audience was predominantly from the United States. The speaker was followed by quite an elaborate program of entertainment supplied by local Toronto artists well known in radio and television.

Saturday was "International Aviation Day". This started off with the usual eight o'clock breakfast which was followed by a fifteen minute talk from Gerhard Neumann, general manager, General Electric's Jet Engine Department at Cincinnati, Ohio. His subject was "A New Look at Engine Development". It was a very interesting fifteen minutes but unfortunately there was not enough time at its conclusion to permit of the usual questioning from the audience. (More about this later.

From the hotel, the group was "bused" to the International Fair

at the exhibition grounds. One of the most interesting features of the whole program took place here during the morning. It was a panel discussion on the subject "The Next Twenty Years in International Aviation". The members of the panel who participated were Moderator Ralph Platt, of the Clevelands *News* and the participants were Dr. Edward Warner of Montreal, president of the council of International Civil Aviation Organization; Sydney G. Cooper, public information officer, International Civil Aviation Organization; J. T. Dyment, M.E.I.C., director of engineering, Trans Canada Air Lines; John Bellringer, Technical Secretariat, International Transport Association, and S. Ralph Cohen, public relations officer, International Air Transport Association.

It is too bad that no verbatim record was kept of this discussion because there were a lot of interesting questions and more interesting answers. Certain notes have been made by this observer and will be commented on after the chronological development of the program in this article has been completed.

Luncheon was held in the Motor Building with the Avro Aircraft Limited as hosts.

Then sharply at 2 p.m. developed the big feature of the whole program, namely the Canadian International Air Show. A special section in the grandstand was reserved for the A.W.A. delegates where every detail of the show could be seen with maximum ease and comfort.

The weather was perfect. There were enough white clouds to give the background for the aerobatics and yet they were hardly thick enough to obscure the sun. Every detail of the various planes' activities could be kept in sight with little or no difficulty.

From the exhibition grounds the delegates returned to their hotels and eventually all appeared at the Royal York Hotel where a reception and dinner were tendered by the City of Toronto with the mayor, His Worship Nathan Phillips, presiding.

Sunday, June 5, was "departure day". This started off as usual with an eight o'cloek breakfast but by nine fifteen buses were leaving for the Malton Airport where planes flew off in many directions to get the delegates back to their homes.

From a Canadian's point of view the meeting was a great success and it is hoped that the visitors from the United States, and other countries as well, were as equally pleased with the program and the arrangements made by the local committee. It was a heavy program, taking in every day from early morning to late at night but after all, the A.W.A. is a working organization and every one in attendance was busy gathering material as a basis for reports and articles in his or her publication. It is not likely that the meeting will be back in Canada for a long time, but it is nice to know that Canada has been so honoured and that we may look forward to a similar occasion in the future even if not in the near future.

The chairman of the Convention Committee was Mr. Ross Wilmot of the Hunting Associates, Toronto. He was re-elected as vice-president of A.W.A. during the business meeting.

The program was in charge of A. F. MacDonald, de Haviland Aircraft, Ron Williams of A. V. Roe (Canada), along with the chairman of the convention committee, Ross Wilmot.

In addition there were committees in charge of the ladies' program, transportation, sponsorship, entertainment and accommodation, promotion and publicity. To all of these hard-working gentlemen much credit is due.

The report of this meeting will be concluded in the August issue with articles on "T.C.A. Viscounts", "International Air Show", and "Where Do We Go in the Next Twenty Years?"

Future of The Columbia River Watershed

Among recent arrivals on the editor's desk is a copy of a paper produced for the Water Resources Development Committee of the Trail, B.C., Chamber of Commerce by A. C. Ridgers, M.E.I.C., of the Consolidated Mining and Smelting Co., Ltd. It is entitled "Proposed Developments Relating to the Columbia River Watershed", and the author is to be commended for the clear and useful way his information has been collected and presented. It is obvious that there is much more on the subject now available for ready reference than there was prior to publication of his paper.

The *Journal* is aware of the nature of the controversy that has been going on for some time between the various interested governments and other agencies over the future development of this great power and water source. The fact that the arguments have become bitter at times simply points up their vital importance — to the territory involved, and to Canadian welfare as a whole. We feel beyond any reasonable doubt that the proper course to follow in the solution of this problem is to await the recommendations of the International Joint Commission, now engaged under the Columbia Reference in carrying out essential surveys on which the right answer will depend. Recent history of the activities of the Joint Commission provides us with ample evidence of their competence and their ability to succeed in untangling some pretty knotty international problems affecting our two nations. The *Journal* hopes, and prays, that the parties involved in this Columbia Watershed wrangle will have the patience and wisdom to leave the apple-cart upright until the work of gathering the facts has been finished, and time has been allowed for their proper assessment. It has come to be expected that the United States and Canada will do business in that manner.

We believe that copies of Mr. Ridgers' paper can be obtained from the Trail Chamber of Commerce, if readers desire to pursue the subject in detail. Simply to indicate the lines taken in its discussion, the "conclusion" of the paper is quoted hereunder, in part. It should be clearly understood that these opinions are not necessarily shared or endorsed by the Engineering Institute of Canada at this time.

"6. CONCLUSION.

Very little engineering data has been released by the authorities in connection with the several proposed developments that we have just finished reviewing. Our observations and conclusions are based in the main on newspaper and magazine reports of statements by Government leaders, publicity releases by Kaiser, and just plain

hearsay. However, within the limits of the information that we have access to, a run down of our foregoing discussions plainly reveals one or two conclusions that can be set down here:

A. To build a dam at Castlegar at this time that would be under foreign control would not be in the best interests of Canada.

B. One thing which we should keep well in mind is the fact that the Kaiser Dam and export of electric power from this area are now both on exactly the same footing; both have been vetoed by the Dominion Government, if only temporarily. And at this distance from Ottawa, the veto on sale of power would appear to stand the better chance of repeal.

Much has been said and inferred, in current discussions, on the subject of maintaining friendly relations with our great neighbour and not playing dog - in - the - manger with our water. Every right thinking Canadian will cordially endorse that sentiment and would gladly help our friends get additional power provided such action did not harm Canadian interests.

If it is power, and only electrical power, that Kaiser is interested in getting, why not sell it to him. We have it. Government spokesmen make no secret of the fact that there is surplus power both at the coast and at Waneta, waiting to be fed into the Northwest grid; perhaps immediate supply is not enough for Kaiser's requirements but, by adding two more generators at Waneta, more than enough would be available within two years, instead of the three years required to put Kaiser's damming scheme into effect.

If we eliminate the Kaiser Dam from our thinking, the following steps in early development of the Columbia appear to fall naturally into place:

Step 1. Build tie line connecting Cominco with Northwest grid.

Step 2. Finish installation at Waneta No. 1 Plant.

Step 3. Mica Creek, initially for flood control purposes.

Step 4. Libby Dam, initially for flood control purposes.

Step 5. Murphy Creek.

Steps 3 and 4 of this program would provide potential resources that would enable us to add generator capacity to our system as demand for power grew.

As already intimated, the above conclusions A and B, are based only on very limited technical information and are set down here merely as food for thought; they are in no sense presented as recommendations from this Committee.

Colonel By Memorial at Ottawa

The following letter has been sent to all branches. It is reproduced here so that it may come to the attention of any members who may wish to participate in the project.

Already several members in different parts of Canada have made substantial contributions. It is felt, however, that every member should be made aware of his privilege of contributing.

This is not a local affair. Ottawa is the national capital, and Colonel By's work was of national — not local — importance. It is planned that the memorial will be financed on a national basis.

Circular letter to branches
Re: Colonel By Memorial

As doubtless you know a memorial to Colonel By is to be erected in Ottawa as part of the celebration to mark the one hundredth anniversary of the changing of the name of the city from Bytown to Ottawa. Colonel By was the great engineer of his time and the Council of the Institute have felt that the Institute should participate in the celebration and should create a memorial of some kind to our pioneer engineer.

The Ottawa Branch committee have had the matter in hand and have arranged for the erection of a fountain on one of the boulevards. Much of the cost is being contributed by the federal government, the federal district commission and the city of Ottawa. However, the Ottawa Branch themselves have put five hundred dollars into the project and the Council of the Institute have agreed to a further contribution up to two thousand dollars.

At the last meeting of Council this matter was discussed and the suggestion was made that some of the branches or members might wish to participate in the project. Accordingly I was instructed to communicate with each branch making them aware of what was underway and suggesting that if the branch or members did wish to participate the contribution should be sent to the headquarters of the Institute. Such support can surely be used to good advantage, inasmuch as it appears that the present basis of financing is going to be short of what will be required.

L. AUSTIN WRIGHT,
General Secretary.
June 10, 1955.

C.I.C. Meets in Quebec City

The 38th annual conference of the Chemical Institute of Canada was held at the Chateau Frontenac, Quebec City, May 30 to June 2. Dr. Roger Gaudry, assistant director of research, Ayerst McKenna and Harrison, Limited, Montreal, was elected president for 1955-56. Dr. Clifford B. Purves of McGill University was elected vice-president. Also elected were 12 new councillors, while 52 prominent Canadian chemists and chemical engineers were elected fellows of the Institute. An honorary degree was conferred by Laval University on E. R. Rowzee, vice-president and manager, Polymer Corporation Ltd., the retiring C.I.C. President.

Dr. Albert Noyes Jr., dean of graduate studies at Rochester University, paid tribute to researchers of the National Research Council in Ottawa.

Dr. Noyes added that the University of Rochester "has felt it wise to start an Institute of Canadian studies. It is to be hoped that this Institute will give at least some United States students a vigorous appreciation of the life, the resources and the promise of Canada".

Chemistry Aids For Food Industry

The fight against the new race of stem rust, 15B, that did so much damage to Canadian wheat last year, illustrates another facet of the chemist's work. With durum wheats, used for macaroni, a couple of simple chemical tests now serve

to assess the macaroni making quality of a new variety. Since durum wheat was particularly hard hit by rust, the maintenance of the premium market for high quality Canadian durums depends on the early development of new rust-resistant varieties.

Few people realize how much research lies behind these develop-

Roger Gaudry, President.

ments. Dr. J. A. Anderson, chief chemist of the Board of Grain Commissioners, Winnipeg, illustrated this point in a paper co-authored by G. N. Irvine, which reviewed the history of durum studies in the Grain Research Laboratory at Winnipeg.

Waterproofed Boards From Straw

Fibre building boards and other pulp products from wood or straw can be waterproofed by using natural substances that are already present in the fibres. This new development was announced by R. S. Evans and H. R. Sallans of the Prairie Regional Laboratory, National Research Council, Saskatoon.

Since the nature of these natural sizing agents in the fibres was unknown, the authors undertook an investigation into the chemical constitution of wheat straw. They found that material isolated by extraction of straw with alcohol would waterproof products prepared from pure cellulose if metal ions were present.

They also observed that the extractive-free straw yielded sized products if pulped with metal ions, and that the ability to become sized was not destroyed by treatment of the straw with caustic or other chemical agents. From this it was apparent that at least two types of materials contributed to the sizing phenomena: an extremely resistant straw component and an alcohol soluble extractive.

Their investigation has shown that products prepared from pulps containing lignin, fatty acids or an unknown phenolic material can be sized by the addition of metal ions to the pulp. The presence of mannitol and a 23 carbon phytosterol in wheat straw was also disclosed for the first time.

Tin Disease

In a paper describing "tin disease", the term used to describe the phenomenon of white tin changing to grey tin at temperatures below 56 degrees Fahrenheit, R. R. Rogers and J. F. Fydell of the Department of Mines and Technical Surveys, Ottawa, pointed out that grey tin is useless for the most purposes and its formation may cause considerable trouble. They reported, however, that "tin disease" can be combatted successfully by ensuring that the composition of the tin is within a certain range before it is exposed to low temperatures.

As far as can be judged from the published literature grey tin is stable only in the temperature range below 13.2°C (55.8°F). If some means could be found to keep tin in the grey form at ordinary temperatures or higher, it might easily become as important as germanium and silicon in the electrical field.

Some types of tin will not change into the grey form even at temperatures below 13.2°C. The composition, thickness and previous history of the tin are important factors in this regard. There is a considerably greater tendency for grey tin to form in thick layers of the metal than in very thin layers. Tin which has been placed in tension at low temperature is more likely to be transformed into the grey variety.

Gasoline And Silicosis

An analytical method that can be used to analyze gasoline for 20 or more components in one hour, using a sample having a volume less than 0.006 cu. inches, was described by R. R. Barefoot and J. E. Currah of the Central Research Laboratory, Canadian Industries (1954) Limited, McMasterville, Que.

The advantages of this technique, called gas or vapor phase partition chromatography, are particularly valuable for materials which boil at temperatures lower than about 392 degrees Fahrenheit. They were recognized by British researchers, and much work has been done the past three years. American workers are now becoming actively interested in this method. The main advantage of the method is that it permits an excellent separation of closely related materials within a very short period, and by use of very small samples.

A new analytical method has been developed that will enable industrial hygienists to assess better the risk of silicosis among workmen in mines and in such industries as foundries and ceramics, according to C. M. Jepheott and H. F. V. Wall of the Department of Health of Ontario, Toronto.

To assess this risk of silicosis among workmen, it is essential to know the amount of quartz in the airborne dust. The procedure described provides a means of doing this which is faster and more accurate than the methods used up till now, and it does not require special equipment. In this new method, quartz can be estimated in coarse and fine dusts with an absolute error of less than 1 per cent.

Plutonium Analysis

A procedure developed at Chalk River for analyzing plutonium was described by G. Zotov and C. A. Fowler of Atomic Energy of Canada Limited. Plutonium is formed in low quantities on irradiation of uranium fuel elements with neutrons in a nuclear reactor.

The extraction of plutonium is made extremely difficult because of high radioactivity. Remote control equipment has to be used in handling such materials. Even then the fuel element has to be set aside for a period of time to let its radioactivity drop to a reasonable level. On extraction, plutonium has to be purified to a fairly high degree for future use. Plutonium itself is highly radioactive, making chemical analysis of this element rather difficult.

The spectrochemical approach chosen by the authors as the mode of analysis is a problem in itself. The quantity of plutonium excited by the spark discharged in each sample exceeds the accepted tolerance of intake of radioactivity by 100,000 fold! In their paper the authors describe how the spectrochemical method was developed. Since an indirect approach was resorted to, this technique might well

be applied to other analytical problems where a direct approach is not feasible.

Other Papers Of Interest For Engineers

Papers dealing with other subjects of interest to the engineering profession were presented during the three day session.

Panel discussions of general interest were also held on "Textbook Treatment of Industrial Chemistry"; "Chemical Engineering Research in Canada"; and "The Utilization of Waste Products in the Pulp and Paper Industry". The luncheon meeting on the first day was addressed by the Hon. W. M. Cottingham, Quebec Minister of Mines, on recent mining developments in Quebec. A post conference visit by bus was arranged for delegates to Arvida and Shipshaw.

Thirty-five Years Ago

Comment on the *JOURNAL* of July 1920

For years there has been much talk about engineers' reluctance to blow their own horns or to allow others to tell the public how much it owes to engineers in general and on occasion to certain engineers in particular. In the *Journal* for July, 1920, there are thumbnail biographies of some members of the Institute who were in the lime light for one reason or another. There was no hesitation there in the use of near superlatives — "more responsible than any other member of the profession," "occupies a premier position," "one of the best known consulting engineers," "services in great demand," "strong supporter of the high ideals of the profession," "one of the best known French engineers." To receive tributes like this, one usually has to die.

It is probably quite true that these encomiums were seen by few except the regular readers of the *Journal*, themselves engineers, but their mere presence there pretty well disposes of the claim that we are all shrinking violets. It is the writer's guess that the author of these little biographies — evidently one person wrote them all — was not thanked by some of his subjects, who cannot all have been pleased with the puffs they got. This kind of publicity seems to savour a little too much of Hollywood methods.

Foundation of C.S.C.E. Recalled

C. E. W. Dodwell, M.E.I.C., of Halifax, reminisced at some length about the circumstances surrounding the foundation of the Canadian Society of Civil Engineers, of which the Institute is the successor. The idea had its birth in discussions between Mr. Dodwell and Alan Macdougall in Toronto in 1884 and 1885. Others became interested and organizing committees were formed in Toronto, in Ottawa and in Montreal. Finally, a joint committee was set up and the C.S.C.E. was born at its meeting of January 20, 1887, in the board room of the Harbour Commissioners of Montreal. "It was a notable and successful achievement in obstetrics. The infant that first saw the light on that . . . occasion . . . has (now) . . . reached a healthful and useful maturity."

A news note gave the appraised valuation of the Institute's grounds and building as $95,000. Another argued strongly that "the proposed new war memorial building" in Ottawa should be designed by Canadian architects and engineers; the prime minister, Sir Robert Borden, "had no information on the subject." Still another is a complaint from the Quebec Branch that incompetent persons were being appointed to engineering positions "by one of the government railway boards." Would the Institute please do something about it?

Apropos of the Toronto Branch's belief that the Institute was not doing enough for its individual members, council came back with a strong resolution, published in this *Journal*, calling upon members not to dissipate their efforts in establishing Canadian branches of foreign technical organizations, but "to stimulate the work (of the Institute) by inquiry or suggestion" and "to maintain an attitude of undivided loyalty . . ."

The New Brunswick Act was published in full and it was announced that the first meeting of the Corporation of Professional Engineers of Quebec had been held at headquarters on May 20, 1920 at a subsequent meeting the Corporation chose as its first officers A. R. Decary, M.E.I.C., president; W. J. Francis, M.E.I.C., vice-president and F B. Brown, M.E.I.C., honorary secretary-treasurer. The Association of Professional Engineers of British Columbia had also organized, with E. G. Matheson M.E.I.C., as president, D. O. Lewis M.E.I.C., as vice-president and H. L .Robertson as registrar and secretary-treasurer.

Technical Papers

The leading technical paper was "Progress in Aviation," by J. A. Wilson, A.M.E.I.C. He thought that what aviation needed was lighter and more powerful engines; the top one seems to have been the 500-hp "Cosmos". Not all of his predictions came true, e.g., "long distance flight . . . will be covered in . . . sections of . . . 200 to 400 miles each machine doing its own section." Like most of the aviation experts of the time, he believed that really long distance flight was going to be the province of the airship, not that of the aeroplane. But he did correctly foresee the importance of aviation to Canada. "(It) seems to lie . . . in the direction of securing access . . . to districts not easily reached by ground transport." He gave helicopter flying short shrift; "It does not seem very vital today." What would the Aluminum Co. or the Iron Ore Co. have said to that?

O. O. Lefebvre, A.M.E.I.C., chief engineer of the Quebec Stream Commission, wrote on "The St. Maurice River Regulation and the Gouin Dam." The dam itself is a relatively simple concrete gravity structure, 1,646 feet long and 90 feet high at most. There were no foundation problems; sound granite underlay the whole structure. It is the reservoir rather than the dam which is notable, storing as it does some 160 billion cubic feet of water and covering 304 square miles. Use of this storage increased the low water flow of the river at Shawinigan Falls from 5,200 second feet to about 12,000 second feet, calculated to represent an increase of 32,250 hp. there, if spread over the whole year, and, of course

proportional increases at all other power sites.

Short experience showed that the reservoir developed an unexpected ground storage: "When the lake level has been lowered a couple feet, the ground which is saturated gives back some of its (stored) water . . ."

The cost of the whole scheme was $2.5 million and the yearly revenue in 1920 was $191,000, or about 7½ per cent on the investment, which would be substantially increased when those who used the river for driving logs were assessed for their share of the benefit.

G. W. F. Johnston, JR.E.I.C., now of the Quebec Hydro Electric Commission, had a paper in this *Journal* dealing with the Federal Government's seismological work. In 1906-1913 it had installed seismographs in Ottawa and was keeping track of all earthquakes recorded there. Not only was the epicentre of each tremor located, but in 1917 Dr. Otto Klotz, the director of the seismological laboratory, devised a method of locating submarine faults from records received from all over the world. Mr. Johnston remarked: ". . . In Canada we seem to be fairly immune from earthquakes. . . . Though not generally known . . . (a) fault line runs right along the channel of the St. Lawrence, beginning at Lake Champlain, reaching the St. Lawrence at Quebec and then following the channel to the Gulf. . . . In 1663 an earthquake . . . in this region did considerable damage. . . . The possibilties of the recurrence of this disturbance . . . are remote, but in the light of the disastrous effects . . . of earthquakes on bridges we cannot help wondering how our . . . Quebec bridge would fare, should the south (side) of the river slip from 7 to 20 feet past the north side."

There is a good deal of sameness in these old *Journals*, which we trust has been in some degree overcome in the current ones. Of course, in 1920 Canada was still getting over a war which seems to have dislocated its economy to a greater extent than did the recent one. And the "boom," if any, was of modest dimensions as compared to the normal activities of recent years. One gets the idea that the 1920 editor was sometimes hard put to it to find material to fill his *Journal*.

News of Other Societies

Canada's Power Show for 1955 is scheduled for November 8-11, at the Show Mart Building in Montreal. Exhibits will feature the products of leading manufacturers of power plant and industrial equipment in Canada and the United States. Combined with the show will be the annual convention of the **Institute of Power Engineers** (410 Bloor Street East, Toronto 5).

The first conference to be conducted by the **Canadian Management Council** (1549 Burnside Place, Montreal) will take place at McGill University and the Ritz Carlton Hotel, September 22, 1955. The theme to be developed by speakers from management, professional societies, and universities, is "Education for Management—Whose Responsibility?"

A joint meeting of the **American Society of Planning Officials** and the **Community Planning Association of Canada** (169 Somerset W., Ottawa 4) will be held in Montreal, September 25-30, at the Sheraton Mount Royal and Laurentien Hotels.

A large attendance of professional planners is expected for this meeting, which is the first one staged in Canada by A.S.P.O. The chairman of the Canadian committee is Humphrey Carver, of Ottawa, and the co-chairmen of the Montreal arrangements committee are Aime Cousineau and Professor Spence-Sales.

The 1955 annual convention of the **Canadian Good Roads Association** (270 Maclaren Street, Ottawa) will be in Banff, Alta., September 13, 14, and 15, 1955.

The second congress of the **Fédération Internationale de la Précontrainte,** will be held in Amsterdam, Netherlands, August 29 to September 2, 1955.

Secretary of the congress is J. A. H. Hartman, Groningsestraat 15, The Hague.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

William Storrie, M.E.I.C., president of the civil and municipal consulting engineering firm of Gore & Storrie Ltd. in Toronto, died at his home in Toronto on May 31, 1955.

Born at Paisley, Scotland, on October 4, 1883, Mr. Storrie received his education at Paisley Technical College and at Glasgow and West Scotland Technical College.

Arriving in Toronto in 1909, Mr. Storrie was employed as resident engineer on the construction of the Toronto water purification plant and later as waterworks engineer for the City of Ottawa. He was named chief engineer of the John verMehr Engineering Company in 1913.

In 1919 he became associated with the late William Gore and Dr. George G. Nasmith and the consulting firm of Gore, Nasmith and Storrie was formed. Later the firm became known as Gore and Storrie Limited and Mr. Storrie was appointed president.

Mr. Storrie has been associated in the design and construction of water works and sewage projects across Canada, including Toronto, Ottawa, Windsor, Kingston, Belleville, Calgary and many other municipalities. In 1948 he was a member of a board of three engineers appointed by the City of Detroit to make a sanitary survey dealing with pollution of the Detroit River and Lake St. Clair in relation to Detroit's water supply.

William Storrie, M.E.I.C.

Mr. Storrie was the only person to receive three of the highest awards for achievement in the water supply and sanitation field. In 1944 he was awarded the George Warren Fuller Award "for distinguished service and engineering skill in the field of water supply, for constructive leadership and many contributions to the activities of the Canadian Section of the American Water Works Association."

In 1947 he was selected by the Federation of Sewage Works Associations as recipient of the Kenneth Allen Award "for outstanding service in the sewerage and sewage treatment works field, as related particularly to the problems and activities of the Canadian Institute on Sewage and Sanitation".

In the same year Mr. Storrie was awarded the Dexter Brackett Memorial Medal by the New England Water Works Association for his paper on the Toronto Water Works Extensions which was published in the Journal of the Association.

Mr. Storrie had been active for many years in various technical associations and societies. He was a past president and past chairman of the Canadian Institute of Sewage and Sanitation; a former director of the Federation of Sewage and Sanitation Wastes Associa-

James Ruddick, M.E.I.C.

tion; and for many years a member of the Institution of Civil Engineers, London, England.

Mr. Storrie joined the Engineering Institute in 1910 as an Associate Member, transferring to Member in 1917. He was a past chairman of the Toronto Branch of the Institute. He attained life membership in 1947.

James Ruddick, M.E.I.C., prominent Quebec City engineer, died at his home in Quebec City on May 6, 1955.

Mr. Ruddick was born in Gateshead, England, on September 19, 1875, and received his secondary education at Vernon School in Gateshead and graduated from the Durham College of Science. He served his apprenticeship with the firm of Selby, Bigge and Company, Newcastle-on-Tyne, and with Messrs. Clarke, Chapman & Company, at Gateshead.

After several years of electrical construction experience in England Mr. Ruddick came to Canada and in 1907 joined the Shawinigan Water & Power Company where he was responsible for construction work. From 1909 to 1912 he was employed by E. A. Wellberg of Cobalt, Ont., as construction engineer, and later as general superintendent of operation. He then became chief construction engineer with the Dominion Coal Company at Glace Bay, and was responsible for the design and construction of coaling piers, colliery equipments, water systems, etc.

From 1915 to 1924 Mr. Ruddick was associated with the Laurentian Power Company in Quebec City as manager and engineer. It was in 1924 that he formed the James Ruddick Engineering and Construction Company of which he was president until his retirement a few years ago.

Mr. Ruddick was considered an authority on hydro-electric power development and during World War II he was appointed consulting engineer to the Royal Canadian Air Force.

He was a member of the Corporation of Professional Engineers of Quebec and a Fellow of the Royal Society of Arts in London.

Mr. Ruddick joined the Engineering Institute as a Member in 1916 and attained life membership in January, 1947.

John William Morris, M.E.I.C., who had retired as general manager of the Newfoundland Light and Power Company ten years ago, died suddenly in St. Lambert, Que., on April 26, 1955.

Mr. Morris was born in Wallace, N.S., on September 2, 1872, and received his early education at Pictou Academy, Pictou, N.S. He received his B.A.Sc. degree from McGill University in 1894.

Upon his graduation he worked on the construction of the Montreal Street Railway and in 1896 became associated with the Royal Electric Company's hydro-electric installation at Drew Falls, Ont., and at Chambly, Que. Mr. Morris went to Georgetown, B.G., in 1899, where he became superintendent of street railway construction, a position he also held in Kingston, Jamaica.

In 1901 Mr. Morris became associated with the Reid Newfoundland Company at St. John's, Nfld., as superintendent of the electrical department. He remained with the company until his appointment as general manager of the Newfoundland Light and Power Company on transfer of the company to the Royal Securities Corporation. He continued as general manager until his retirement.

Mr. Morris throughout his life maintained a keen interest in guns and took part in many shooting contests, among them the Dominion rifle shooting contest held in Ottawa annually. During World War I he was awarded the M.B.E. for the part he played in the training of Newfoundland soldiers in the use of small firearms. He also took part in the training of Newfoundland Air Force Cadets in rifle shooting and in promoting their participation in the Dominion rifle shooting contest.

Mr. Morris was a member of Rotary International for over thirty years, and was a life member of the American Institute of Electrical Engineers.

He joined the Engineering Institute in 1920 as a Member and attained life membership in the Institute in 1951,

J. W. Morris, M.E.I.C.

during which year he served as councillor for the Newfoundland Branch of the Institute.

Rex L. Brown, M.E.I.C., chief chemist for Imperial Oil's Regina refinery, died in Regina on March 17, 1955.

Mr. Brown, who was born in Medicine Hat, Alta., on August 1, 1904, received his early schooling at Prince of Wales High School in Vancouver, B.C. He graduated from the University of British Columbia in 1927 with the degree of B.A.Sc. in chemical engineering.

Upon graduation from college Mr. Brown joined the staff of Imperial Oil Limited at the Ioco refinery near Vancouver, B.C., as a chemist. In 1935 he went to Talara, Peru, and became associated with International Petroleum Limited as chemist and then chief chemist in 1938.

Mr. Brown returned to Canada in 1942 and rejoined Imperial Oil Limited at the Sarnia, Ont., refinery as assistant chief chemist. He came to Regina in 1947 as chief chemist, a position he held until his death.

He was Fellow of the Chemical Institute of Canada and honorary president of the South Saskatchewan branch and a member of the Association of Professional Engineers of Saskatchewan.

Mr. Brown joined the Engineering Institute as a Member in 1947.

Willet George Bedell, S.E.I.C., who was connected with the Minneapolis Honeywell Regulator Company at Montreal, died in a traffic accident in Montreal on February 17, 1955.

Mr. Bedell was born in Dauphin, Man., on June 7, 1930, and received his secondary education at Kingston Collegiate and Vocational Institute. He graduated from Queen's University in 1954 with a degree in mechanical engineering.

He joined the staff of Minneapolis-Honeywell upon his graduation as sales engineer and remained with the company until his death.

Mr. Bedell distinguished himself during his college career as an athlete, taking part in track and field events, football and boxing, with equal success.

He became a Student Member of the Engineering Institute in 1953.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

New Brunswick

Officers for 1955

D. J. Brewer, president of the Planet Construction Company, Fredericton, has been elected president of the Association of Professional Engineers of New Brunswick for the year 1955. He succeeds J. M. M. Lamb, district marine agent of the Department of Transport, Saint John.

D. R. Webb of Saint John succeeds Mr. Brewer as vice-president, while R. D. C. Clark of Saint John continues as secretary-treasurer.

The seven councillors elected to serve the Association in four districts are: Saint John, K. V. Cox and L. O. Cass; Fredericton, Professor E. E. Wheatley and C. E. Weyman; Moncton, W. D. G. Stratton and R. L. Parsons; and Chatham, P. G. Robinson.

Ontario

News of the Members

A. E. Sibbick of the Canadian National Railways, has been appointed divisional engineer of the Hornepayne division and is making his headquarters in Hornepayne. Prior to assuming his new duties, Mr. Sibbick was assistant division engineer of the London division.

Frederick Hooson, of Ajax, Ont., and formerly on the instructional staff of the Ryerson Institute of Technology, Toronto, is employed as a production engineer with Dowty Equipment of Canada Limited in Ajax.

Terence W. Algeo has changed his residence from London to Hamilton, and is co-ordinating engineer of special projects in the industrial products division of the Canadian Westinghouse Co. Ltd., in that city.

Prior to the change, Mr. Algeo was associated with General Motors Diesel Ltd., in London, as a projects engineer.

Thomas C. Hall is the plant electrical engineer of Fibreglas Canada Ltd., in Sarnia. Prior to undertaking these new duties Mr. Hall was employed by Renfrew Aircraft and Engineering Ltd., in Renfrew, Ont.

Norman A. Eager, of the Burlington Steel Company Ltd., Hamilton, Ont., has been elected to the office of president and general manager of that company.

Mr. Eager, who was a member of Council of the Association during 1952-3 and has been an active member on Association committees, graduated in arts and later in civil engineering from McGill University. He afterwards undertook post-graduate work at Cornell University where he obtained his master's degree in civil engineering. In 1940 he joined the Burlington Steel Co. Ltd., and served latterly as vice-president and general manager.

H. E. Tilbe, formerly with Atomic Energy of Canada Ltd. at Chalk River, is now employed by the Canadian General Electric Co. Ltd. at Peterborough, Ont., in the new department associated with nuclear power development.

Walter G. Ward has moved from the Canadian General Electric Co. Ltd., Toronto, where he was general manager of the appliance division, to the New York office of the General Electric Company, where he is with the management consultation service division.

Peter Stauft, of Imperial Oil Limited, is now located in the company's offices at 2431-11th Avenue, Regina, Sask.

Gerald R. Nayler has joined the staff of Packard Electric Co. Ltd. as sales engineer, and is with the company's Toronto office, 111 Richmond Street West.

A graduate of the University of Manitoba in 1951 in electrical engineering, Mr. Nayler was engaged in sales work with the British General Electric Company (Canada) Ltd. before joining the Packard organization.

D. J. S. King, of the Ontario Department of Highways, has moved from Chatham to Bancroft, Ont., and is acting as construction engineer in that area.

F. W. Iveson, who was formerly with the engineering department of the Municipality of Ottawa, has joined Giffels & Vallet of Canada Ltd., 65 Elliott Street, East, Windsor, Ont., as assistant chief mechanical engineer.

F. C. Totino has recently been appointed sales engineer for Alberta for Rosco Metal Products (Alberta) Ltd., whose head office is at 11031-106th Avenue, Edmonton.

George M. Nixon who is engaged in consulting practice in Vancouver, B.C., has moved to 1165 Ottaburn Road, Hollyburn, West Vancouver.

William C. Commick has left Cockshutt Farm Equipment of Brantford and is now in Coldwater, Ohio, and is employed as a project engineer by the Avro Corporation.

D. Zavitzianos has severed his connection with General Engineering Co., Ltd., Toronto, and is employed in the structural department of Shore and Moffat, Toronto Architects.

W. Przesiecki has moved from Gananoque to Toronto and is employed by Massey-Harris-Ferguson Ltd. in the field test section of the company.

John H. Redding, of the engineering staff of H. G. Acres & Company Ltd., Niagara Falls, Ont., is at present located at Daud Khal, Punjab, West Pakistan, where he is employed on a project.

J. A. Oliver, who is employed by the Ontario Hydro Electric Power Commission, has moved from Toronto to Niagara Falls, Ont., where he is an industrial engineer with H.E.P.C. Frequency Standardization.

John A. Paxton has resigned from the engineering staff of International Nickel Co. of Canada Ltd., Port Colborne, Ont. to take the position of project engineer with Babcock-Wilcox & Goldie-McCulloch Ltd. He will be located in Galt, Ont.

Thomas G. Quance has accepted the position of executive vice-president with Mueller Limited of Sarnia, Ont. To assume this new position Mr. Quance resigned as assistant manager of Canadian Line Materials Limited, Scarboro, Toronto.

A graduate in electrical engineering of the University of Toronto, in 1938, Mr. Quance served overseas with the R.C.E.M.E. during the Second World War, latterly commanding R.C.E.M.E. units of the 3rd Canadian Infantry Division with the rank of lieutenant-colonel.

Alfred Tober, formerly employed by Foster-Wheeler Ltd., of St. Catharines, has joined the engineering staff of H. G. Acres & Company Limited, in Niagara Falls, Ont.

C. M. Bishop, of Toronto, has joined R. V. Anderson & Associates Ltd., 136 Felbrigg Avenue, Toronto as mechanical engineer. This firm is engaged in consulting practice.

Mr. Bishop who graduated in mechanical engineering from the University of Toronto in 1949, was previously employed in Toronto with International Business Machines Co. Ltd.

A. J. Barker has moved to Riverside, Ont., from Toronto, and is employed by Ford Motor Company of

Canada Ltd. as construction design engineer with the company's maintenance department. Before joining the Ford organization Mr. Barker was assistant engineer with Etobicoke Township.

J. H. Jackson of the engineering staff of Ontario Hydro has been moved from Niagara Falls, Ont., where he was a construction superintendent, to Leaside, where he is construction engineer, generation.

M. E. Dickenson is chief engineer at Canadian Pittsburgh Piping Limited, 835 Beach Road, Hamilton, Ont. Prior to this appointment Mr. Dickenson, who graduated from the University of Toronto in 1951, was products engineer with Taylor Forge & Pipe Works of Canada Ltd., also of Hamilton.

Frank M. Banks, of The Bell Telephone Co. of Canada has moved from Toronto to Montreal, where he is with the special contract department of Bell Telephone in that city.

Vernon D. MacDonald has joined Howard Smith Paper Mills of Cornwall. He was formerly employed by Canadian Cottons Ltd., also of Cornwall, Ont.

J. N. Timberlake has been appointed town engineer of Lindsay, Ont., having moved from Wallaceburg to assume his appointment.

K. C. Wilson has moved from Winnipeg, Man., to St. Felicien, Que., where he is associated with Chibaugamau Explorers Ltd. Mr. Wilson, who is a graduate of R.M.C. and of Queen's University in mining engineering, was previously with North Rankin Nickel Mines Ltd. in Manitoba.

A. R. Irwin of the engineering staff of H.E.P.C. of Ontario, has moved from Windsor, Ont., to Sarnia where he is meter engineer for Hydro at that place.

J. D. Kingston has moved from Kingston, Ont., to Levack, Que., where he is on the engineering staff of Temiskaming Construction Ltd., at Fecunis Lake Mine.

Gordon F. Colborne has been transferred recently from the research and development division of Eldorado Mining and Refining Ltd. in Ottawa, to the Beaverlodge Operation at Eldorado, Sask., where he is plant metallurgist.

D. E. Loudon is with the chemical engineering division of The M. W. Kellogg Company, 75 Maiden Lane, New York 38. Mr. Loudon was formerly with the engineering staff of Chemical Construction (Inter-American) Ltd., of Toronto.

Arthur F. Branscombe of The Bell Telephone Company of Canada is assistant general manager of the special contract department and is located at 1050 Beaver Hall Hill, Montreal.

Manitoba

Working Committees Selected

The council of the Association of Professional Engineers of Manitoba held a meeting at the University on May 25 to finalize the selection of working committees. A group of engineers who had earlier signified a wish to act in this capacity were invited to attend and as a result of this meeting six committees were established.

A brief description of each committee and its executive is as follows:—Advisory Committee which will study membership dues and other administrative requirements of the association, president, A. M. Tallman, secretary, D. S. G. Ross; the Salary Committee which will study prevailing salaries and make surveys from time to time to provide up-to-date schedules, president, E. H. Martin; Engineering Consultants—to provide proper consulting fee schedules as well as to review professional practice of consulting engineers in Manitoba, president, W. L. Wardrop, secretary, T. A. Crosier; Public Relations Committee—to promote interest in the engineering profession, president, Maurice Magnan, secretary, H. S. Heeley; Board of Examiners—to set and evaluate examination of prospective members for admission to the Association, president, O. Marantz, secretary, S. J Borgford; Membership Committee—a group to canvass non-members in an effort to increase the size and influence of the Association, president, R. S. Williams, secretary, T. J. Halme.

Professor Hoogstraten on his return from the Dominion Council of Engineers meeting stated that a desire for uniformity between the Associations in regard to examination syllabus, salary schedule, admission requirements, continues to progress and the general feeling of the delegates was in favour of this idea.

British Columbia

Random Notes from the Registrar

Employment

Doug Russell, assistant registrar, and the man in charge of the Association's Placement Service, reports that employment prospects for engineers are very bright at the moment. I think I can safely say that in my five years with the Association I have never seen it so good. About three years ago, when construction at Kitimat was just under way, there were also plenty of jobs for engineers, but most of them were on a temporary basis. That was a boom period, but the situation now is a much healthier one as the positions that are open are almost all of a permanent nature. This is, I presume, due to new industries coming in and to present industries expanding. In addition, I think that quite a few firms who have never had engineers before are now employing them or looking for them. I like to think that this is, in some measure, due to our public relations program.

All in all, it now appears that the long talked about "shortage of engineers" may after all be a reality here in B.C. I think, however, that I shall have to stick to my original opinion on the matter, namely, that any "shortage" that exists is due more to misemployment of engineers than to a lack of personnel with engineering training.

Presidential Visits

During the coming month, Dr. H. C. Gunning, our president, and myself will be visiting centres up coast on one of our usual annual tours. On this trip, we shall be accompanied by a member of Council, F. R. "Bill" Killam or rather, we shall accompany him in his boat. Calls will be made at Prince Rupert, Kitimat, Ocean Falls and Port Alice, with meetings of the Branches being held in each place. Anyone wishing to contact me personally should advise the secretaries of the local branches. These are: Prince Rupert, E. Bartlett; Ocean Falls, J. Graham; Kitimat, D. P. I. Hawkins; and Port Alice, S. M. Schofield.

Past President

Members will be sorry to hear that the immediate past president of the Association, C. Bentall, recently suffered a slight heart attack and has been confined to the hospital for the last month. All of the members will join in wishing him a speedy recovery.

6th Field Company, R.C.E.

A history of the 6th Field Company, Royal Canadian Engineers, is almost completed, and friends of the unit who wish to have copies are requested to order them immediately. Contents of the book will be:

(1) A short history of the 6th Field Company, R.C.E., 1912-1939.

(2) Seventeen chapters of the story of the 6th Field Company, R.C.E 1939-1945.

(3) A short chapter on the 2/6th Field Company, R.C.E., in occupation of Germany.

(4) Approximately 30 pages of pictures of events, groups and official action photographs, following the progress of the Company from Vancouver to Aurich.

(5) Lists of casualties, awards, and possibly nominal rolls.

(6) Several maps showing areas where the Company saw action.

The price of the book is $5.00, which should accompany the order and be sent to S. A. Flatt, 1411 Eleventh Avenue, New Westminster.

B.C Professional Engineer

The response to our questionnaire sent out in April regarding the "B.C. Professional Engineer" exceeded our expectations. We had hoped that we would be able to give the results in this issue in tabulated form, but have found this to be impossible, particularly with regard to the dislikes and suggestions, as there was no trend in any general direction and it would be impossible to list them individually.

Generally speaking, the returns, 97 per cent of which indicated that the senders read the magazine regularly, constituted a vote of confidence in the Editorial Board. This, of course, is very gratifying to the Board.

Some people indicated that they would like to see more technical articles, but just as many again protested that there were too many technical articles and asked for more general articles. Some very good suggestions were received and as time goes on we hope to follow them through.

Of the regular departments in the magazine, "Engineers in the News" was shown to be the most popular, with

"Association Affairs" being next. The survey has proved to be most useful to the Board, and the information obtained will be used to improve the magazine.

Engineers in the News

G. W. Meckling has accepted the position of municipal engineer of the District of North Vancouver. He will carry on his duties as city engineer of Kelowna until July 15, the effective date of his new appointment.

James Watson former general traffic officer of B.C. Telephone, has been appointed to the newly-created post of plant extension engineer.

Wilfred Morley, an electrical engineering graduate of U.B.C. '50, who had been working in Eastern Canada, has returned to this province and has taken a position with B.C. Electric.

J. H. van Wijlen, formerly with H. A. Simons Ltd., has taken up a new position with Sandwell and Co.

W. F. Jarrett, powerhouse superintendent at Bridge River, will assume the post of manager of operations for B.C. Electric in the Powell River area on July 1. **F. M. Nosworthy,** assistant power sales engineer for B.C. Electric, was named manager of general sales for the Powell River area. The responsibilities of both Mr. Jarrett and Mr. Nosworthy will include Westview, Texada, Cranberry, Wildwood, Stillwater and Malaspina, as well as Powell River.

L. B. Gatenby formerly with Cowichan Copper, is now with Technical Mine Consultants.

M. Malchewski is now in Toronto as project engineer with the Photographic Survey Corporation Ltd. He used to be senior field engineer with T. & H. Engineering & Forestry Ltd. of Vancouver.

A. H. Ashworth, of the recently established North Western Associated Engineering Consultants, Vancouver, is currently in New Zealand to work on the planning and design of the Auckland Harbour Board's foreshore development. Auckland newspapers quote him as stating that it is a very similar harbour to Vancouver, with the same problem of passenger transport. He plans to return to Vancouver in August.

G. A. van Exel who was with MacMillan and Bloedel at Port Alberni, has started work with the B.C. Telephone Co. in Vancouver.

Five engineers of the Powell River Co. have been given special assignments in connection with the company's present expansion program centering around the coming installation of the No. 9 paper machine. They are: **J. G. D'Aoust,** assigned to the post of senior project engineer; **A. E. Chard,** who will assume the duties of project engineer at Groundwood Mills, in addition to his present duties as development engineer; **A. C. Mullen,** appointed paper mills project engineer; **G. E. Harrison,** project engineer on Wood Separation and Services; **W. G. Kennedy,** field supervisor on all construction work in the development program.

V. S. Bright is now with H. A. Simons Ltd., in Vancouver and will be going to Hinton, Alberta, as resident engineer on a new project. Mr. Bright's previous position was resident engineer at Port Alice with Alaska Pine and Cellulose Co. Ltd.

J. T. Turner has been named chairman of the Vancouver section of the American Institute of Electrical Engineers. Mr. Turner is transportation maintenance manager for B.C. Electric. Other officers of the section are **R. B. Carter,** vice-chairman; **G. J. Henrikson,** secretary-treasurer; **M. I. G. Bradwell,** assistant secretary-treasurer, and **W. W. Pullinger,** discussion group chairman. The Vancouver section has 312 members.

C. D. Grigg, divisional engineer, Department of Highways, has been transferred from his post at Williams Lake to a similar position at New Westminster.

G. D. Gunrahakalis, a '53 civil graduate of U.B.C., is presently employed as irrigation engineer by the White Nile Pumping Scheme, Kosti, Sudan, Africa.

S. S. Aulakh, a recent arrival from India, has taken a position with the Department of Highways in Victoria.

Harold Hastings, formerly with the English Electric Co., has joined the electrical engineering staff of B.C. Electric.

Art Evans, formerly municipal engineer of West Vancouver, is now with West Coast Equipment.

L. D. Fenske has returned to B.C. and taken a position with Britannia Mining and Smelting Co. Ltd. at Mount Sheer, B.C. He has been in Santa Barbara, Mexico, working as a shiftboss for Cia Minera Asarco, S.A.

J. H. Croockewit recently returned from a trip to Holland and has joined his former employers, Vancouver Iron Works Ltd.

D. G. Hepburn, a graduate of this year's mechanical class, has gone with Finning Tractor and Equipment Co. Ltd.

C. H. Townsend has accepted a position with H. A. Simons Ltd. Previously, he was field engineer for B. Greening Wire Co. of Hamilton.

T. S. Hughes, formerly district engineer with the Provincial Department of Highways at Kelowna, has accepted the post of superintendent of grounds and buildings at the University of British Columbia.

E. N. Walton, of the Powell River Co. has been transferred to Vancouver as engineering assistant to **H. Moorhead,** chief engineer.

Jan Verkerk has accepted a position with Crippen-Wright Engineering Ltd. He was previously employed by C. B. K. Van Norman.

R. H. Beaton has taken up a position on the engineering staff of the Clayburn Co. at Abbotsford. For the past year he had been with the Pioneer Gold Mines doing property examination, chiefly in Utah.

B. C. Lewall is now with the P.G.E. Railway as construction engineer in charge of the new construction from Prince George to the Peace River. Mr. Lewall previously ran his own business as civil engineer and B.C. land surveyor at Kamloops.

H. R. M. Murray is moving to Nelson, B.C., where he will act as resident engineer on the Nelson Bridge for A. B. Sanderson. Mr. Murray was previously structural and design engineer with the Department of Public Works at Victoria.

R. A. Cox has taken a position as electrical designer with the B.C. Engineering Co. For the past two years, he has been back in Manitoba as travelling secretary for the Varsity Christian Fellowship.

D. H. Rutherford, who is with Stone and Webster Engineering Corp., has been transferred from Roanoke Rapids, North Carolina, to Concrete, Washington.

A. D. Fonseca, formerly with the B.C. Telephone Co., has accepted a position with Canadian Westinghouse in Vancouver.

A. W. Gilmour, has accepted the position of staff electrical engineer with the Powell River Co. He had previously been transmission and communications engineer with the B.C. Electric Co. at Victoria.

L. R. Dear, a recent arrival from Australia, who had been working with Ripley and Associates, has joined the staff of the B.C. Engineering Co.

C. C. Inkman, previously with American Fabricators Ltd., is now employed by Stanley Smith Engineering Ltd.

R. E. Wells, has left construction on the Terrace-Kitimat branch line, C.N.R., and has been transferred to the bridge department at Winnipeg.

B. C. Walley has returned to B.C. and taken up employment with the Northwest Telephone Co. He had been in Winnipeg with Canadian Aviation Electronic.

W. M. Watkins has left American Fabricators Ltd. and has joined the staff of Phillips, Barratt and Partners.

I. N. Jachontoff has changed his position from engineering assistant with the Municipality of Kitimat to office engineer with Johnson-Crooks Construction Corporation (B.C.).

H. R. Bryett, former resident engineer for the Holman Co. of Great Britain is now with the Eimco Corporation of Salt Lake City, Utah. The Eimco Corporation has incorporated its first company in Canada and has located it in Vancouver.

H. H. Friedrichs recently started work with Phillips, Barratt and Partners. He was engaged in field work with G. W. Ledingham.

Association Affairs

Schedule of Minimum Salaries

As a result of the Salary Survey held in December for the Dominion of Canada, changes have been made in the Schedule of Minimum Salaries and have been approved by all the Associations and Corporation in Canada. These changes are as follows: Grade I, 3,780.00; Grade II, 4,620.00; Grade III, 5,520.00; Grade IV, 6,540.00; Grade V, 7,860.00; Grade VI, 10,500.00; Grade VII, 14,400.00; Grade VIII, 22,000.00.

The following change was also made in the definition of Grade VIII: "Duties and Qualifications—to exercise high executive authority for which the minimum qualifications are education equivalent to graduation in engineering or applied science from a recognized university; outstanding degree of administrative and/or engineering ability and experience plus personal qualifications of a high order." New copies of the revised Schedule are now being printed and will be available to the membership in the near future.

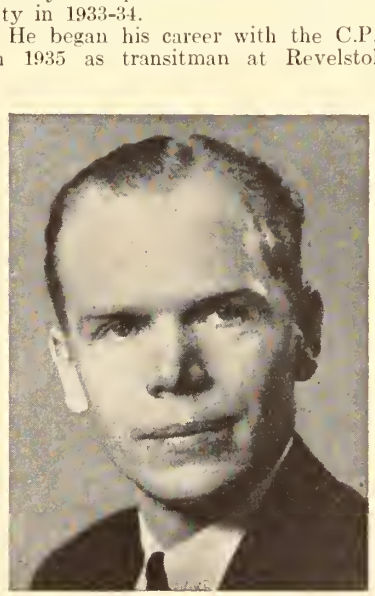
Personals

News of the Personal Activities of Members of the Institute

R. A. Emerson, M.E.I.C., formerly chief engineer of the Canadian Pacific Railway Company, has been named vice-president of operations and maintenance. The announcement was made by **N. R. Crump,** M.E.I.C., newly-elected president of the company.

A graduate engineer of the University of Manitoba, class of 1930, Mr. Emerson took post-graduate studies in railway transportation at Yale University in 1933-34.

He began his career with the C.P.R. in 1935 as transitman at Revelstoke,



R. A. Emerson, M.E.I.C.

B.C. Later he was roadmaster at Deloraine, Man., and served as division engineer at Brandon and at Moose Jaw from 1941 to 1944. At that time he went to Vancouver as assistant district engineer and then as district engineer for the British Columbia district. Mr. Emerson came to Montreal in 1948 to take over the system office of engineer of track and was promoted to assistant chief engineer two years later. He was appointed chief engineer of the company in 1951.

Mr. Emerson is a member of the Corporation of Professional Engineers of Quebec and a member of the American Railway Engineering Association.

C. A. Colpitts, M.E.I.C., has been appointed chief engineer of the Canadian Pacific Railway Company, taking charge of the engineering in the 17,000 mile system.

Mr. Colpitts joined the C.P.R.'s engineering department following his graduation from the University of Manitoba. He became division engineer at Saskatoon in 1941 and went to Vancouver in 1944 as division engineer for five years and then was promoted to the position of district engineer of British Columbia.

Mr. Colpitts came to Montreal in 1950 as engineer of track and the following year became assistant chief engineer.

He is also a member of the Association of Provincial Engineers of British Columbia, The Corporation of Professional Engineers of Quebec, and the American Railway Engineering Association.

T. A. Lindsay, M.E.I.C., vice-president of Phillips Electric Company (1953) Limited, has been appointed president of the company, succeeding **T. W. Brackenreid,** M.E.I.C., who recently retired.

Mr. Lindsay is a graduate of the University of Manitoba in electrical engineering, and is well known in both eastern and western Canada where he has served during his 21 years of association with the company. He was appointed vice-president and director in 1951 and executive vice-president in charge of executive operation and general administration of the company last November.

He has been on the board of the Electric Club of Toronto for the past ten years, and has served in other capacities with the Canadian Electrical Manufacturers Association.

C. A. Colpitts, M.E.I.C.

George Glinski, M.E.I.C., has been elected president and director of Data Processing Associates Ltd. in Ottawa.

Mr. Glinski has been associated with electronic research and development for twenty years and since 1948 has specialized in electronic compution and automation.

Until his new appointment Mr. Glinski has been a director of Computing Devices of Canada Ltd. in Ottawa for the past seven years, having been a co-founder of that company.

Mr. Glinski was the first in Canada to conduct graduate courses in digital and analogical computation and will continue to do so at McGill University and Carlton College.

George Glinski, M.E.I.C.

Ronald R. Lloyd, M.E.I.C., has been appointed vice-president and general manager of F. A. Tucker (Canada) Ltd., general contractors of Montreal. He was formerly chief engineer and manager of the company.

Mr. Lloyd, a native of London, England, received his M.A. degree from the University of Cambridge, and served for four years with the Royal Electrical and Mechanical Engineers on air defense installation in England and later in Egypt, Palestine and Syria.

After some time with a British general contractor, mainly concerned with prestressed concrete construction, and a period of two years in Nigeria, British West Africa, as superintendent on dams, road and bridge construction, Mr. Lloyd came to Canada. He joined the corps of engineers, U.S. Army as a civil engineer on an Arctic defense construction job, where he served for two years as chief technical assistant and as resident engineer to the project.

He is an associate member of the Institution of Civil Engineers of Great Britain and a member of the Prestressed Concrete Development Group of Great Britain.

SOLVING PLATEWORK PROBLEMS

THIS PROBLEM, presented to us by the Sun Oil Company, Ltd. for their Sarnia refinery, through The Catalytic Construction Company of Canada, involved the fabrication and erection of the main vessels for the first Houdriflow unit ever built in this country. The kiln reactor measured 20 ft. 6 ins. (max.) diameter by 128 ft. high and weighed 325 tons. The surge hopper measured 15 ft. in diameter by 50 ft. high and weighed 70 tons.

FABRICATION PROBLEMS resulted from the size of the vessels and the numerous types of carbon, alloy and clad steel plate used to withstand process requirements; and from the complicated internal construction of the kiln reactor, with its 8 heads and 8 cooling coils composed of hundreds of pipes.

ERECTION PROBLEMS came from the fact that these massive vessels had to be field assembled to a total height of 270 ft. For this work, special lifting equipment, including a 150-ton guy derrick, was designed and built by Dominion Bridge Company.

We solved these problems to the complete satisfaction of our customer. May we do the same for you?

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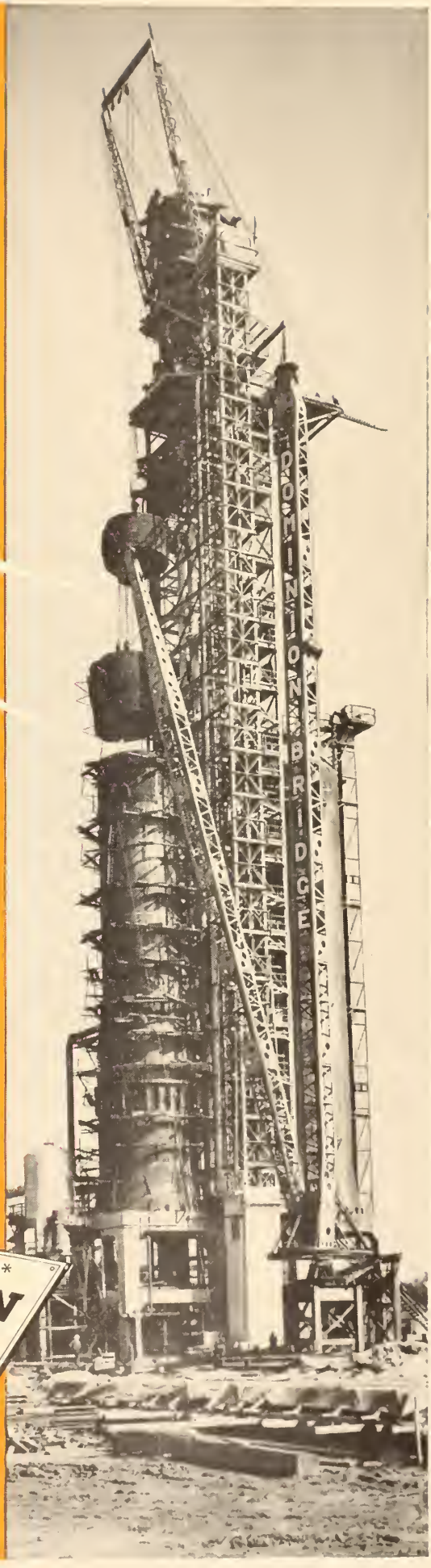

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• Personals

Percy Walter Geldard, M.E.I.C., has been elected president of the Canadian Gas Association at its annual meeting at Niagara Falls, Ont. He is with the Consumers' Gas Company in Toronto as engineer of distribution, in charge of the company's planning and development.

Mr. Geldard has been with the Consumers' Gas Company since his graduation from the University of Toronto in 1929 with a B.A.Sc. degree in civil engineering.

Mr. Geldard served for many years on technical committees of the American Gas Association, and last year, served as chairman of the A.G.A.'s distribution committee. He was active in having the Canadian Gas Association installation code written into the provincial statutes and he also helped to write the official "practices and principles of gas purging" handbook.

He is a member of the Metropolitan Toronto Civil Defence Committee and a member of the six-man committee on Civil Defence set up by the Association of Professional Engineers of Ontario in 1952 to advise the provincial secretary.

Gerald Bowen Williams, M.E.I.C., has been appointed chief engineer of the development engineering branch of the Federal Department of Public Works.

A native of Manitoba, Mr. Williams graduated from the University of Manitoba in 1935 with the degree of B.Sc. in civil engineering. Since graduation he had been employed by the Provincial Government of Manitoba.

Until 1946 he was resident and materials engineer with the Department of Public Works and then served two years as executive assistant to the Deputy Minister of Public Works. He spent a year as maintenance engineer and in 1949 was appointed chief engineer of the Highways Branch, a position he held until his recent appointment.

P. W. Geldard, M.E.I.C.

Mr. Williams has been chairman of the Western Canada Association of Highway Officials, and is a past-chairman of the observer committee on test roads for the Canadian Good Roads Association. He is immediate past-president of the Association of Professional Engineers of Manitoba.

He became a Member of the Engineering Institute in 1945 and has served as chairman of the Winnipeg Branch of the Institute.

G. B. Williams, M.E.I.C.

William J. Riley, M.E.I.C., has been appointed chief engineer of Sperry Gyroscope Company of Canada Ltd. He was previously works manager of Sperry Gyroscope Ottawa Limited.

Mr. Riley graduated from McGill University in 1948 with a degree in mechanical engineering. He has spent some time in the diesel division of Dominion Engineering Works Ltd. in Montreal, and before joining Sperry Gyroscope in 1953, he was assistant works manager for Canadian General Electric Company Ltd. in Montreal.

L. L. Goddard, M.E.I.C., has been appointed sales manager in the Montreal district of Chas. Cusson Limited.

Mr. Goddard graduated from McGill

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• Personals

University in 1944 with a degree in mechanical engineering. He served in the Royal Canadian Navy as lieutenant and, after passing a watchkeeping certificate, was in charge of machinery on the HMCS Fort William.

Returning to Montreal after the war, he joined Dominion Engineering Works Limited and was active in material procurement. After sales experience with Canadian Gypsum Company he became associated with Chas. Cusson Ltd. and has been with the company for the past seven years.

Mr. Goddard is a member of the Corporation of Professional Engineers of Quebec and of the American Materials Handling Society.

W. J. Riley, M.E.I.C.

L. L. Goddard, M.E.I.C.

Donald A. R. McCannel, M.E.I.C., has retired from his post of chief engineer of the City of Regina. He has been with the city's engineering department since May 1914.

During the first World War he became acting city engineer in 1917 and city engineer in 1919 and has since been associated with every major work project undertaken in that city.

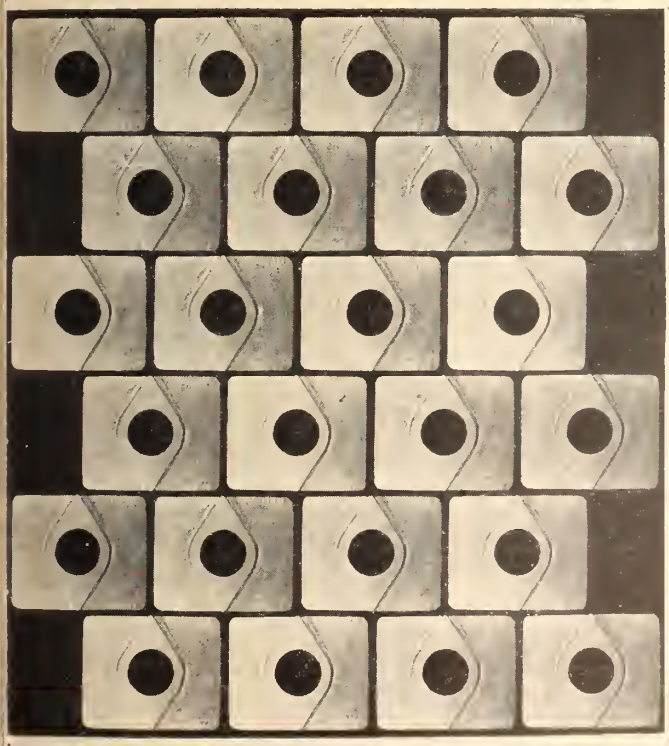
He graduated from Queen's University in 1914 with a degree of B.Sc. in engineering.

Mr. McCannell is a past-president of the Association of Professional Engineers of Saskatchewan. He was that province's representative on the Dominion Council of professional engineers from 1936 to 1942 and president for two years.

He joined the Engineering Institute in 1914 as a Student, transferring to Junior in 1917, and to Member in 1930. He attained life membership in 1953. He has served as councillor for the Saskatchewan Branch of the Institute.

S. Hairsine, M.E.I.C., has joined the St. Lawrence Seaway Authority in Montreal and is in charge of electrical-mechanical engineering. He was previously with the Department of Transport in Montreal as electrical and mechanical engineer.

In 1946 he was electrical engineer with the Department of Transport in Ottawa concerned with canals administration. Mr. Hairsine was also connected with the Welland Ship Canal as assistant electrical engineer.



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• Personals

W. R. Staples, M.E.I.C., associate professor, College of Engineering at University of Saskatchewan, has been elected president of the Association of Professional Engineers of Saskatchewan. He has also been elected chairman of the Saskatchewan Branch of the Engineering Institute.

A native of Cobourg, Ont., Professor Staples received his secondary education in Cobourg and graduated from the University of Saskatchewan in 1942 with a degree in mechanical engineering. During the summers of his university course he worked with the Saskatchewan Department of Transport as instrumentman, and as draughtsman with Dominion Engineering Works at Lachine, Que.

Upon graduation he became connected with the university as instructor of mechanical engineering. He served with the R.C.N.V.R. during World War II and returned to the University of Saskatchewan in 1946. He became assistant professor of the College of Engineering of the university and then associate professor in 1947.

He joined the Institute as a Student in 1941, transferring to Junior in 1943, and to Member in 1947.

R. M. Campbell, M.E.I.C., has joined the firm of Racey, MacCallum & Associates Ltd., consulting engineers, Montreal, as assistant to the president (technical).

Mr. Campbell received his early education in Ottawa Collegiate Institutes. He joined the Canadian Army in 1940, serving overseas from 1942 to 1945, receiving his commission in the Canadian Armoured Corps at Sandhurst in 1944. Upon leaving the service, he entered Queen's University, receiving his B.Sc. in mechanical engineering in 1948.

Upon graduation Mr. Campbell was associated with Dominion Engineering Works, as a designer in the hydraulic division. For the past four years he has been in charge of a major engineering group in the C. D. Howe Company Ltd. concerned with the design and construction of the N.R.U. atomic energy reactor at Chalk River. Mr. Campbell will continue to be available to this group in an advisory capacity during completion of erection and testing of this reactor and will be in overall charge of the engineering inspection work on this project being performed by Racey, MacCallum & Associates Ltd.

W. R. Staples, M.E.I.C.

R. M. Campbell, M.E.I.C.

F. E. Ayers, M.E.I.C., formerly city engineer at Fort William, Ont., has been named design engineer in Ottawa's planning and works department. His appointment marks another major step in the re-organization of this branch.

Mr. Ayers is a civil engineering graduate of the University of Saskatchewan class of 1943, and served as a lieutenant

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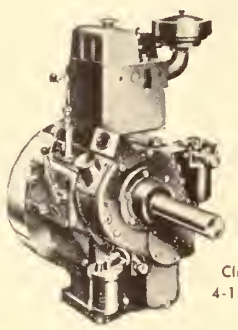

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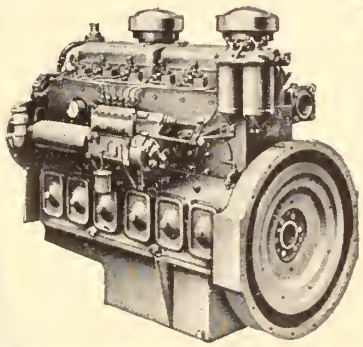

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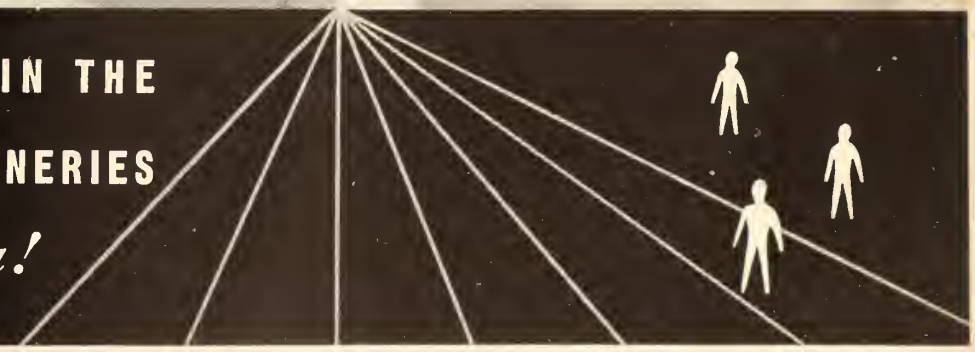

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• Personals

during the war with the Royal Canadian Engineers.

After the war he was an instructor for a year at the University of Saskatchewan, and then joined the Canadian National Railways as an instrumentman in the Port Arthur division. He became city engineer of Fort William in 1947.

Mr. Ayers joined the Institute in 1945 as a Junior, transferring to Member in 1947, and has served as chairman of the Lakehead Branch of the Institute.

Dr. T. A. Monti, M.E.I.C., has been elected vice-president of the Corporation of Professional Engineers of Quebec at the annual meeting in Quebec.

Dr. Monti is a partner in the firm of Letendre, Monti & Associates in Montreal, Que.

A civil engineering graduate from Ecole Polytechnique in 1941, he has been associated with the Dominion Bridge Company in Montreal as mechanical designer. From 1943 to 1947 he was a consulting engineer in the mechanical field and then joined the National Research Council as their Montreal representative. He joined the firm of Royer, Letendre & Associates in 1952, becoming a partner the following year.

Guy Beaudet, M.E.I.C., has been named manager of the port of Montreal. He has been acting port manager since August 1954, having previously been assistant manager.

A 1938 graduate from Ecole Polytechnique in Montreal in civil engineering, Mr. Beaudet served during the war with the Royal Canadian Engineers, rising to the rank of acting lieutenant-colonel.

At the end of the war he joined the Central Mortgage & Housing Corporation as Montreal branch manager and remained in that position until his appointment as assistant manager of the Montreal harbour in 1947.

Mr. Beaudet joined the Engineering Institute as a Student in 1936, transferring to Junior in 1939 and to Member in 1947. He received the Engineering Institute of Canada Prize awarded to undergraduate students in their third year in 1937.

R. R. Prescott, M.E.I.C., electrical superintendent of the Canadian International Paper Company at Temiskaming, Que., has been elected chairman of the Nipissing & Upper Ottawa Branch of the Engineering Institute.

Born at Walton, N.S., he received his secondary education at Wolfville, N.S. After attending Acadia University Mr. Prescott graduated from Nova Scotia Technical College with a B.Sc. degree in electrical engineering in 1932.

Prior to joining Canadian International Paper Company at Gatineau, Que. in 1947 as assistant electrical superintendent, Mr. Prescott had been with the New Brunswick International Paper Company at Dalhousie, N.B. as assistant electrical superintendent from 1940 to 1947, and with St. Anthony Gold Mines at Savant Lake, Ont. as chief electrician from 1936 to 1940.

He became a Member of the Institute in 1949.

H. A. Nelson Holland, M.E.I.C., has been appointed a director of Raymond Concrete Pile Company Ltd. at their head office in Toronto. He has been chief engineer of the company in Montreal and will continue in that capacity with headquarters in Toronto.

Mr. Holland graduated from McGill University in 1942 with a B.Eng. degree in civil engineering. He spent some time as engineering assistant in the toll cable department of the Bell Telephone Company of Canada in Montreal, and then joined Raymond Concrete Pile Company Ltd. in 1947 to become chief engineer for the company in Montreal.

He is a member of the Corporation of Professional Engineers of Quebec.

A. H. Harris Jr., M.E.I.C., vice-president and manager of Winnipeg & Central Gas Company, has retired from active management of the company. He will continue as a member of the organization in the capacity of consultant.

A graduate of Stevens Institute of Technology in mechanical engineering in 1911, Mr. Harris became vice-president and manager in 1953 when the Winnipeg & Central Gas Company was formed, acquiring all rights, privileges and responsibilities of the Winnipeg Electric Company insofar as its former gas business was concerned. He had previously been manager of the gas utility of the Winnipeg Electric Company.

A. M. Snider, M.E.I.C., vice-president and general manager of Sunshine Waterloo Company Ltd. in Waterloo, Ont., has been appointed a member of the National Industrial Design Council, Ottawa, for a two year period.

Also appointed to the council for a two year period is **Professor E. A. Allcut,** M.E.I.C., head of the Department of Mechanical Engineering at the University of Toronto.

L. J. R. Sanders, M.E.I.C., president and general manager of Sanders Engineering Company, Galt, Ont., has been elected chairman of the Kitchener Branch of the Engineering Institute.

Mr. Sanders was born in Chippenham, England, and received his secondary education there. He served with the Royal Naval Air Service from 1918 to 1919, after which he attended Loughborough College, England, graduating in 1922. Before coming to the United States in 1926 he was associated with Georg Constantinesco, Consulting Enginee London, England, as a technical assistan

After a year's study at Cornell Un versity, Mr. Sanders came to Canada a assistant to the chief engineer at Lak Shore Mines, Kirkland Lake, Ont. Fro 1929 to 1934 he was associated with th Aluminum Company both in Toront and in England. In 1934 he joined th staff of George S. May, Industrial En gineers, as a senior staff engineer.

He was with Algoma Steel Corpora tion at Saut Ste. Marie, Ont. from 193 to 1940. In 1941 he joined Wartim Merchant Shipping Ltd. and was pro moted in 1942 to the position of pro duction manager and was later mad director of Naval Headquarters, Ottaw In 1946 he founded the L. J. R. Sande Engineering Co., Galt, Ont. of whic he is now president and general mana ger.

Mr. Sanders is a member of the In stitution of Mechanical Engineers, Lon don, England.

He became a Member of the Institut in 1942.

Clifford E. Frost, M.E.I.C., constructio contract engineer with the Bell Tele phone Company of Canada Ltd., ha been elected chairman of the Montre Branch of the Engineering Institute.

Mr. Frost was born in Danville, Que and attended Lachine High School. H graduated from McGill University i 1931 with a B.Sc. degree in civil en gineering. Following graduation h joined the National Harbours Board i Montreal as assistant engineer.

In 1937 Mr. Frost began his associa tion with the Bell Telephone Compan of Canada receiving an appointment o the engineering staff. During World Wa II he served with the R.C.A.F. and a the end of the war returned to the Be Telephone Company as engineer on th chief engineer's staff. In 1949 he wa appointed special duties engineer and i 1953 became construction contract en gineer for the company in Montreal.

C. E. Frost, M.E.I.C

Mr. Frost joined the Institute i 1936 as an Associate Member, transfe ring to Member in 1940. He served a chairman of the Junior Section of th Montreal Branch of the Institute i 1937.

The Editor invites discussion of papers appearing in the *Journal*

• Personals

Karl E. Gustafson, M.E.I.C., has returned to his position as advisory manager at the Aliveri Lignite Mines, Aliveri (Euboea Island) Greece, after having recovered from burns received during a mine fire caused by spontaneous combustion of the lignite.

Mr. Gustafson was formerly assistant to the chief mining engineer (coal division) of Dominion Steel and Coal Corporation, Sydney, Nova Scotia. He went to Greece in 1951 with Pierce Management Inc., Scranton, Pennsylvania, which firm had a contract with the Greek Government for the construction of two lignite mines including surface railroad, necessary buildings and central plant equipped for air cleaning. During the construction and development period he served as resident mining engineer-manager at Aliveri. In May 1954, when the construction was completed, he was retained for an additional two years in a consulting capacity.

He had the opportunity to become familiar with continental mining during the last war as a technical officer while serving in British and American army areas in the Campine Basin in Eastern Belgium and in the Ruhr District in Germany. He also served with the British Control Commission for Germany as a district production controller in the Ruhr district and, later, as inspector for northern Ruhr with the joint U.K./U.S. Coal Control Group.

Mr. Gustafson is a graduate of McGill University in mining engineering. Before entering McGill he worked in the Estevan Saskatchewan lignite coal fields as a colliery manager. After graduation in 1940 he worked with the International Nickel Co. in the Sudbury, Ont. Mines and with Beattie Gold Mines at Duparquet, Que. He resigned his position as assistant mine superintendent with the latter company in 1943 to join the Royal Canadian Engineers. Before going overseas in 1944 he served as Camp Engineer Officer at Regina, Sask.

Guillaume Piette, M.E.I.C., consulting engineer of Quebec City, has been elected chairman of the Quebec Branch of the Engineering Institute.

Mr. Piette was born at Berthierville, Que., and received his secondary education at Assomption and Brebeuf Colleges. He graduated from the Ecole Polytechnique with a B.A.Sc. degree in 1939, and received his M.Sc. degree from the University of Michigan in civil engineering, class of 1942.

Mr. Piette's early engineering experience was with the Department of Highways at Quebec City. In 1946 he became associated with J. U. Ste. Marie, contractor, in Quebec City as consulting engineer.

He joined the Engineering Institute as a Student in 1938, transferred to Junior in 1941 and to Member in 1947.

J. N. Cram, M.E.I.C., is now chief engineer with Crothers Manufacturing Limited in Toronto. He has been in the Canadian Army as a major with the Directorate of Armament Development, Army Headquarters in Ottawa.

Mr. Cram also served as resident staff officer in Halifax with the army.

He received his B.Sc. degree in chemistry from the University of Saskatchewan in 1935 and his B.Sc. degree in chemical engineering in 1937 from the same University. Mr. Cram also received his B.Eng. degree in mechanical engineering in 1950 from Nova Scotia Technical College.

John Livingstone Phelps, M.E.I.C., president of Yukon Electrical Company Ltd. in Whitehorse, has been elected chairman of the Yukon Branch of the Engineering Institute.

A native of Whitehorse, Mr. Phelps received his secondary education there. He graduated from the University of British Columbia in 1940 with a B.A.Sc. degree.

While at university he worked during the summer months with the Treadwell

• Personals

Yukon Corporation, engaged in sampling and assaying work. Upon his graduation Mr. Phelps became associated with Yukon Electrical Company Ltd. as superintendent and secretary-treasurer. In 1950 he also was appointed managing director and sec.-treas. of Yukon Hydro Company Ltd., and a partner in the firm of Phelps and Scott, engineers. He was named president of Yukon Electrical Company Ltd. in 1953.

Mr. Phelps became a Member of the Institute in 1951.

S. F. Sznajder, M.E.I.C., has joined the St. Lawrence Seaway Authority in Montreal as a structural engineer.

He has previously been associated with the C. D. Howe Company in Hamilton, Ont., and with Canadian-Brazilian Services Ltd. in Toronto.

Mr. Sznajder is a graduate of the University of Warsaw in civil engineering.

W. C. Robertson, M.E.I.C., is now vice-president and general manager of Cementation Brasil S.A. in Sao Paulo, Brazil.

He was formerly superintendent of construction with Sao Paulo Light & Power Company Ltd.

Mr. Robertson graduated from McGill University in 1946 with a B.Eng. degree in civil engineering.

L. D. Briden, M.E.I.C., has been appointed construction engineer with Defence Construction (1951) Limited at Ottawa. He was formerly divisional supervisor of western Canada for the company.

Mr. Briden has also been associated with Central Mortgage & Housing Corporation and was for a time in La Paz, Bolivia with the Bolivian Power Company as resident construction engineer.

He received his B.Sc. degree in mining engineering from Michigan College of Mining and Technology in 1940.

L. Allaire, M.E.I.C., is now general manager for Ferland Construction Inc. in Ste. Emelie, Que.

Mr. Allaire, who graduated from Ecole Polytechnique in civil engineering, was formerly connected with George Demers, consulting engineer, in Quebec City.

Benoit Baribeau, M.E.I.C., has been transferred to Paris, France, by Defence Construction (1951) Limited. He will be their representative in charge of European operations.

Mr. Baribeau, a civil engineering graduate of Ecole Polytechnique, was previously branch manager for the province of Quebec with headquarters in Montreal for the company. From 1946 to 1954 he was associated with Arthur Suveyer & Company in Quebec City as assistant resident engineer. He has also been with British American Oil Company Ltd. in Montreal as an engineer in the maintenance department.

J. W. Demcoe, M.E.I.C., has been named general superintendent of the northern Ontario district of the Canadian National Railways, with headquarters in North Bay, Ont.

Mr. Demcoe, who joined the railway as structural draughtsman in 1939, was operations assistant at the system headquarters in Montreal prior to his new appointment.

He graduated from the University of Manitoba in civil engineering.

J. E. B. Sawyer, M.E.I.C., is now plant engineer with the Canadian International Paper Company in La Tuque, Que.

A civil engineering graduate from the University of Manitoba in 1943, Mr. Sawyer was formerly assistant chief engineer with the Brown Corporation at La Tuque

T. G. Edgeworth, M.E.I.C., superintendent of the reduction division of Aluminum Company of Canada Ltd. at Shawinigan Falls, Que., has been elected chairman of the St. Maurice Valley Branch of the Engineering Institute.

A native of Tate Creek, B.C., Mr. Edgeworth graduated from Queen's University in 1943 with a B.Sc. degree in chemical engineering.

T. G. Edgeworth, M.E.I.C.

During World War II he served with the R.C.A.F. as navigation instructor.

At the end of the war he became associated with the Ontario Department of Mines and later with Eldorado Mining and Refining Limited. He joined the Aluminum Company in 1951 as pot room supervisor in Shawinigan Falls.

Mr. Edgeworth joined the Institute as a Junior in 1945, transferring to Member in 1951.

William Murdoch Brenan, M.E.I.C., has joined the staff of Wiggs, Walford, Frost and Lindsay, consulting engineers, in Montreal.

Mr. Brenan, who graduated from the University of New Brunswick in 1941 with a degree in civil engineering, was formerly a partner of H. S. Brenan & Son, architect and engineer, in Saint John, N.B.

Felix Henry Lypaczewski, M.E.I.C., has joined Foundation of Canada Engineering Corporation Ltd. in Montreal as structural engineer.

He received his civil engineering diploma from the Polish University College in London, England in 1951, and has been associated with Brian R. Perry, consulting engineer of Montreal until his present appointment.

R. H. Tivy, M.E.I.C., is now regional transportation engineer of the Atlantic region of the Canadian National Railways at Moncton, N.B. He was formerly assistant engineer in the department of research and development for the company.

Mr. Tivy, who graduated from the University of Manitoba in electrical engineering in 1943, has also been with the Manitoba Power Commission at St. Boniface, Man. as electrical engineer.

W. Peplowski, M.E.I.C., is now structural engineer with the Foundation Company of Canada in Montreal.

He was formerly with MacKinnon Structural Steel Company in Sherbrooke, Que., as structural engineer.

Mr. Peplowski graduated from the Polish University College in London, England in civil engineering.

Richard Neil Payton, Jr.E.I.C., is now with R. M. Way Company Ltd. in Toronto. He was previously with H. G. Acres & Company Ltd. in Niagara Falls, Ont. as vessel designer in the petrochemical division.

A 1945 graduate of the University of Saskatchewan in mechanical engineering, he has also been associated with H. K. Ferguson Company Inc. in New York as senior mechanical designer, and as project engineer with Canadian Industries Limited in Montreal. He has also been with Canadian Synthetic Rubber Ltd. in Sarnia, Ont. and with Galt Metal Industries at Galt, Ont.

E. L. Fytche, Jr.E.I.C., has moved to Brazil and is with Rio de Janeiro Tramway, Light & Power Company Ltd. in Rio de Janeiro. He was formerly in Ottawa with the Gatineau Power Company.

Mr. Fytche graduated from the University of New Brunswick with a degree in electrical engineering, class of 1947. He has also been with the British Electricity Authority in Surrey, England.

J. George Celmins, Jr.E.I.C., is now with the Ontario Department of Highways, located in Toronto.

He has also been connected with Catalytic Construction of Canada Ltd. in Sarnia, Ont. as party chief and subsequently as assistant maintenance superintendent. He was with International Nickel Company of Canada Ltd. at Copper Cliff, Ont. as rodman and instrumentman.

Mr. Celmins graduated from the Technical University in Hanover, Germany in 1947 with a degree in structural engineering.

D. C. Johnston, Jr.E.I.C., has been transferred from Ottawa to Cornwall, Ont by Welch & Johnston Ltd.

A mechanical engineering graduate from Queen's University in 1948, Mr Johnston joined the company as junior executive in Ottawa upon graduation and subsequently became assistant sales manager.

Michael D. Arnaud, Jr.E.I.C., is now design engineer with the Shawinigan Engineering Company in Montreal. He has been with Canadian Brazilian Services both in Toronto and in Sao Paulo, Brazil, where he worked for the Sao Paulo Tramway, Light & Power Company in the hydro-electric construction department.

Mr. Arnaud graduated from the University of Toronto with a degree in civil

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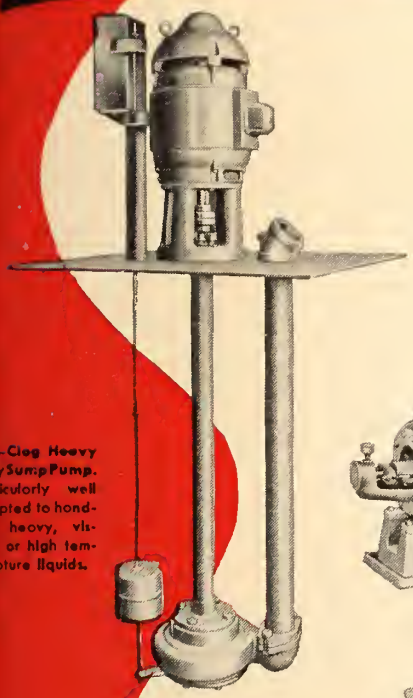

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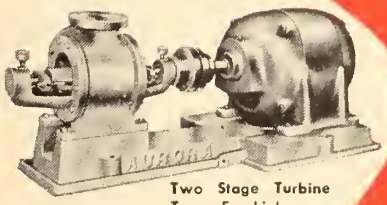

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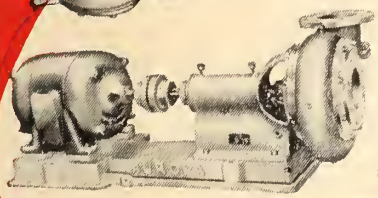

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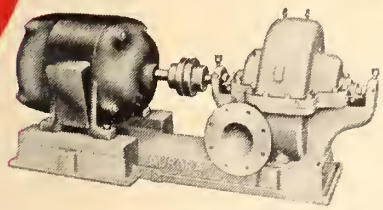

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• Personals

engineering in 1948 and was for a time junior engineer with H. G. Acres & Company Ltd. at Niagara Falls, Ont.

Real R. Bernard, JR.E.I.C., is now general manager and associate of J. R. A. Carignan, plasterer, of Montreal.

Mr. Bernard, who graduated in 1949 from McGill University in civil engineering, has also been associated with Raymond Concrete Pile Company Ltd. in Montreal as assistant chief engineer, and with J. L. E. Price Company Ltd. in Montreal as project engineer.

D. T. Bourke, JR.E.I.C., has been transferred from Montreal to Toronto by Drummond McCall & Company Limited.

A mechanical engineering graduate of McGill University in 1949, he has also been with Turner & Newall (Canada) Ltd. in Montreal.

D. P. Murray, JR.E.I.C., has been transferred by Otis Elevator Company Ltd. from Winnipeg, Man. to the head office in Hamilton, Ont.

He graduated from the University of Manitoba in mechanical engineering in 1949, and has been with the company since his graduation when he joined as a service representative in Winnipeg.

D. S. Cameron, JR.E.I.C., is now employed as resident engineer for the St. Lawrence Seaway Authority for the construction of a canal and lock at Iroquois, Ont.

Mr. Cameron graduated from the University of Saskatchewan in civil engineering, class of 1949. He has been associated with Fraser-Brace Terminal Contractors in Saint John, N.B., and with the Johns-Manville Company in Asbestos, Que.

G. W. Walker, JR.E.I.C. is presently employed by Mannix Limited in Calgary, Alta., as manager of the petroleum division.

A civil engineering graduate of the University of Alberta, class of 1949, he became associated with the Interprovincial Pipe Line Company upon graduation as civil engineer, then as materials engineer and subsequently as design and construction engineer at Edmonton, Alta.

J. J. Bleau, JR.E.I.C., is now office manager of the Linde Air Products Company, formerly Dominion Oxygen Company, a division of Union Carbide Canada Limited in Montreal. He was previously engineering representative for the company.

Mr. Bleau graduated from McGill University with a degree in mechanical engineering in 1950.

Roy S. Thibodeau, JR.E.I.C., has been transferred to the engineering sales department of the Toronto branch of Crane Limited. He had been in the head office at Montreal as industrial sales engineer.

A 1950 graduate of Nova Scotia Technical College in mechanical engineering, Mr. Thibodeau has also been connected with Molson's Brewery Limited in Montreal.

G. H. Curtis, JR.E.I.C., has moved to Toronto and is with Stone, Webster Canada Limited. Prior to his new position Mr. Curtis was with Anglin-Norcross Corporation Ltd. in Montreal as construction engineer.

He is a civil engineering graduate of the University of Toronto, class of 1948, and studied business administration at Harvard.

A. G. Loadman, JR.E.I.C., has been transferred to Vancouver by the bridge department of Canadian National Railways. Mr. Loadman, who has been with C.N.R. since his graduation from the University of Manitoba in civil engineering in 1950, was previously bridge engineer in Winnipeg, Man. for the company.

Ross K. Simmons, JR.E.I.C., has been appointed town engineer for Markham, Ont.

Mr. Simmons graduated from the University of Toronto in 1950 and has been town engineer for Acton, Georgetown and Milton, Ont., for the past two years. He has also been associated with the Imperial Tobacco Company in Montreal.

G. S. Langman, JR.E.I.C., is now in Calgary, Alta., with Haddin, Davis & Brown Limited.

Mr. Langman graduated from the University of Alberta in civil engineering in 1950 and has also been connected with Stone and Webster as junior field engineer in Trail, B.C. He has also been with the topographical branch of the Department of Public Works at Williams Lake, B.C. and at Ottawa, Ont.

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• Personals

A. V. Delcloo, JR.E.I.C., has been named assistant sales manager of the tire division of Dominion Rubber Company in Montreal.

A mechanical engineering graduate of the University of Manitoba, class of 1950, he was formerly field service representative with the company in Montreal.

R. A. Plouffe, JR.E.I.C., has been transferred from the Montreal office of Canadian Westinghouse Company Ltd. to Quebec City. His new duties will be those of sales engineer in charge of the apparatus division office.

Mr. Plouffe joined the company as sales engineer in Montreal following his graduation from Ecole Polytechnique in 1951 with a degree in civil engineering.

R. J. O'Sullivan, JR.E.I.C., has been transferred by the Canadian International Paper Company to La Tuque, Que. as paper mill engineer on the construction of a new machine and new machine room in the plant there.

A civil engineering graduate of McGill University, class of 1951, Mr. O'Sullivan has also been with the New Brunswick International Paper Company at Dalhousie, N.B.

J. E. Jensen, JR.E.I.C., is now engineer in charge of the mechanical design project of Motorola Inc. at Chicago, Ill.

Mr. Jensen graduated from the University of Toronto in 1951 in mechanical engineering and was formerly in Baltimore, Maryland, with the Bendix radio division of Bendix Aviation Corporation.

James R. Goff, JR.E.I.C., is now with the electrical design department of B.C. Engineering Company Ltd. in Vancouver.

An electrical engineering graduate of Nova Scotia Technical College, class of 1951, Mr. Goff has also been associated with Hydrographic Surveys in Victoria, B.C.

Walter Bloch, JR.E.I.C., has joined Shore and Moffat, architects, as an electrical design engineer in Toronto.

Mr. Bloch graduated in electrical engineering from the University of Toronto in 1952.

He has previously been associated with El-Met-Parts Limited in Dundas, Ont., as chief engineer; with Chemical Construction (Inter American) Limited, Toronto; and with W. C. Berker Equipment Company Ltd. also in Toronto.

Eric W. Spurrell, JR.E.I.C., formerly with Montreal Engineering Company Ltd. in Montreal, is now with the Newfoundland Light and Power Company in St. John's, Nfld.

Mr. Spurrell, who graduated from Nova Scotia Technical College in electrical engineering in 1952, has also been with the Department of Transport in Ottawa and with the United States corps of engineers at Goose Bay, Labrador.

J. F. Acton, JR.E.I.C., has been named vice-president of Unit Step of Toronto Ltd. in Woodstock, Ont.

He is an electrical engineering graduate from the University of Saskatchewan in 1952 and has been associated with Canadian Westinghouse Company Ltd. in Hamilton, Ont. as student engineer.

L. J. Ingolfsrud, JR.E.I.C., is employed as a mechanical engineer on erection planning for the Foundation Company of Canada at Chalk River, Ont.

He graduated with honors from Queen's University in 1951 with a degree in mechanical engineering and received his master of science degree from the Massachusetts Institute of Technology in 1952 in mechanical engineering. He has been with Dominion Bridge Company Ltd. in Montreal as design engineer.

J. B. Frederick, JR.E.I.C., has been named technical superintendent of Kimberly Clark Corporation of Canada in Kapuskasing, Ont.

Mr. Frederick graduated from Queen's University with a degree in chemical engineering in 1949.

He is secretary-treasurer of the North Eastern Ontario Branch of the Institute, having joined as a Junior in 1952.

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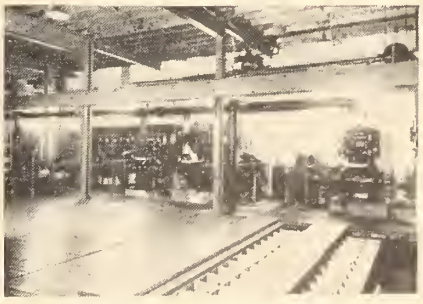

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NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

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ELECTRICAL AND MECHANICAL ENGINEER, B.Sc., (Elect.) Alberta 1936, M.E.I.C., Canadian Born. Experience in Alberta and Quebec as follows. 4½ years oil refinery maintenance and construction and process instrument maintenance; 8 years public utility, of which 4 years high voltage substation design and operation and 4 years re operation and extension of town waterworks systems; 7 years electrometallurgical plant, of which 2 years as electrical engineer and 5 years as works engineer and purchasing agent re bulk material handling, conveying, elevating, drying, furnacing, crushing, screening, dust collecting. File No. 3028-W.

MECHANICAL ENGINEER M.E.I.C. with 12 years experience in the design, construction, operation and management of a wide variety of process plants across Canada. Seeks interesting and challenging job preferably located in Montreal. Good organizer, age 34. File No. 3405-W.

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MECHANICAL ENGINEER (M.E.I.C.,) age 36, married. Experience 2 years designer draftsman, 3 years industrial engineering methods and production control. Trained in time and motion study and certificate as MTM practitioner. Desires responsible position in industrial engineering methods or plant management. File No. 3900-W.

GRADUATE ENGINEER, B.Sc. 1951, Jr.E.I.C. P.Eng. (Ont.) age 26, married. Two years experience with consultant on municipal projects and two years mechanical handling seeks position in mechanical handling, plant engineering or general industrial engineering. File No. 4207-W.

PROFESSIONAL ENGINEER, consulting, academic, food, beverage industries, 36, B.A.Sc electrical, M.S. mechanical engineering, power field (3), University lecturing (3), consultative capacity preliminary survey, design, erection, supervision, refrigeration cold storage plants, breweries, air conditioning systems, processing, industrial in Canada, South America, Asia (5). Working knowledge French, Spanish, German. Willing to travel or relocate, no preference to location, domestic or foreign. File No. 4240-W.

INDUSTRIAL SALES ENGINEER, graduate mechanical engineer, senior, experience in diversified machinery and tools, good appearance and personality, bilingual, seeks position only in the industrial sales field suitable to qualifications and possibilities, on salary and commission basis. File No. 4300-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng., Jr.A.S.M.E., B.A.Sc., Toronto 1950, age 32, married and family of one, 5 years experience in petro-chemical plant in pressure vessel inspection, maintenance and capital project development, field engineering on maintenance and project installation. Familiar with all phases of plant operation. Considerable practical pre-engineering experience. Desire general plant engineering, mechanical test and or development, or maintenance or process supervisional work. Prefer Ontario or the West. Will welcome and answer all inquiries or proposals. File No. 4329-W.

EXPERIENCED MANAGER. A.M.I.Mech.E., M.E.I.C., A.M.I.Prod.E., 16 years experience in England. Engineering and manufacturing telecommunications, aircraft and domestic refrigeration. Full apprenticeship served. Tooling, methods and plant layout. Presently completed 12 months tour of U.S. plants, and wishes to return to Canada in position of responsibility. Minimum commencing salary $7,500. Detailed resume on request. File No. 4356-W.

ELECTRICAL ENGINEER, Jr.E.I.C., B.Eng. (Hons.), McGill U. (1950), P.Eng. (Ont.), age 32, recently married, desires technical work with consulting engineering firm, plant engineering department or utility. Four years with plant engineering department in design, layout and drawing up of distribution and lighting systems, plant electrical services, automatic sequencing controls for process equipment; and in application of adjustable speed drives. One year with architectural firm in designing, distribution, lighting and services for commercial and institutional buildings. Practical experience includes construction or rural distribution lines and operating diesel power house. File No. 4448-W.

CIVIL ENGINEER, 35. Veteran, married with two children, Jr.E.I.C., P.Eng., B.Sc., with 5 years varied experience—1 in design, 1 in supervising building construction and 3 in management, seeks responsible position in Western Canada. Would prefer Junior partnership or associateship. File No. 4538-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng., N.S.T.C. graduate 1951. Four years experience in development and design. Available on reasonable notice. File No. 4559-W.

MECHANICAL ENGINEER, M.E.I.C., age 34, married, 10 years experience in drafting, piping layouts, estimating, inspection and plant maintenance in petroleum refinery. Desires position in industrial plant or refinery. Location Alberta or British Columbia interior. Available on one month's notice. File No. 4637-W.

INDUSTRIAL - METALLURGICAL ENGINEER, master of science degree in metallurgical engineering, B.Sc. (Hons.) in chemistry, P.Eng., Jr.E.I.C., National Foundry College Diploma in foundry management and technology. Applied experience includes cost savings development, work study and time standards, heat treatment, foundry work, ferrous and non-ferrous, steel melting and rolling, machining, specifications and standards writing. Particular background was specifically obtained for a supervisory or managerial position in the manufacturing or engineering field, or with a consulting firm. Location and size of company is not important. File No. 4648-W.

CIVIL ENGINEER Jr. E.I.C., M.Eng., McGill, age 34, 5 years diversified experience includes 2 years experience in laboratory testing soils, steel and concrete, and concrete design, 2 years R.C. and pile foundation designs, reviews R.C. and steel structures, soil investigations and soil reports. Pressure vessel designs. Has aptitude for report writing and indeterminate structural problems. Seeks employment with consultant, growing firm or growing construction company where knowledge, ability and hard work will eventually lead to responsible position or partnership. File No. 4706-W.

MECHANICAL ENGINEER, 26, Canadian citizen, Canadian degree, varied experience in Canada, British heavy engineering training under Athlone Fellowship. At present in heavy Swiss engineering plant. Working knowledge of French and German, experienced traveller, single. Seeks to use experience to best advantage upon return to Canada in September. File No. 4709-W.

METALLURGICAL ENGINEER, Jr. E.I.C., B.A.Sc., 1952, R.C.A.F. veteran, married. Employed since graduation in materials department of large manufacturing firm; engaged chiefly in selection of materials and processes, enquiry into new materials and processes, collection of data, specification writing, etc.; small amount of shop and laboratory

experience. Good background of industrial experience before graduation. Seeking employment in a metallurgical industry or closely related field. Opportunity to assume increasing responsibility with increased experience is an important consideration. File No. 4710-W.

CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.), Queen's 1949, desires supervisory position with contractor or consultants on engineering, highway or heavy building construction. Location Canada, Ontario preferred. Experience in construction, industrial engineering and technical sales. Able administrator. Age 36, married, two children. File No. 4712-W.

MECHANICAL ENGINEER 1943, McGill, desires position of senior responsibility in design, project, development or plant maintenance. Past experience: 2 years engineering teaching; 10 years on plant layout, machinery foundation, design of process piping, plant services, steam plants, combustion work, industrial furnaces, structural design building construction, field supervision. Also holder of B.A. degree, married, 2 children, and thoroughly bilingual. File No. 4713-W.

ELECTRICAL ENGINEER, B. Sc., P.Eng. (Ont), Jr.E.I.C., age 40, 1951 graduate, plant engineering, instrumentation, and administrative experience, seeks position in engineering sales. File No. 4714-W.

CIVIL ENGINEER, Jr.E.I.C., P.Eng., graduate N.S.T.C. 1952, age 27, married. Three years experience with construction company mainly in field work and supervision of residential and heavy construction projects. One year in residential construction including housing reinforced concrete, streets, water and sewer lines, sewage disposal plant, central heating. Two years experience in heavy construction on large mass concrete lock project including steel piling, cofferdams, earth and rock excavation. Good references available. Desires responsible position with opportunity for advancements. File No. 4715-W.

CHEMICAL ENGINEER, B.Sc., Alberta, 1948, Jr.E.I.C., married. Seven years experience in development and production in metallurgical industry. At present in charge of development group working closely with production. Capable of carrying production problems to completion with a practical viewpoint. Have had recent experience in new plant start up in foreign country. Desires position leading to responsibility, in Western Canada or Ontario. Available August. File No. 4716-W.

GRADUATE ENGINEER, Civil, Jr.E.I.C., McGill 1950, with extensive experience in railroad maintenance and considerable experience in allied works desirous of obtaining employment anywhere. Would seriously consider municipal engineering. Available on reasonable notice to present employer. File No. 4718-W.

MECHANICAL ENGINEER, M.E.I.C. & P.Eng. Ontario. Age 46, married. Eleven years diversified experience in design and development engineering in oil refinery and chemical plants including power house and process piping design. Eleven years in plant engineering in the plastics and chemical industry. Accustomed to dealing with management and personnel (technical and otherwise). Capable of organizing and administering. Interested in a position where capabilities will be fully utilized, and opportunity for advancement is available. File No. 4720-W.

SALES ENGINEER, young graduate mechanical engineer having acquired three years of sales experience with international precision machine tool corporation. Interested in position as sales representative involving responsibility and challenge in specialized technical field. 29, single, Canadian citizen presently residing in U.S.A. File No. 4721-W.

MECHANICAL ENGINEER, Jr.E.I.C. graduate from University of Denmark 1950, 32 years old, married. Two years manual shop experience. Five years experience in mechanical and structural design, materials handling, plateworks, heavy machinery, maintenance and development. Three years in Canada. Desires position with responsibility and opportunities. Available on one month's notice to present employer. File No. 4723-W.

ELECTRICAL ENGINEER, B.A.Sc., 1945, P. Eng., M.E.I.C., age 31, married with family, C.G.E. test course, presently employed. Excellent technical and practical background combined with administrative experience including 7 years complete charge of electrical engineering, design, construction, operation, and maintenance of large papermill and hydro electric stations including water control, transmission, relaying, and distribution. Other experience includes substation, illumination design and sales. Desires position in Canada or elsewhere with heavy industrial, power or consulting company where experience will be an asset. File No. 4725-W.

METALLURGICAL ENGINEER, Jr.E.I.C., returning to Canada in December after two years in England on an Athlone Fellowship. B.Eng. McGill 1953, Diploma in graduate studies (industrial metallurgy), Birmingham, 1954. One year experience in a British steel plant mostly in the melting shops (open hearth and electric furnaces). Undergraduate experience in nickel, copper and aluminum industries. Desires work in metal industry, preferably connected with production. Location open. File No. 4726-W.

CHEMICAL ENGINEER, Jr.E.I.C., M.A.Sc. U.B.C. (1953), Ph.D. (expected) Cambridge. Research experience in physical, radio, and radiation chemistry. Returning to Canada in October. Desires research or development work. Details furnished on request. File No. 4731-W.

ELECTRICAL ENGINEER, P. Eng. Quebec, B.A.Sc. 1949 Laval University, test course, age 28. Four years experience in sales of electrical apparatus, motors, controls, switchgear, metallic rectifier specialist, some knowledge of water conditioning. Two years with electrical contractor and motor repair shop, layout, estimate, supervision of industrial electrical installations, technical and administrative responsibility for service shop. Seeks challenging position with advancement and incentive for consulting engineers or contractor. File No. 4733-W.

YOUNG CIVIL ENGINEER, A.M.I.C.E., Jr. E. I.C., married, one child. Three years highway and bridge design (England), three years R.C. and steel, bridge and structural design (Canada). Desires interesting and responsible position in British Columbia, will consider other Western provinces. File No. 4734-W.

MECHANICAL ENGINEER Jr.E.I.C., P.Eng. Toronto graduate 1950, age 31, married, one child. R.C.A.F. aero engine mechanic 4 years. Wishes to offer training and experience in: pipe manufactures sales office ½ year, plant engineering 1½ years, test and development of combustion engines including design and liaison with all company departments involved in procurement and manufacturer of test models 3 years. Desires work in sales or a position in industry where initiative and the ability to get a job done will lead to an executive position. Prefer Niagara or Southern Ontario. File No. 4735-W.

CIVIL ENGINEER graduate of London University 1937 P. Eng. M.E.I.C., M.Jnr.Ins. Engineers, age 40 with the following experience: 10 years on design, estimating and construction, 2 years in supervisory capacity and 4 years in administrative post, requires post in Ottawa locality. File No. 4736-W.

CIVIL ENGINEER, Dipl.Ing., Jr. E.I.C., 37, and married, European University graduate, seeks permanent employment as design engineer with well established consulting firm. European experience: 4 years factory construction and hydraulic calculation in hydroelectric power field. Experience in Canada: 2 years engineering design of commercial and industrial buildings, involving design of foundations. R.C.-steel and wood structures. Excellent references. Presently in permanent position. Preferred location in Western Canada. Available one month after agreement is reached. File No. 4737-W.

MECHANICAL ENGINEER, Jr.E.I.C., Canadian University Graduate, 25, with 2 years experience in heavy engineering design. Mother tongue English, reasonably fluent French, some German. Presently living abroad, desires employment in machine tool sales, service, or field engineering with Canadian Machine Tools. Training period in Canada, or on the continent considered. Available on reasonable notice to present employer. Reply File No. 4740-W.

MECHANICAL ELECTRICAL ENGINEER, P.Eng., Jr.E.I.C., B.A.Sc. (Hons.), Toronto 1951. Four years field engineering (Sales) with prominent electrical manufacturer. Promotion and representative duties. Electrical layout and estimating for application and usage of electrical distribution and motor control equipment. Administrative and associated duties. Desires position offering supervisory experience with scope for initiative. Further details upon request. Travel not objectionable. Would locate in one month. Prefer S.W. Ontario, Western Canada or U.S.A. File No. 4741-W.

CIVIL ENGINEER, M.E.I.C., University of New Brunswick 1933. Experience includes considerable travel in Maritime Provinces, Newfoundland and Ontario. Fully acquainted with many phases of construction and complete knowledge of concrete design and laboratory testing. Seeks opportunity where diversified experience could be best utilized. Not adverse to travel. File No. 4742-W.

ADMINISTRATIVE POSITION sought by young (29) bilingual, mechanical engineer, Jr.E.I.C., M.B.A., married. Retired naval engineering officer. Five years industrial experience in technical sales, industrial engineering and maintenance supervision. Willing to relocate anywhere in or outside Canada. Resume sent on request. File No. 4743-W.

MECHANICAL ENGINEER, Jr.E.I.C., B.Eng. (1948), M.Eng. (1950), Ph.D. (1953), McGill, single, age 28. Experience includes three years on a Canadian coal-burning gas turbine research and development project, involving thermodynamic and heat transfer analysis, stress analysis and mechanical design. Has also spent one summer on a similar American project. Has done research in heat transfer and gas turbine combustion. At present teaching thermodynamics and machine design at an eastern Canadian college. Desires position in industry where qualifications may be utilized. Available on short notice. File No. 4744-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), B.A.Sc. University of Toronto, 1949, Age 30, married with 2 children. 3 years experience as electrical mechanical field engineer in steam and power plant responsible for operation and maintenance of associated equipment, supervision of new construction, liaison with consultants and contractors, etc. 2 years electrical design experience covering building power and lighting, design for new boiler installation, petrochemical plant electrical design, etc. 1 year experience in administration of large construction and building program. Seeks responsible, permanent position with good future and scope where experience can be utilized. File No. 4745-W.

CIVIL ENGINEER, Jr.E.I.C., P.Eng. (Man.), 1952 graduate. Experience in both field and office work in municipal engineering. Will consider any offer of employment for qualified civil engineer. 1 year experience with engineering department of railway, 2 years experience with consulting municipal engineers, 1 year as assistant city engineer. Single. Age 25. Location of work no object. Available on one month's notice to present employer. File No. 4747-W.

CIVIL ENGINEER, D.R.T.C., A.R.T.C. (Glasgow), 1949 P.Eng. (Alberta), M.E.I.C., age 32, eight years experience in municipal engineering. Heavy and light construction work, reinforced concrete and steel construction and design, hydraulic design, bridges, irrigation, drainage and roads. Wishes job of some responsibility in structural design with varied interest and good future prospects. Precis of experience and qualifications can be supplied on request. File No. 4748-W.

ELECTRICAL ENGINEER, 27, married, two children, 1949 honors graduate, masters degree, Westinghouse training course, four years with Montreal consultant, desires to relocate. Experience includes distribution, relaying, generation and system studies. Foreign service acceptable. File No. 4750-W.

ELECTRICAL ENGINEER, age 32, married, graduate (England), seven years experience in high voltage laboratory of a cable company, specialized in high voltage impulse testing of cables and accessories, design of portable impulse equipment, electronic impulse measuring and recording apparatus, seeks situation in Ontario. Membership of the Association of Professional Engineers applied for. File No. 4751-W.

MECHANICAL ENGINEER, P.Eng. (Alta.), M.E.I.C., graduate 1950, 30 years old, married, two children. Experience 2 years as works manager of steel fabricating and machine shop, 3 years as estimator, project engineer and superintendent on construction of bridges, buildings, water lines, sewer lines, and road. Desires employment with opportunities for advancement. File No. 4752-W.

CHEMICAL ENGINEER patents, B.A.Sc., Toronto 1954, P.Eng. S.E.I.C., age 28, married, 2 children. Experience includes some plant experience, a years experience in patent department of U.S. chemical manufacturing firm, patent office organization, search reports, validity investigation, preparation of patent applications and amendments. Desires position in small patent department of a chemical manufacturer or as liaison engineer with outside patent firm, offering responsibility, scope and future. File No. 4753-W.

MECHANICAL ENGINEER, very good manufacturing background, extensive management experience in engineering and quality control, strong bent for product design in relation to sales' needs. 9 years experience one company on domestic laundry equipment, ranges, water heaters, first as chief engineer, then product development manager with sales, preceded by 9 years design on industrial equipment involving fabrication, welding, machining, stressing and electrics. B.A.Sc.

Toronto, M.E.I.C., P.Eng., age 44, married, living in Toronto. Would relocate. File No. 4754-W.

MECHANICAL AND INDUSTRIAL ENGINEER, P.Eng., Jr.E.I.C., Physics degree, honors degree in mechanical engineering from Canadian University, 1951. Master's degree upon completion of thesis. Test course, industrial engineering course. Age 28, married. Captain, Army Reserve. Desires responsible position in junior management, industrial engineering, design, development, or production control. Particularly interested in cost reduction. Good experience in above fields, also some plant engineering and heating experience before graduation. Prefers Toronto-Hamilton area but will take right position anywhere. File No. 4755-W.

SITUATIONS VACANT

CHEMICAL

CHEMICAL SALESMAN for Montreal area to represent an established manufacturer of fine chemicals, offering a wide range of products reinforced by intensive research and development policies. Primary responsibility will be industrial accounts. Preferred qualifications include technical degree, several years experience in field work, ability to plan and execute without close direction, age under thirty-five, own automobile. Liberal employee benefits, salary commensurate with qualifications. Replies will be held in confidence. Please submit full details of training and experience by letter only to File No. 5195-V.

TWO SALES ENGINEERS wanted with plant maintenance experience preferred, but not necessary, to sell corrosion resistant cements, coatings, pipes, tanks, etc. We prefer chemical engineers and require one each for Quebec and Ontario. Salary and expenses plus profit sharing. File No. 5199-V.

ATOMIC ENERGY OF CANADA Limited has openings for chemical engineers for their expanding program on atomic power development. The work will be mainly the development of full preparation and processing methods, cost analysis and equipment development. Candidates must have a good academic background, preferably with some graduate training. Some industrial experience is essential. The responsibilities and salary depend on the qualifications of the candidate. State particulars including age, marital status, education and experience in first letter. File No. 5206-V.

TWO GRADUATE CHEMICAL ENGINEERS or chemists required for a newsprint and specialty mill, located in Province of Quebec. Some experience in pulp and paper desired but not essential. Excellent opportunity for advancement. Salary dependent on experience and ability. Initial letter to include full resume of experience and references. File No. 5231-V.

SENIOR PROCESS ENGINEER is required by large petrochemical cellulose acetate and synthetic yarn plant near Edmonton. Minimum of five years experience since graduation is required. Experience in field of petrochemicals is preferred. This is a permanent staff position and the opening is immediate. Write stating personal information, experience in full detail, salary required, and date available to File No. 5246-V.

TWO GRADUATE CHEMICAL ENGINEERS, required with 2 to 5 years experience in the petro-chemical or rubber industries. The type of work which these men will do will be process control, raw material and product control process modification and design work. Location Ontario. File No. 5254-V.

CHEMICAL ENGINEER OR CHEMIST for medium sized manufacturer in an Ontario town on the St. Lawrence River. Experience in wire and cable business useful. Write giving age, education, marital status, complete details of experience, and salary required. File No. 5268-V.

SALES ENGINEER required to sell and service the application of specialized chemicals to industrial accounts. Largest and most progressive company in its field. Applicants may be graduates of any field with 1 or 2 years experience in industry or sales. Applicants will probably travel Quebec area but should be willing to work across Canada. File No. 5287-V.

CIVIL

CIVIL ENGINEER preferably recent graduate, for bridge section of large transportation company with headquarters in Montreal. Duties include design for steel and reinforced concrete structures, preparation of reports and some travelling. File No. 5127-V.

CIVIL ENGINEER required by Provincial Government Department with headquarters in Toronto. To assist in the design and construction of small timber and concrete dams and maintenance and operation of locks and dams, etc., throughout the Province of Ontario. Applicant should have experience in the construction of timber and concrete dams. Salary can be arranged to meet qualifications. Permanent position with illness, vacation and pension privilege if applicant proves satisfactory after a trial period. File No. 5180-V.

ARCHITECTURAL DESIGN, structural engineers and draughtsmen required for long range industrial program in an established consulting office. Must be experienced and capable of checking design drawings. Draftsmen experienced in structural steel detailing. Send complete resume of experience. Location Toledo, Ohio. File No. 5181-V.

ESTIMATOR QUANTITY SURVEYOR, required by construction company in Ottawa. State qualifications, age, marital status, experience, salary expected. Replies will be treated confidentially. File No. 5187-V.

CIVIL ENGINEER (Junior) required by established public utility supervisory-consulting organization, 2-3 years experience, preferably in field on construction and/or surveying, for work connection design and operation hydro systems, also structural, foundations for steam and diesel plants. Location New York. Some travel field future. Reply stating age, education, experience, personal particulars, minimum salary expected. File No. 5193-V.

MUNICIPAL ENGINEER required by Montreal suburb. Graduate engineer with two or more years experience in layout and supervision of watermain and sewage extensions, street and sidewalk construction. Reply stating age, experience, education, salary expected and telephone number to File No. 5203-V.

ENGINEER, ARCHITECT OR ESTIMATOR wanted for young construction company doing sewers, roadwork and building. Apply stating age, experience, references and salary expected. File No. 5205-V.

CIVIL ENGINEER with a minimum of 4 years experience in supervision and design of heavy engineering works. Duties would consist of supervising, during the coming summer, the construction of roads, sewage and water supply for community located in the Province of Quebec. During the winter would be located in Montreal office and work on design in the civil engineering field. File No. 5208-V.

GRADUATE CIVIL ENGINEER with at least three years experience. Man to be employed on the design, construction and maintenance of reinforced concrete, building structures and building services. He would also have other duties such as the maintenance of roads and lands, occasional instrument surveys and other civil engineering work. Location Province of Quebec with large chemical plant. File No. 5210-V.

QUALIFIED CIVIL ENGINEER for road work and excavating. Man required should bave at least five years experience in the field. Duties woold require him to be able to accurately estimate costs on this type of work and supervise the field work. Location Ontario. File No. 5222-V.

CIVIL ENGINEERS. Continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and developing communications systems involving uses of the latest types of microwave equipment, network TV transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known, it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary: commensurate with experience and ability. File No. 5227-V.

YOUNG ENGINEER required by a Montreal construction company. Applicant must be bilingual and have experience in construction. State age, education and business experience in first letter to File No. 5232-V.

ASSISTANT CITY ENGINEER required for St. Thomas, Ontario. The salary will depend on the qualifications of the person who is appointed. Applicant should be either Professional Engineer of Ontario, or qualified to receive registration on application. Some experience in municipal work is desirable, particularly in the matter of sewers, both design and construction, and roadways. Opportunity for city engineer's position in near future. File No. 5261-V.

FIELD ENGINEER required in Montreal who has preferably had experience in working on housing projects, relative to instrument work for elevations, etc., blue-print reading, etc. File No. 5263-V.

CITY OF WINNIPEG, engineer's department requires design engineer (civil). Applications are invited from engineers, with pump or other hydraulic municipal services design experience. This is a permanent position. Salary in accordance with experience. File No. 5264-V.

ASSISTANT CIVIL ENGINEER required by an established public utility supervisory-consulting organization. Age 30-45, minimum 5 years experience on structural steel, reinforced concrete and foundation design of steam electric power plants. Location New York. Some travel field future. Reply stating age, education, experience, personal particulars. File No. 5271-V.

GRADUATE CIVIL ENGINEER for head office sales work with firm engaged in engineering manufacturing and erection of industrial and commercial building products. Responsibilities to include administration, technical and structural calculations and product application engineering. Prefer applicant with minimum two or three years experience in structural steel design and potential for eventual position as field sales engineer. Location Niagara Peninsula. Salary open. File No. 5275-V.

SALES ENGINEERS. Recent graduate civil engineers required to train for positions as field sales engineers with firm engaged in engineering manufacturing and erection of industrial and commercial building products. Extensive training program provided. Immediate location, Niagara Peninsula. Salary open. File No. 5275-V.

CIVIL ENGINEER, 1955 or 1954 graduate for the position of planner with paper company located in Quebec. The applicant should be interested in detailed maintenance and construction of buildings. His duties would be to assist in planning work of building maintenance. File No. 5295-V.

MUNICIPAL ENGINEER, with one or two years experience, required by the Department of Municipal Affairs and Supply in Newfoundland. Man to be employed on topographic surveys, preparation of water and sewer design and road and bridge construction. Salary $4600-$4900. Replies should state qualifications, age and experience. File No. 5297-V.

ELECTRICAL

ELECTRICAL ENGINEER required as junior or assistant distribution engineer. Graduate with at least 3 years field experience operating U.S. or Canadian Public utility. Permanent position with long established consulting organization New York. Some travel Latin America necessary in future. Knowledge of Spanish or Portuguese useful. Salary commensurate with experience. Reply giving age, education, experience and personal particulars. File No. 5042-V.

GRADUATE ELECTRICAL ENGINEERS, one senior — two juniors. Senior at least 10 years experience — junior 3-5 years experience in electrical design, operation and construction of steam, hydro plants and sub-stations. Permanent position with long established consulting organization for public utility operating companies located Latin America. Headquarters New York. Some travel necessary in future. Knowledge of Spanish or Portuguese useful not essential. Salary commensurate with qualifications. Good opportunity. Reply stating age, education, experience and personal particulars. File No. 5118-V.

GRADUATE ELECTRICAL ENGINEER to assume responsibility for design and development of distribution and small power transformers with manufacture established in

SALES ENGINEERS

Recent graduate civil engineers required to train for positions as field sales engineers with firm engaged in engineering manufacturing and erection of industrial and commercial building products. Extensive training program provided. Immediate location: Niagara Peninsula. Salary open. Apply File No. 5275-V.

MECHANICAL ENGINEER

REQUIRED FOR SUPERVISION OF DESIGN FOR A VARIETY OF HEAVY MACHINERY. APPLICANT MUST BE AN ENGINEERING GRADUATE OR HAVE EQUIVALENT STATUS, 35 TO 40 YEARS OF AGE, CAPABLE OF PROMOTING DESIGN FOR BOTH ECONOMY AND PRACTICABILITY, AS WELL AS CONTROL OF QUALITY CONSISTENT WITH DESIGN INTENT AND FACILITIES OF MANUFACTURE.

PLEASE REPLY IN DETAIL, STATING EXPERIENCE, EDUCATION, ETC. ALL REPLIES WILL BE KEPT IN STRICT CONFIDENCE.

SALARY COMMENSURATE WITH EXPERIENCE AND QUALIFICATIONS. OFFICE AND SHOPS IN MONTREAL AREA. FILE NUMBER 5282-V.

Alberta. At least one year's design and/or manufacturing experience desirable. Applicants to give personal data (including recent photo), education, experience, reference and minimum initial salary expected. File No. 5131-V.

SENIOR ELECTRONIC ENGINEERS and physicists are required by a leading Canadian firm to carry out design and development work in the fields of radar, microwave communications, telephony and AM and TV broadcast equipment. All replies are confidential and will be acknowledged. Location Toronto, Ontario. File No. 5135-V.

PROJECT ENGINEER (electrical and electronic) to design electrical and electronic installations in aircraft and to supervise a small section of electrical and mechanical draughtsmen. Applicants should have a degree in electrical engineering or mechanical engineering with electrical subjects as a strong secondary and preferably 5 years experience in design of electrical and electronic installations in aircraft. Experience in supervision of draughtsmen desirable. Salary commensurate with experience and qualifications. Reply stating age, education, experience, personal particulars and salary expected. File No. 5147-V.

JUNIOR ELECTRICAL ENGINEER, required to act as an assistant to the distribution engineer. Please state education, experience, and salary expected. Replies will be held strictly confidential. Location Ottawa. File No. 5188-V.

ELECTRICAL ENGINEER university graduate of two or three years experience in electrical field and above average literary ability. Permanent employment in Ottawa with well known industrial association, pension plan. File No. 5217-V.

ASSISTANT PROFESSOR electrical engineering duties: to instruct undergraduate studies and develop post-graduate work. Time and facilities for research. Qualifications university graduate, preferably some post graduate training, several years practical experience which may include industrial graduate engineer training course. Location Maritime Province. File No. 5220-V.

ELECTRIC AND ELECTRONIC ENGINEERS continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and developing communications systems involving uses of the latest types of microwave equipment, network T.V. transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known, it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary commensurate with experience and ability. File No. 5227-V.

A GRADUATE ELECTRICAL ENGINEER to assist in the laboratory and lecture work of the department of electrical engineering. The appointment will be made initially on the basis of sessional lecturer after which the appointment may be made permanent. Duties to commence September 1st, 1955. Apply to Dean of Engineering, University of Alberta, Edmonton. File No. 5233-V.

THE LARGEST CANADIAN OWNED electronics company has immediate openings in its engineering department. These are highly paid permanent and interesting positions with excellent opportunities for advancement. Successful applicants will be employed as project supervisors or senior design engineers in a field exclusive to this company in Canada. The applicants should possess a degree in electrical engineering from a Canadian, British or American University, or hold equivalent academic standing such as the Higher National Certificate and have 3 to 5 years industrial experience. Starting salaries are commensurate with proven ability and experience. Local interviews will be arranged. Pleasant working conditions in modern plant, 5 day week, full program of employee benefits. File No. 5240-V.

ELECTRICAL ENGINEERS required with experience in the design of power transformers. Full employee benefits. Large manufacturer in Ontario. File No. 5242-V.

ENGINEERS required for development in connection with telephony magnetic amplifiers, radar, transistor circuits, fire control systems and other servo operated instruments for both military and commercial application. The continuing expansion of work in our engineering department offers opportunities for both senior and intermediate engineers. Previous experience in fire control or electro-accoustical systems is desirable and supervisory ability would be an asset. Location Montreal. File No. 5244-V.

SALES ENGINEER, required to sell communications equipment in the Montreal area. Applicants must be bilingual and have an extensive electrical background. Above average remuneration on a base salary plus commission arrangement. Car, company benefits and excellent future with expanding company. File No. 5245-V.

ELECTRICAL ENGINEER. Toronto manufacturer requires graduate electrical engineer with some mechanical design experience for product development work on transformers and substations. File No. 5247-V.

TWO DESIGN ENGINEERS for commercial vehicle design. Good opportunity with a sound future for a graduate mechanical engineer, who has had practical experience in structural design. Location Ontario. File No. 5251-V.

GRADUATE ELECTRICAL ENGINEER to inspect electrical work comprising unit substations, 6600-V distribution, and 550 volt wiring for motors and controls, at Dominion Wabana Ore Limited mine at Belle Island Wabana, Newfoundland. This work will last until the end of September. File No. 5252-V.

GRADUATE ELECTRICAL ENGINEER to eventually superintend maintenance and operation of electrical equipment underground and on surface at a mine in Newfoundland. Should be about 35 years of age and have mining experience. File No. 5252-V.

TELEVISION BROADCAST ENGINEER required by Ontario manufacturer. Must be familiar with television transmission equipment including camera chains, transmitters, antennas, etc. Must be qualified to lay out television studio broadcast equipment and prepare technical briefs covering television station operation. Considerable customer contact will be involved. Position may develop into sales engineering in the television field. File No. 5256-V.

RADIO COMMUNICATIONS ENGINEERS for research and development on HF and UHF equipment required by Ontario manufacturer. Some practical experience in this field essential. This is a varied and interesting position with a small but rapidly expanding communications company with excellent opportunities for future progress. File No. 5256-V.

ELECTRICAL ENGINEER required by engineering consultants engaged in the thermal and electrical power field. While employees may expect to be located in Toronto, it is possible that successful applicant spend a year or more in Britain, becoming familiar with the nature of the work. File No. 5267-V.

JUNIOR ELECTRICAL ENGINEER required by paper company located in Province of Quebec. Graduate engineer preferably 1950 interested in working in the engineering and operating fields. File No. 5269-V.

GRADUATE ELECTRICAL engineer with several years experience in plant mechanical work required by a prominent Montreal industrial engineering firm. Experience in air conditioning and plant mechanical design desirable. Position involves supervision of all mechanical and electrical design and offers possible participation in the firm for the right man. Five day week with Blue Cross and pension plan. Reply should detail education, experience, personal qualifications and starting salary required. File No. 5286-V.

ELECTRICAL ENGINEER required by paper makers with at least two years experience in paper mill or other industrial work. Initially his work will consist of design on specification of paper mill electrical equipment. Good starting salary. File No. 5295-V.

MECHANICAL

MECHANICAL ENGINEER required by automotive manufacturing company in Montreal. Applicant should be between the ages of 30-40 and preferably bilingual with experience in internal combustion engines. Duties will include the study of quality problems and production planning. File No. 5178-V.

MECHANICAL ENGINEER with 5 years or more experience in materials handling. Age 28-35. Must be Canadian citizen and must be registered professional engineer in Canada or qualified. Position headquarters in Minneapolis, Minnesota, with heavy travel in Canada. Prefer man with materials handling or packaging experience in food industry, but can consider others. Position offers good salary, opportunity and permanence. Reply giving complete information regarding personal history, education, and experience. File No. 5184-V.

RCA VICTOR COMPANY, LTD.

has immediate openings for ELECTRONIC ENGINEERS

General company exponsion has created several opportunities far men with proven ability ond experience far the design and development af complex electronic apparatus. There are openings for electrical and mechanical engineers in the following fields:

Electronic Computers Microwave Reloy Systems Test Equipment Design and Development Systems Engineering Transistors

If you ore interested in improving yaur profassianal status and knawledge by jaining a firm thot offers the security ond prestige of leadership, send full details as ta age, education and post experience by mail. All replies will be held in strict confidence and will be acknowledged. Address replies to:

Employment Manager: 901 Lenoir Street, Montreal, Quebec

A RECENT GRADUATE MECHANICAL ENGINEER, bilingual, is required by a large Western Ontario firm. This position involves travel and would be best filled by a young man who likes people and is interested in the sales and service of diesel engines. File No. 5186-V.

GRADUATE MECHANICAL ENGINEER with steam plant experience preferably in a central station utilizing pressures of 850 P.S.I. and temperatures of 900 degrees. Opportunities for advancement are excellent for right man interested in career in Latin America with a Canadian electric utility. Location Maracaibo, Venezuela. Housing provided. Salary open depending on experience and qualifications. File No. 5190-V.

MECHANICAL PLANT BETTERMENT ENGINEER, required by operating division of supervisory-consulting organization, for public utilities located eleven Latin American countries. Mechanical engineering graduate preferred with 5 to 10 years experience operation and betterment of steam electric plants. Diesel experience helpful. Some travel. Knowledge of Spanish desirable but not necessary. Location N.Y. Reply giving age, education, experience, personal particulars, minimum salary expected. File No. 5192-V.

MECHANICAL DESIGN ENGINEER required in Bathurst, New Brunswick, who has graduated from a recognized Canadian University and who has had two years experience in the machine shop and steel fabricating industry. Duties will include development and design of earthmoving and industrial equipment. Reply with details of education, experience, and age together with salary range required. File No. 5196-V.

DESIGN ENGINEER required by a firm in Hamilton, Ontario, for development and product design of sheet metal working machinery such as presses, shears, and roll forming machines. Applicant must have at least four years of machine design experience and preferably a graduate engineer. He must be able to design and develop such equipment with a minimum of supervision. Replies should outline qualifications, experience, age and salary expected. File No. 5200-V.

YOUNG MECHANICAL ENGINEER for work in connection with process plant. Previous experience in industry is not essential but it is possible that the successful applicant may be required to spend a short initial training period with our parent companies in England. Organization is part of a large world-wide engineering organization. File No. 5202-V.

MAINTENANCE ENGINEER required for new 12,000 BPD refinery at Winnipeg to be directly responsible to mechanical superintendent for all maintenance problems, materials, and scheduling and supervision of maintenance personnel and shop. Preferably mechanical engineer with five to ten years experience in general refinery engineering, maintenance and metals inspection, and with potential for future promotion. Remuneration will be negotiated. Send full details of previous experience and responsibility, and recent photograph to File No. 5204-V.

MECHANICAL ENGINEER for plant engineering work in the viscose rayon industry. Duties will include investigations, reports, design, and supervision of plant engineering activities, including maintenance, alterations. Must be graduate engineer age 26 to 35 with several years of practical experience in plant engineering work. Must have ability to take over leadership of a group and be prepared to make his own decisions and be responsible for them. Preferably should also have had full or partial trade apprenticeship training in industrial or plant. Position will be permanent, and offers excellent opportunity for advancement to the right man. Applications should contain all necessary personal data and full information about previous engineering experience. File No. 5207-V.

MECHANICAL ENGINEER as plant engineer for large plant manufacturing fibre conduit pipe at Cornwall, Ontario; three or four years mechanical engineering experience with some knowledge of machine design; starting salary $400-$450 per month. File No. 5212-V.

MECHANICAL ENGINEER required by plant engineering department in Montreal. Responsibilities will be to design processing equipment for plating, anodizing, cleaning, degreasing, etc. 5-7 years experience in plant engineering or process planning is a requirement. Please apply in writing giving full details of education, experience, past earnings and personal history. File No. 5221-V.

MECHANICAL ENGINEER required by American chemical company establishing in P.Q. Applicant should have some experience in plant maintenance and general engineering. Position offers good opportunity and will include training in U.S. plant. File No. 5224-V.

MECHANICAL ENGINEERS. Continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and development communications systems involving uses of the latest types of microwave equipment, network TV transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known, it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary commensurate with experience and ability. File No. 5227-V.

PERFORMANCE ENGINEER required who, in addition of having a degree in engineering or science should possess a strong mathematical background. A knowledge of hydraulics and aerodynamics essential and experience in servo-mechanisms most desirable by manufacturer of aircraft engine fuel systems located in Toronto. Apply with full details as to experience, age, education, etc., and state approximate starting salary required. File No. 5228-V.

ENGINEER BETWEEN 30 and 40 years of age with sound knowledge of mechanical engineering to take up responsible position as sales engineer with a St. John's Newfoundland company. Applicants should write stating education, training and experience. Knowledge of selling desirable but not essential. Field of sales would cover a wide line of heavy engineering items. An applicant should be prepared to travel fairly frequently within the Province. All applications will be strictly confidential and salary etc. can be discussed when application is received and suitability of applicant determined. Reply in own handwriting to File No. 5229-V.

Chemical engineer required for large cement plant in Toronto area, for running the chemical and physical test laboratories. Analytical background and some industrial experience desired.

A training period of 1 year will be given at the Quebec plant.

Apply to:

D. A. Schneider
St. Lawrence Cement Co.,
P.O. Box 1156,
Quebec, P.Q.

GRADUATE CIVIL ENGINEER

for head office sales work with firm engaged in engineering manufacturing and erection of industrial and commercial building products. Responsibilities to include administration, technical and structural calculations and product application engineering. Prefer applicant with minimum two or three years experience in structural steel design and potential for eventual position as field sales engineer. Location: Niagara Peninsula. Salary open. Apply File No. 5275-V.

JUNIOR ELECTRICAL ENGINEER

(P.Eng. Prov. Ont.) required as assistant to chief electrical engineer for large new industrial plant in Toronto area to be built by established Canadian industry. Should have reasonable experience in layout drawings and wiring diagrams for distribution, control, instrumentation and lighting. Experience in field supervision or other practical experience desirable. Please give details of age, education, experience and other relevant information to File No. 5290-V.

Applications are invited for the position of Assistant Professor of Applied Mechonics, duties to commence on September 1, 1955. Salary $4,000.00 plus a cost-of-living bonus of about $300.00; the annual increment is $250.00. Duties will include teaching and research. Confirmation of the appointment will be subject to the satisfactory completion of a probationary period of two years. Applications should be addressed to the Dean, Faculty of Engineering, University of Alberta, Edmonton, Alberta, Canada, and should give personal data, details of training and experience, the nomes of three referees, and be accompanied by a recent photograph. Closing date August 1, 1955.

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A GRADUATE MECHANICAL ENGINEER to lecture in thermodynamics and or machine design and assist in laboratory instruction. Appointment to be on sessional basis for the first year after which a permanent appointment as lecturer may be made. Duties to commence September 1, 1955. Apply to Dean of Engineering, University of Alberta, Edmonton. File No. 5233-V.

YOUNG MECHANICAL ENGINEER, preferably not over thirty years of age required for newly constructed plant in Montreal by large world wide manufacturer. To act as supervisor of building and mechanical maintenance departments. Experience not entirely necessary but useful. File No. 5234-V.

MECHANICAL ENGINEERS with or without paper mill experience required for large pulp and paper company in the Province of Quebec. Work available in either engineering or operating departments. Salary commensurate with experience and ability. Please reply to File No. 5235-V.

MECHANICAL OR METALLURGICAL ENGINEER interested in sales work required by progressive steel foundry to assume sales promotion responsibilities. Foundry experience an asset. Bilingualism a help. Location Montreal. Salary open. Car provided, pension plan and other benefits. Write outlining experience, qualifications and approximate salary required. File No. 5238-V.

MECHANICAL ENGINEER with executive ability required for manufacturing plant, located in Montreal, expanding operations. Please submit full details as to past experience, marital status, etc., to File No. 5239-V.

GRADUATE ENGINEER required as plant engineer. Duties entail supervision of three draughtsmen in the engineering department, and estimating miscellaneous metal contracts for construction of buildings, shop drawings, mechanical design such as conveyors and platework. This position will be permanent and salary will be commensurate with experience and ability. Location Maritimes. File No. 5241-V.

MECHANICAL ENGINEER required with six to eight years experience on pressure vessel design, medium to heavy structural steel or plate design. Full employee benefits. Large reputable manufacturer in Ontario. File No. 5242-V.

MECHANICAL ENGINEER newly graduated or with two or three years experience to work in the development and research engineering department of large mechanical manufacturer located outside Montreal. File No. 5243-V.

MECHANICAL ENGINEER required, and whose duties will include general mechanical design on a variety of projects associated with the commercial application of atomic energy. Applicants should have a minimum of 4 years experience, a small portion of which should be in the electrical field. Engineering graduates of Canadian or British universities preferred. Please reply in writing giving full details of education and experience to File No. 5259-V.

THOROUGHLY EXPERIENCED INDUSTRIAL engineer required by manufacturer of large range of heavy mechanical equipment. Applicant should be of department head calibre and capable of setting up and administering an industrial engineering group. A mechanical engineering degree and five years of applicable experience are preferable qualifications. File No. 5265-V.

SALES ENGINEERS required by Montreal manufacturer of a wide range of heavy mechanical equipment. Applicants should be graduate engineers, in the age bracket of 25 to 35, with a minimum of perhaps three years sales experience in mechanicial equipment or allied lines. They must be mature and personable with strong sales or sales administration interests and aptitudes. File No. 5266-V.

MECHANICAL ENGINEER required in construction department of pulp and paper company located in Maritime Provinces. Engineer with experience in design and installation of power plant equipment. We are contemplating the installation of an 850 p.s.i., 200,000 lb. hr. power boiler, oil fired. File No. 5277-V.

APPLICATIONS WILL BE RECEIVED BY THE

Federal District Commission for the position of Director of Planning. The duties of this position will be to supervise the planning staff dealing with the National Capital District and to attend meetings of consultation with all bodies responsible for phases of this planning. Applicants should be architects, engineers or landscape architects, who have full professional qualifications in their respective professions and who have also had extensive experience in the field of Community Planning.

Apply in writing on or before August 1, 1955, to the undersigned stating salary expected. Prior to final selection, a personal interview will be arranged with those deemed suitable on the basis of the applications.

H. R. CRAM,
Assistant General Manager and Secretary,
Federal District Commission,
291 Carling Avenue,
Ottawa, Ontario.

MECHANICAL ENGINEER to take charge of mechanical department of a prominent Montreal industrial engineering firm. Experience in air conditioning design, steam plant and plant mechanical services required. For an experienced man with good personality this position offers an unlimited future including participation in the firm. Five day week with blue cross and pension plan. Reply should detail education, experience, personal qualifications and starting salary required. File No. 5286-V.

MECHANICAL ENGINEER or engineering physics graduates of 1953, 1954 or 1955. We have an opportunity for an engineer with a desire for a future in sales engineering work in heating, ventilating, air conditioning and power plant equipment. You would take a training program which includes a five months graduate engineering course in sales, research, design, and product engineering in United States, after which you would return to a Branch office of our company in Canada. Your inquiry for further information will be treated as highly confidential. File No. 5298-V.

MISCELLANEOUS

HYDRAULIC ENGINEERS, salary up to $7,200 per annum, depending upon qualification for St. Lawrence River Joint Board—competition 55-1252. Northern affairs and National Resources, Ottawa, competition 55-1250. Quote competition number. File No. 5182-V.

NATIONAL RESEARCH COUNCIL division Building Research Ottawa requires a physic or engineering physicist, to assist with t Division s Fire research program. Qualific tions: applicants must be graduates from recognized university. Salary commensura with qualifications. The program is intend to reduce the toll of life and the immen property loss which arise from fires in kinds of buildings in Canada. A wide gener scientific knowledge and originality and ve satility in experimental work are more des able than any advanced specialization; b an interest in measurement of therm radiation and flame temperatures, in u steady-state heat transfer and in statisti would be an advantage, and the capacity write reports which are clear to the publ is indispensable. File No. 5183-V.

AN EXPANDING CANADIAN company h openings for engineers of university gradua or equivalent status preferably with g turbine experience in the following field Experience in gas dynamics problems desir and the ability to assume responsibility f organizing and executing detailed progran for the development of gas turbine combuste and related equipment. Vibration enginee with previous experience preferred in vibr tion problems on gas turbine blading ar engine structures. The work will include dire tion of laboratory, test house and flight vibr tion tests in addition to analysis of test dat Location Ontario. File No. 5185-V.

A DIESEL LOCOMOTIVE manufacturer Western Ontario requires recent graduate electrical and mechanical department. Th position will involve design, development ar testing of the locomotive and its component Experience not essential. File No. 5186-V.

ENGINEER WITH SOIL EXPERIENCE an soil mechanics training for interesting pos tion in Montreal. Should be professional e gineer or eligible for registration in Quebe This position has good prospects for an inte ligent engineer with initiative who has a re sonable amount of soil training with labor tory and field experience. The position i volves some work in other fields where an type of engineering experience will be a asset. Please give details of education an experience and other relevant information File No. 5194-V.

MECHANICAL OR ELECTRICAL ENGINEE recent graduate, required as project engine for expanding progressive company of e gineering contractors specializing in industri combustion applications. After a brief trainin period he will make surveys, estimates, pr posals and become responsible for desig installation and operation. Location Montre and vicinity. Salary commensurate with qu lifications. Please reply stating experienc or background. File No. 5197-V.

ELECTRICAL OR METALLULGICAL ENG NEER, recent graduate, required by machin

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CIVIL OR MECHANICAL ENGINEER

For the Engineering Staff of a Two Machine, High Speed Newsprint Mill.

Applicants should preferably, but not necessarily, have had some experience in engineering work in the poper industry. Solary commensurote with experience and quolifications. Reply stating oge, education, experience, personal particulors, ond salary expected to:

Personnel Manoger,
Mersey Paper Compony, Limited,
Liverpool, Nova Scotia.

TWENTY-FIVE (25) OPPORTUNITIES
for
ELECTRICAL AND MECHANICAL ENGINEERS

TO UNDERGO TRAINING AS PATENT EXAMINERS WITH THE FEDERAL GOVERNMENT AT OTTAWA

Good Careers – Numerous Benefits
Starting Salaries Up to $4,620

For additional information write to:

Civil Service Commission of Canada
Ottawa
Ask for Circular B297

tool house to train for service and sales of technical production machinery in the plastics, electronic and metallurgical field. Location Montreal. Territory Eastern Canada. File No. 5209-V.

MECHANICAL OR CIVIL ENGINEERS required by a large metallurgical company located in Southern Ontario as designing draftsmen. Some experience required in either plant layout, reinforced concrete structural steel or materials handling. Please reply giving details of experience and salary required. File No. 5213-V.

ENGINEER REQUIRED with 5-10 years experience in Production control covering stores functions, physical inventory operations, and dispatch and/or scheduling functions. Engineering degree preferred but experience in production control probably more essential. Position requires supervision of staff of approximately 100. Salary range $6,000-$7,500 depending upon experience. Location Montreal. File No. 5214-V.

RELAY ENGINEER to undertake system studies and provide relay settings for all generation and transmission plant of young B.C. utility with headquarters in Victoria. Reply stating age, experience, education, salary expected. File No. 5215-V.

SALES ENGINEER LOCATED Northern Ontario, required by established manufacturers' representative. Selling to pulp and paper, mining, industrial and heating contractors. Applications are invited from graduate engineers with civil or mechanical background and an aptitude for sales work. Address full details of education and experience to File No. 5216-V.

ELECTRICAL OR MECHANICAL ENGINEER required for utility company in Eastern Ontario. Assistant to engineer. Company operations include distribution of electricity, urban transportation, and rail switching operations. Company carries out all design, construction and maintenance. Some experience in utility work would be desirable and an interest in electric utility is essential. This is an addition to present staff required by growth and future retirement program. Salary commensurate with experience. Applicants should include resume of education, martial status, health, experience, and interest references, and a recent picture. All replies in confidence. File No. 5225-V.

SALES ENGINEER required for Province of Quebec with experience in automatic heating with gas, etc. Applicant should be bilingual. Good opportunity. Salary plus commission. File No. 5226-V.

ENGINEERS WITH 2 or more years experience required for rapidly expanding chemical company. Civil, electrical, mechanical. Good opportunity and permanent position with central engineering office in downtown Toronto. Top salary for right men. Applications will be confidential. File No. 5230-V.

MECHANICAL OR CHEMICAL engineers with 2 to 4 years experience, required for positions in the engineering division of textile industry located in Cornwall, Ontario. Duties will include investigations, reports, design and other affiliated duties connected with the engineering division. The successful applicant must have the ability to assume leadership of a group and to take full responsibility for their work and the decisions made. This position offers an excellent opportunity to the right man for future advancement to an executive position. File No. 5236-V.

ENGINEER REQUIRED TO develop sales for continuous vacuum filtration equipment. This equipment manufactured in the United States by a leading firm and consisting of drum filters, disc filters, precoat filters, pressure filters, etc. The sales engineer would reside in Toronto and make calls, from time to time, throughout the Dominion of Canada. Previous sales experience would be an advantage but not a necessity. Full details supplied during interview. Reply giving age, education, marital status and previous experience. File No. 5237-V.

YOUNG GRADUATE ENGINEERS required who would like to begin their career in the electrical and mechanical phases of power transformer design. Full employee benefits. Large reputable manufacturer located in Ontario. File No. 5242-V.

SALES AND SERVICE ENGINEER required by water treatment engineering firms to work in the Quebec City area. Require man who is completely bilingual and preferably with an engineering degree. File No. 5248-V.

MECHANICAL OR CIVIL ENGINEER, graduate of this year or one with a few years of experience. The duties will consist of layout and design work in a paper mill engineering office. Salary $375.00 per month. Location Province of Quebec. File No. 5249-V.

AMERICAN ELECTRONIC CONCERN seeks a top-notch microwave engineer to head up a newly formed division. The corporation, which is located in Boston, Massachusetts, desires a person thoroughly capable of designing highly precision microwave components to operate in the "C", "K", "S", and "X" band regions. The initial objective of the candidate would be to develop a line of microwave components which could be catalogued and sold to the United States electronic industry in general. In addition to moving expense; salary, commensurate with ability to produce; the successful candidate would be given an opportunity of voting-stock participation at division level. Every opportunity for further advancement and financial interest in the parent corporation would be encouraged. Write full details of marital status, education, accomplishments and experience. File No. 5250-V.

FOR LARGE INDUSTRIAL development in Middle East, several engineers are required. Salaries from $15,000 to $30,000, tax free. Expenses of family to and from destination included. Following are general qualifications: 1) Civil Engineer, in charge of general expansion and construction of all capital works. 2) Civil engineer familiar with water power development. 3) Electrical and mechanical engineer for industrial expansion and co-ordination of industries. 4) Agricultural engineer. 5) Transportation engineer for construction and extension of roads, railways, airports, docks, canals, etc. 6) Industrial engineers, to advise on processes, operations, maintenance, expansion. 7) mining and metallurgical engineer to develop coal, iron ore, lead, tin, etc. Holiday allowance—30 days per year. Two-year contract with possibility of extension. Salaries guaranteed by international organization. Age limit, generally from 45 to 60. File No. 5253-V.

A NATIONAL ORGANIZATION requires an engineering staff manager to coordinate departments supplying product engineering services for their very diversified lines. The man will have engineering training and experience but will also be strong in administrative ability and experience and able to build an outstanding organization. He will motivate his staffs to design in terms of sales appeal, manufacturing costs and production. He himself will be seriously concerned with the mutual impacts of market trends, sales forecasts, service and engineering. He will determine policy, guide and direct organization to provide information for order negotiation, manufacturing, quality control, production and industrial engineering, product development and design, selection and training of personnel. He will maintain close liaison with sales, manufacturing and purchasing. This position will be both demanding and challenging. If your experience and ambitions line up with our description send us all pertinent information as to training and experience. File No. 5255-V.

CHIEF ENGINEER, responsible to the president. Age 35 to 40. In charge of all product engineering activities. Duties through a group of four to five product engineers, to direct experimental engineering activities, conceive, develop and design new products supervise re-design of all regular line products for improvement and cost reduction. To supervise engineering department of fifty persons, through unit heads. To maintain adequate engineering records, including drafting and blueprinting sections. Engineering graduate in mechanical or electrical with experience in the direction of product engineering, preferably in the field of consumer durables. File No. 5255-V.

SENIOR CHECKER to lay out and check details of aircraft installations. Applicant should have had at least 15 years experience in drawing offices of aircraft manufacturers or in drawing in connection with allied light engineering work. This is a position suitable for an engineer who is retired or nearing retirement age. Reply stating age, education, experience, personnel particulars and salary expected. File No. 5257-V.

TECHNICAL ASSISTANT to director of maintenance and operations required by Sask. department of public works. Salary range $382-$464 per month. Competition No. c.c. 3582. Applicants require considerable experience in building construction repair and maintenance preferably including electrical and mechanical design and installation; supplemented by engineering degree or equivalent in training. Incumbent is expected to provide professional advice to the director on repairs and maintenance of government buildings and to assist the director in formulating repair and maintenance programs and to administer these programs. Competition will close when suitable applicant is obtained. File No. 5258-V.

ENGINEERING-PHYSICIST required, and whose duties will consist of development engineering in group engaged in the commercial application of radioactivity to the medical and industrial fields. Minimum of 3-4 years experience in the field of nuclear physics, or alternately in the electronics field with some knowledge of radiation physics. Graduates of Canadian or British universities preferred. Please reply in writing giving full details of education and experience to file No. 5259-V.

PRODUCTION SUPERINTENDENT for supervision over a department of hand screw machines and grinders. This is a newly created position which requires a sound oper-

WANTED ENGINEER

Applicotions from engineers with ot leost five yeors experience to oct as Assistont to present engineer—must hove experience in design, planning, groding ond poving roods ond streets. Good permanent position for right person. Pension plon ond other fringe benefits.

Officiol opplicotion forms moy be obtoined ot the executive Director's office, 3rd floor, City Holl, Soint John, N.B.

ational background and a good degree of organizing ability. Location Southern Ontario. File No. 5260-V.

OPPORTUNITIES IN A GROWING organization for production engineer for methods, tooling, and estimating in precision machine shops, engaged in manufacture of machine parts and machine tools. Under 35 years of age, with time and motion study experience and University degree preferred. Location Southern Ontario. File 5260-V.

TOOL ENGINEER REQUIRED BY automotive manufacturing company in Southeastern Ontario. Applicants must have experience in design of small single purpose dies and general tool and machine problems. Applicant should be between the ages of 25 and 35 and when applying state experience and salary expected. Duties include layouts and designing on board and supervising of draughtsmen and clerical help. Engineering degree not necessarily required. File No. 5262-V.

PULP AND PAPER SALES ENGINEER required by manufacturer of a wide range of mechanical equipment with head office in Montreal, to work out of their Vancouver office. This man should have a minimum of five years experience in the pulp and paper business, be thoroughly familiar with the industry and have strong sales interests or potential. He should be a graduate mechanical or chemical engineer with a good knowledge of instrumentation and controls. File No. 5265-V.

GRADUATE ENGINEER required for heavy clay products plant in south-eastern Alberta. Duties will consist of plant layout re plant expansion, equipment replacement, materials handling, and related matters. Please reply in own handwriting. All replies will be held in strict confidence. File No. 5270-V.

PROCESS ENGINEER required for heavy clay products plant in southeastern Alberta. Duties will consist of quality control, specifications, laboratory and field work, process studies, and related matters. Please reply in own handwritting. All replies will be held in strict confidence. File No. 5270-V.

PRODUCTION MAN REQUIRED for heavy clay products plant in Southeast Alberta to understudy plant superintendent. Engineering training desirable but not essential. Please reply in own handwriting. All replies will be held in strict confidence. File No. 5270-V.

ASSISTANT PLANT ENGINEER required for heavy clay products plant located on the lower mainland of British Columbia. Duties will consist of plant layout, equipment replacement and installation, time studies, materials handling and related matters. All replies will be held in strict confidence. File No. 5270-V.

WANTED ONE SENIOR MECHANICAL ENGINEER, 1 senior civil engineer, 3 junior mechanical or civil engineers for mining and concentrating plant for design and layout. Please state full details of qualifications, experience and age in first letter to File No. 5272-V.

GRADUATE Canadian engineer, preferably with manufacturing experience, required by financial institution to make surveys of and write reports on industries in Eastern Canada. Salary according to qualifications. File No. 5273-V.

TWO GRADUATE ENGINEERS wanted for permanent position, one civil and one mechanical with 2 or 3 years experience, pulp and paper preferred but not essential. Location at Northern Ontario Lakehead, with progressive, expanding company, having all employee benefits. Furnish qualifications, salary expected and availability for interview with application. File No. 5274-V.

THE QUEENS COMMISSION in the Regular Army offers a career of unusual importance, challenge and opportunities. It offers many rewards. The financial returns, the pension plan, the opportunities for advancement match, and in some ways, exceed those of any civilian profession or career. However, no one can measure the many intangible rewards of a leadership career in the service of Queen and Country. There are special opportunities and need for graduate engineers in The Royal Canadian Engineers, The Royal Canadian Corps of Signals, The Royal Canadian Electrical and Mechanical Engineers. File No. 5276-V.

METHODS ENGINEER with some time study experience, one who is willing and able to supervise the work of junior time study observers and who has good future potential as a member of management. This is a permanent position with good starting salary. Location Ontario. File No. 5279-V.

SALES ENGINEER required by water treatment engineers located in Ontario for the Hamilton and Niagara Peninsula area. Prefer man with engineering degree. File No. 5281-V.

RECENT GRADUATE OR ENGINEER with experience required to act as assistant plant engineer for paper mill located in Province of Quebec. Duties include design and general plant maintenance. Good starting salary. File No. 5283-V.

ASSISTANT PROFESSOR of metallurgical engineering for appointment September 1, 1955, to give undergraduate instruction in ferrous, non ferrous, and general metallurgy. Salary range $4,000 to $5,000, with superannuation, hospital insurance, and other benefits. Applicant should be university graduate, preferably with some years experience in process metallurgy. Location Maritime Provinces. File No. 5288-V.

INDUSTRIAL ENGINEER required by large manufacturer Toronto. Applicant should be a recent graduate with one to two years experience in time-study, budgetary control, cost reduction, preferably in the metal industry. File No. 5289-V.

PLANT MANAGER AND TWO production superintendents for new plant operation to be located north of Toronto. Established multi-plant manufacturing organization. Successful applicants will have practical experience background in ground wood pulp or paper mill. May be superintendents or senior production supervisors who have reached a standstill through lack of scope. Chemical or mechanical engineering background desirable. Ages 32 to 45. Sound salary plan and full benefit program. These are permanent challenging positions for men of proven production ability, drive and vision. Excellent opportunity for growth in international expanding organization. Reply giving full details of industrial experience, age, educational background, etc. All serious applications will be acknowledged and treated on a strictly confidential basis. File No. 5291-V.

MECHANICAL OR ELECTRICAL ENGINEER, graduate of recent years with some industrial experience. The responsibilities would include sales and also engineering required for our products and services. We are electrical and mechanical contractors. Electrical construction work and the sale of electrical apparatus represents a major portion of our business. The starting salary is a matter we would consider individually with each applicant and would depend upon experience, however, we feel that this can be arranged to mutual satisfaction. File No. 5292-V.

INDUSTRIAL OR MECHANICAL ENGINEER required for the industrial engineering department of a large organization in the Montreal area. Excellent opportunity for a progressive engineer who is interested in acquiring a sound, industrial training and is capable of eventually assuming a responsible position. Preference will be given to an engineer with one to three years practical experience in industrial engineering. Please write giving full details, including experience, age, references, etc. File No. 5293-V.

SALES ENGINEER in industrial water treatment department to work in the city of Montreal. We would prefer to have a bilingual man if at all possible, but it is not absolutely necessary that he be able to speak French. File No. 5294-V.

STRUCTURAL STEEL DESIGNER

Outstanding opportunity for Ontorio professionol engineer with minimum of 5 yeors' experience in the design of structurol steel buildings. Excellent storting salary, modern office and good working conditions. Please stote age, experience, references ond salary required.

RUNNYMEDE STEEL CONSTRUCTION LIMITED
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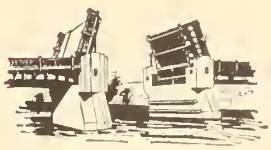

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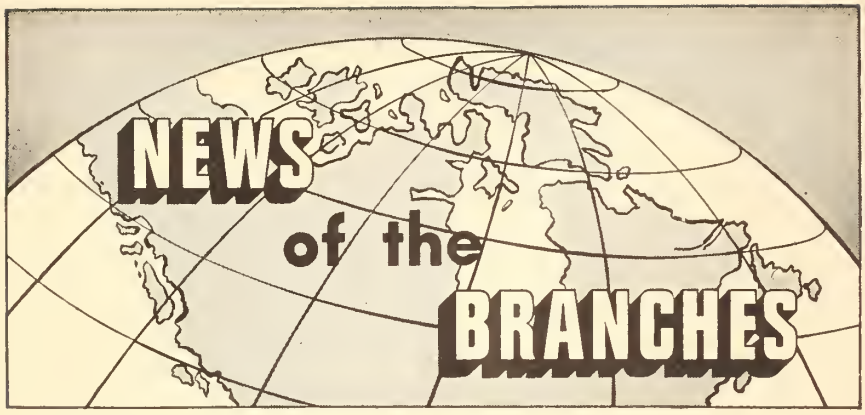

Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Belleville

J. A. Grant, M.E.I.C.
Secretary-Treasurer

Annuol Meeting

The annual meeting of the Belleville Branch was held on April 18, 1955, at the Masonic Temple and a slate of officers for the coming year was presented by the chairman of the Nominating Committee, C. H. Whittemore as follows: chairman, C. H. Lusk; vice-chairman, A. D. Janitsch; committee members, A. E. Argue, T. E. Flinn and B. H. Downman, for a two-year term; J. C. R. Punchard and A. G. Tooth for a one-year term.

Further names were called from the floor by the chairman, A. O. Drysdale. No further names were presented and in turn it was moved that nominations for chairman be closed by J. A. Grant and seconded by A. E. Argue; for vice-chairman, moved by H. Floyd and seconded by B. H. Downman; for two-year executive committee term by J. A. Grant, seconded by J. C. R. Punchard, and for one-year committee term moved by T. E. Flinn, seconded by D. Pullan. The chairman declared the slate elected by acclamation.

The incoming chairman re-appointed J. A. Grant as secretary-treasurer.

Year's Activities Outlined

A. O. Drysdale, the outgoing chairman, outlined the activities of the Branch during the past year. He stressed the value of the monthly meetings to the members and expressed his satisfaction of the calibre of speakers who participated in the year's activities. He drew attention to the very successful professional development course consisting of 20 lectures held during the past winter organized by the Branch in collaboration with Queen's University. The course covered such topics as cost control, marketing, control of assets, advertising, etc.

C. M. Turnbull Guest Speoker

The special speaker of the evening was C. M. Turnbull of Nesbitt Thomson & Co. Ltd. who delivered a talk on "How to Share in Canada's Growth". His remarks were very well received and the extended question period at the end of the formal talk indicated the interest of the members in financing an investment.

Brockville

M. H. D. Broadbent, M.E.I.C.
Secretary-Treasurer

G. M. Woods, M.E.I.C.
Branch News Editor

Colour in Home Decorating

A glimpse into the fascinating world of colour and its effect on everyday living was given to 40 members and their ladies of the E.I.C. Brockville Branch by Wilfred D. Sinclair, supervisor, Colour Advisory Service, Canadian Industries (1954) Limited. The meeting was held in the Hotel Manitonna in Brockville on the evening of May 18.

"Speaking under the title 'Tips for Home Decorating', Mr. Sinclair, who is a leading Canadian authority on colour and its scientific use, went into the origin of colour and demonstrated the principles for its most effective use in home decorating.

"Painting is an interesting activity today", he said, "because of the advances made with the manufacture of paint. Paints are easy to use, objectionable odours have been removed and, because they dry quickly, the home is never upset by painting activities."

Mr. Sinclair gave some valuable tips on the properties that should be sought in paints and how they should be applied in the home.

Psychologicol Reoction

"Because colour is a psychological reaction, and is in light, we should know some facts about colour before we do any decorating", continued Mr. Sinclair. Using illustrative material, he demonstrated a number of optical illusions and showed how after-image, background and adjacent colours and light can effect the colours people see. Assisted by Mrs. J. Daly, he demonstrated how to blend the colour scheme in the home with draperies, rugs, and fabrics to obtain the best results.

"Milady is a vision of delight", said Mr. Sinclair, "With her rich titian hair she can use blues and reds of almost every tone. Her dress is Cafe Blue, Bluegloss gloves with purse to match and Admiral Blue or Parma Red shoes with matching lipstick case, and Pearl Taupe nylon hosiery. The impact of Milady on the male species is beyond calculation especially her wearing of colour."

"Man presents himself as a blend of colours representing personality", he said. "He has a Dacron suit of Royal Blue, nylon shirt and tie in muted cream and tan with matching nylon socks, and shoes of Town Brown, a Beige Brown hat, with his whole ensemble blending. His good taste extends to the colour of his car. He is colour balance itself."

Mr. Sinclair was introduced by Chairman Fred F. Walsh and thanked by Vice-Chairman Walter W. Ashworth.

Cornwall

L. H. Snelgrove, M.E.I.C.
Secretary-Treasurer

W. Rothwell, M.E.I.C.
Branch News Editor

Professor J. C. Comeron Speoker

Professor J. C. Cameron was the guest speaker at the May meeting held on Thursday evening May 26 at the Cornwall Golf and Country Club. This was a dinner meeting and was well attended, there being approximately 70 members and guests present.

The subject of Professor Cameron's talk was "The Impact that Collective Bargaining has had on Management and Management's Rights in Industry".

The speaker has held the position of head of the department of industrial relations at Queen's University since 1937 and has devoted all his time since his appointment to labour problems. He has acted on a number of occasions as chairman of conciliation boards and as an impartial umpire on other labour disputes.

He explained at some length, giving the historical background of the Canadian acts of parliament governing the negotiating of labour contracts and compared them with legislation set up in the United States for the same purpose. The legal status, obligations and rights of both labour and management were clearly defined, he said.

The steps leading to conciliation and arbitration were discussed and a clear description given of the problems inherent in this procedure and the difficulties to be overcome by the parties striving to produce a settlement of the dispute.

Professor Cameron was introduced by Ben Stidwell and at the close of the meeting, was thanked by Tim Corbet.

Vocotionol Guidonce

Each year a vocational guidance committee consisting of members of the Cornwall Branch of the E.I.C. co-operate with the student guidance directors of the St. Lawrence High School and the Cornwall Collegiate and Vocational School in advising and directing students interested in an engineering career.

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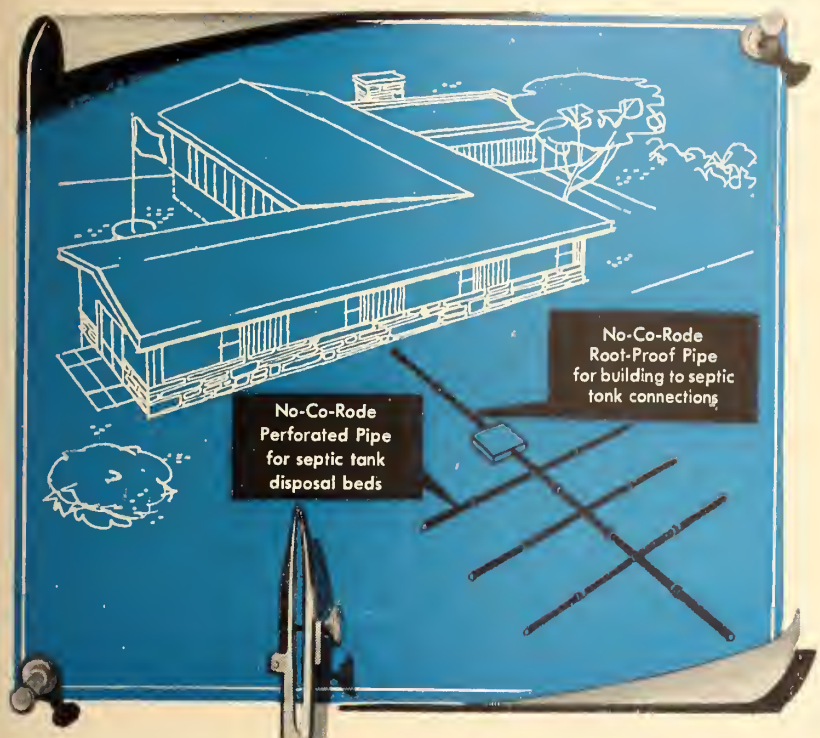

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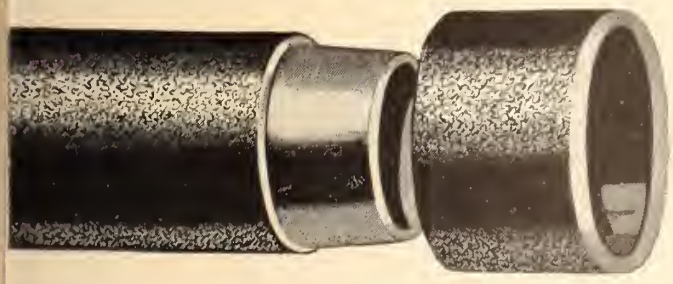

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• Branch News

In previous years, this has taken the form of an informal talk to the boys by Institute members and information given to them in the form of questions and answer period discussions. However, this year's plan, fostered by W. P. Nesbitt, was a departure from that of previous years.

Each student contemplating a career in engineering was invited to spend a day on the job with one of the Branch members who, while carrying out his normal duties, gave the boy an insight into the practical work involved and discussed with him as many aspects of an engineering education as possible. The member also arranged to bring the student along to one of the Branch meetings.

Power Project Visit

To round off the instruction a visit was arranged to the St. Lawrence Power Project in co-operation with Charles McIntosh, Hydro's St. Lawrence Project information officer, and on Thursday, April 21 about 30 students accompanied by several teachers, E.I.C. officials and Ontario Hydro engineers and officials made a trip to the project site. Here they visited the project administrative headquarters, they saw tunnels made under the canal and a retractable Bailey bridge across the canal.

They were taken out on the 4,500 ft. cofferdam under construction between Barnhart Island and the Canadian mainland where Hydro Engineers, Vic Harrison and Walter Lechman, explained many engineering aspects of the project.

They also visited the head of Sheek Island where several phases of the U.S. project could be seen and were outlined to them.

Montreal

R. J. Harvey, M.E.I.C.
Secretary-Treasurer

Junior Section Guests of Mayor

Almost 50 Junior members were privileged to be guests recently of Mayor Jean Drapeau at the City Hall.

Mr. Drapeau welcomed the group as a whole and expressed a great deal of pleasure that so many of Montreal's young engineers were interested in municipal affairs. Mr. Drapeau also welcomed future group visits and assured each individual a warm welcome at any time.

Gaetan Ducharme, president of the Junior Section, offered His Honour, the Mayor, the wholehearted co-operation of the Junior Section.

The visit was a great success and the group had the opportunity of viewing the City Council in session. Afterwards refreshments were served in the Mayor's offices and the Golden Book was signed by each visitor.

Nipissing and Upper Ottawa

E. A. Watson, M.E.I.C.
Secretary-Treasurer

A. T. McKerrall, M.E.I.C.
Branch News Editor

Annual Meeting

R. R Prescott of Temiskaming was elected chairman of the Nipissing and

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• Branch News

Upper Ottawa Branch of the Engineering Institute of Canada at the annual meeting of the Branch held on April 27, 1955, at the Manor Hotel.

Following dinner J. W. Millar, the outgoing chairman, presided over the election of officers and a business session. E. A. Watson presented the secretary-treasurer's report, G. L. Hood, the Membership Committee's Report, F. R. Marshall, the Entertainment Committee's Report and R. R. Prescott, the report by the committee studying the Smith Report on amalgamation.

Those elected to the executive of the Branch were as follows: R. R. Prescott, chairman; T. C. MacNabb, vice-chairman; F. R. Marshall, committeeman, North Bay, and R. A. Booy, committeeman, Temiskaming.

Ottawa

GORDON A. SUTHERLAND, M.E.I.C.
Secretary-Treasurer

CARL B. CRAWFORD, JT.E.I.C.
Branch News Editor

1954 Arctic Voyage

At a joint dinner meeting of the Ottawa branches of the Engineering Institute and the American Institute of Electrical Engineers members and their wives enjoyed a vivid description by Cdr. John M. Leeming, CD, R.C.N., Executive Officer, of the maiden voyage of H.M.C.S. *Labrador* through the Northwest passage.

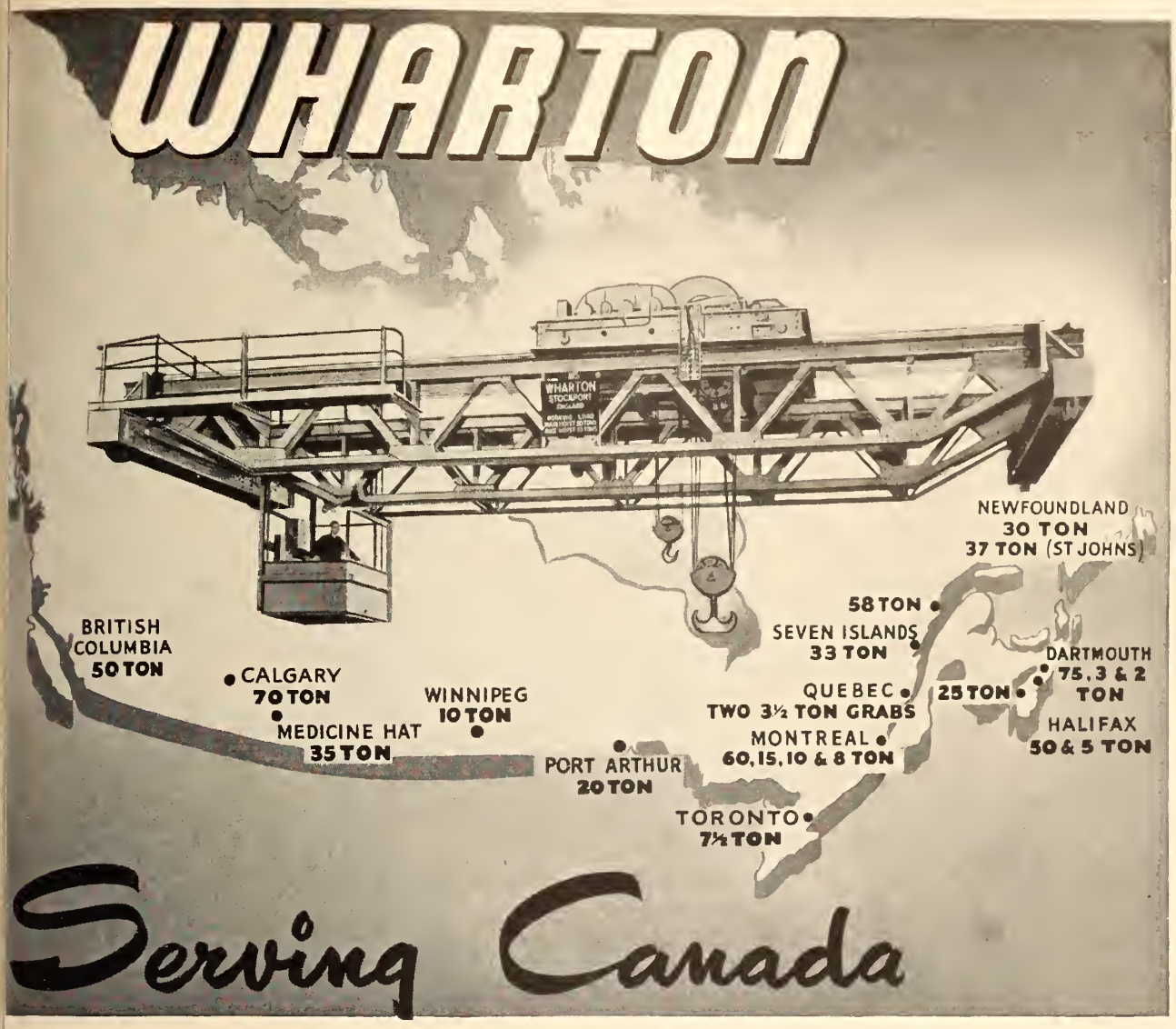
Following an interesting historical background of early attempts to discover a Northwest passage from the Atlantic to the Pacific, Cdr. Leeming described the main features of *The Labrador*. The $20 million ship was built in Sorel, Quebec and after five years of construction it was commissioned in July, 1954. Fifteen ton propellers, cast in one piece of manganese bronze, are driven by 10,000 horse power at a speed of 16 knots. The crew consisted of 22 officers, 12 scientists and 201 men.

Record-breaking Trip

The 6,400-ton ship made the trip from Halifax to Vancouver in two months. The previous record had been three years. This record was not established without exhausting work by the crew. In one week, the Captain on three occasions spent 30 continuous hours on the bridge. Still, working and living conditions were much improved in the 100 years since the first attempt to follow a Northwest passage was made. Each man on board H.M.C.S. *Labrador* was able to have a daily shower, and fresh food lasted for six of the eight weeks during which the ship was in the North.

Cdr. Leeming thought that regular travel through the Northwest passage would never be practical since passage is possible only during late August in an exceptional year.

He kept his audience interested and amused with humorous accounts of lighter incidents. He reported that on one occasion during a fog, radar was used for navigation and at one time 200 icebergs were sighted on the screen. "When the fog lifted and I saw the icebergs," said Cdr. Leeming, "I prayed for fog again. I'd rather do it by radar."



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• Branch News

The speaker was introduced by R. F. Legget, chairman of the Ottawa Branch, E.I.C., and thanked by J. Purvis, chairman of the Ottawa Branch of the A.I.E.E.

Peterborough

J. I. Beggs, Jr.E.I.C.
Secretary-Treasurer

D. G. Donaldson, Jr.E.I.C.
Branch News Editor

Nuclear Reactor Operation

"The future lies ahead and wide open in the development of nuclear energy," said W. E. Cooper, speaking to about 75 members and guests of the Peterborough Branch of the Engineering Institute of Canada an Wednesday evening, April 27, 1955.

Mr. Cooper is a member of the Ontario Hydro co-ordinating group at Chalk River. In his two years in this capacity he has not only had extensive practical experience but has done many hours of personal research in the field.

The speaker began with a detailed explanation of the "fission process," followed by the working of chain reaction. Radioactivity was covered fully and a general rundown on nuclear reactors given.

Canadian Effort

"Our Canadian effort in nuclear power has been much greater than most people give us credit for," Mr. Cooper told his audience. He said that in 1953, to develop atomic energy, the HEPC and other organizations appointed liaison officers to join the scientists at Chalk River and extensive study courses were begun.

In August, 1954, the Nuclear Power group was assigned the job of preparing a preliminary design for a small prototype nuclear power plant as the first step necessary in the nuclear power program recently announced by the Atomic Energy of Canada Limited and the Federal government.

Several objects were in mind in this project. First, the construction would demonstrate the practicability of a future full-scale economic power plant. Secondly, it provided a basis for estimating future power reactors and thirdly it would concentrate development work on power reactors, and serve as a training centre for personnel in the design and operation of power reactors.

Mr. Cooper described the operation and construction of the reactor, showing diagrams and photos of the various types, including the submarine nuclear reactor.

As to future possibilities, Mr. Cooper said that within the next decade the world will have nuclear power in a practical form.

At the annual meeting of the Sudbury Branch, left to right; W. H. Ripley, a past chairman; L. Lane, vice chairman; W. S. Black, chairman; F. Orange, past chairman; and R. Moore, councillor.

Sudbury

A. D. Finlayson, Jr.E.I.C.
Secretary-Treasurer

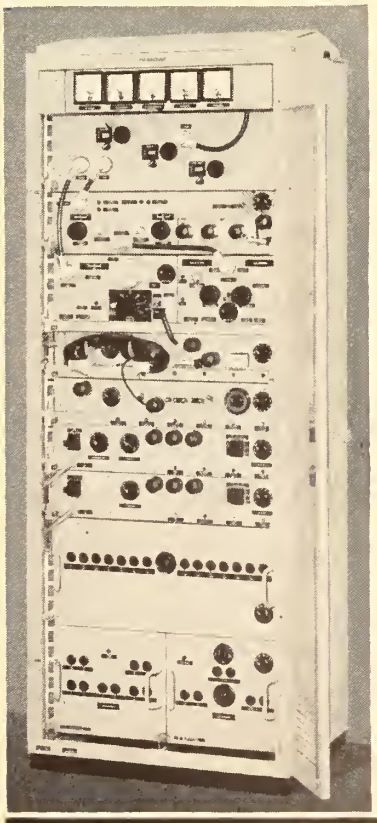
A. Eldridge, M.E.I.C.
Branch News Editor

Annual Meeting

The annual meeting of the Sudbury Branch was held on April 25 at the Sudbury Granite Club, with 30 members attending. The chairman, Frank Orange spoke to the meeting on the activities which were carried out during the year and also thanked the executive and committees for their work. Reports were submitted by the secretary-treasurer, A. D. Finlayson, and by the auditor, M. Whittles.

The chairman of each committee then gave a short report on the work carried out by them during the year. Russ Eaton, the retiring councillor, spoke to the members on council affairs.

The officers elected for next season were W. S. Black, chairman; L. T. Lane vice-chairman; and resident committeemen elected for two years, J. W. Smith and T. C. Robertson.



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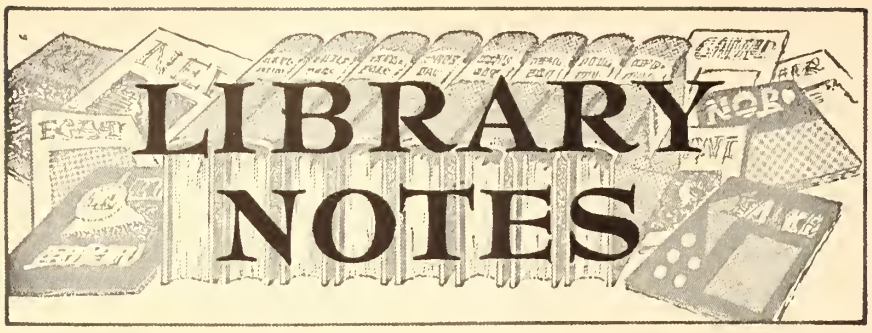

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Manufacture and application of lubricating greases. C. J. Boner, New York, Reinhold, 1954. 977 pp., illus., $18.50 (U.S.).

Only rarely does a comprehensive book on the subject of lubricating grease manufacture come off the press. When such a volume carries the authority of one whose position with a major producer of greases is recognized throughout the industry, it is a matter of some importance.

Within this volume may be found formulae and manufacturing procedures for the older types of grease which might be termed conventional, but the most up-to-date theory of soap fibre and grease structure is applied to explain their behaviour in production and use. From this point the writer proceeds to the more modern greases made from rarer metals and more highly synthesized fats and fatty acids, to create products which will meet the rigid qualifications required today in military and industrial service.

Since the storage and service characteristics of a grease are closely related to the quality of its components, the writer deals extensively with the oil components, petroleum and synthetic, the oxidation inhibitors which are compatible and give them the service life required, or the special resistance to heat, cold, water and similar adverse service factors. What might be termed the less conventional "non-soap" greases receive full recognition, including products thickened with organic and inorganic gelling agents and organic polymers.

The manufacturing equipment for compounding, milling, and packaging, highly important to the producer, are given detailed consideration by an author who knows the many physical problems of manufacture and application.

Properties of raw materials, fats and fatty acids, organic and morganic bases, antioxidants, lubricating oils, both petroleum and synthetic are described in relation to their effectiveness as grease components. Test methods to check specifications of such materials, as well as the finished product, are described and include a large variety of special tests to demonstrate service characteristics of the grease.

The author introduces a chapter on grease application which might well be studied by one interested only in this aspect of the grease problem, with great profit to the user.

Throughout this book there is a wealth of reference to nationally recognized authorities whose work and theories the author quotes freely to support his views, or to demonstrate differences in theory or practice of grease manufacture.

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BOOK NOTES

Prepared by the Library

The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

The accident. Dexter Masters. Toronto, McClelland & Stewart, 1955. 406 pp. $4.50.

From a little publicized incident which occurred nine years ago at the atomic bomb centre in Los Alamos the author has fashioned a lengthy and well-told novel. An accident at that time, which took the life of a man who helped to make the bombs which fell on Hiroshima, is the nucleus for the story. So much of the book is true but the rest is the result of a novelist's ability to shape a very pertinent theme into a novel which will interest both the general reader and the scientist or engineer.

Dexter Masters has written a great deal about science and the men who have made scientific history and is well qualified to write about the pioneering atomic project, and of the effect of the bomb's radiation on the human body. Medical details are linked to very human incidents, and to tension and drama.

It is refreshing to read a novel with a timely and somewhat different theme by an experienced writer.

Aciers inoxydables; aciers réfractaires. L. Colombier et J. Hochman. Paris, Dunod, 1955. 526 pp., illus., $20.90.

This book was written as a guide to the best qualities of stainless and resistant steels for engineers in France where the use of these steels is not as widespread as in the United States and Canada.

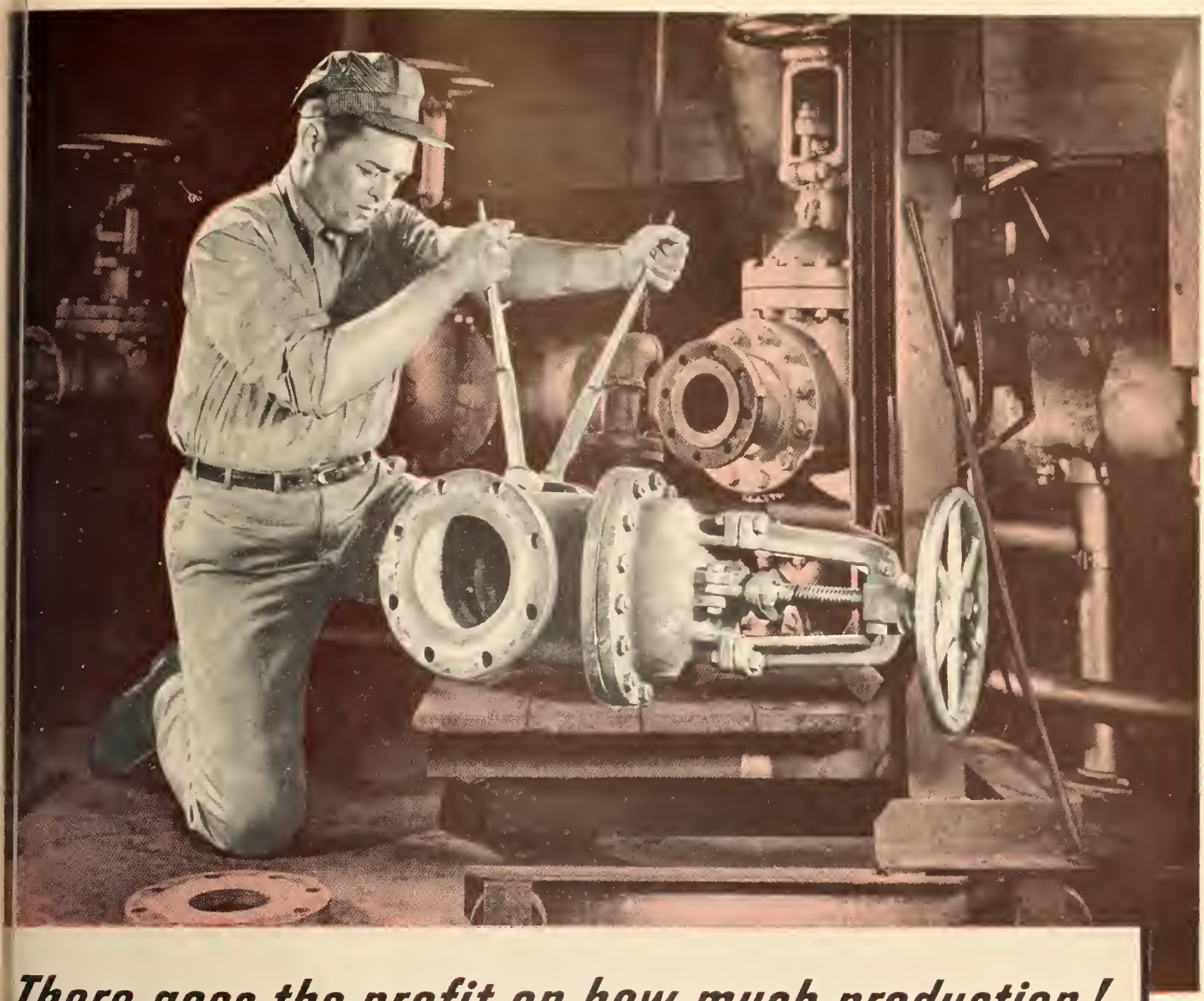
The first part, dealing with stainless steels, discusses the influence of various metals, such as nickel, on their structure. The general properties of various groups of stainless steels e.g. martensitic and austenitic steels, are covered and are followed by several chapters on corrosion.

The second section of the book covers the chemical and mechanical resistance of steels to high temperatures and various uses for highly resistant steels and alloys.

The book concludes with methods of manufacturing stainless steel.

Aeronautical engineering catalog 1955, 11th ed. New York, Institute of the aeronautical sciences, 1955. 346 pp., illus., $7.50 (U.S.).

In this edition special attention has been given to the fields of automatic flight, jet and rocket propulsion, electronics, and guided missile components. These subjects are found in the Airborne products directory which lists over 2,000 materials, parts and equipment



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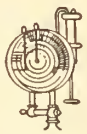
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used in the construction of aircraft with the names of manufacturers of each product. Other sections contain the names, addresses, and description of products of the principal manufacturers and primary sources of supply in the aircraft field. A file of individual company catalogues is included as well as two pages of product inquiry cards for convenience in obtaining further information.

Aide-mémoire Dunod; mécanique-physique générale, 5e. ed. Maurice Denis-Papin. Paris, Dunod, 1955. 216 pp., $2.25.

This is a general treatise on physical mechanics, covering such topics as kinematics, statics, dynamics, heat and thermodynamics, and the mechanics of fluids. One section is devoted to elastic and electromagnetic displacements and vibrations, while the last two chapters deal with cosmography and units of measure.

The amplification and distribution of sound, 3rd ed. rev. A. E. Greenlees. Toronto, British Book Service, 1954. 300 pp., diagrs., $6.00.

The present edition includes new developments in the field of sound amplification and distribution and covers all the necessary information for the specification, layout and operation of equipment.

Beginning with the fundamentals of electrical circuits, the author goes on to discuss transformers, amplifiers, radio receivers, microphones, record reproduction, loud-speakers, installation planning, and test equipment.

No advanced knowledge of mathematics is necessary and the text should prove valuable to radio and public address engineers, wireless operators, motion picture operators, architects and university students.

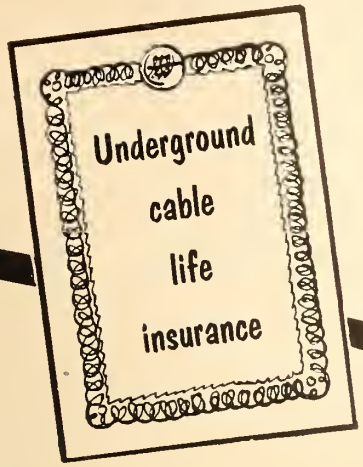
Analog methods in computation and simulation. W. W. Soroka. Toronto, McGraw-Hill, 1954. 390 pp., figs., $9.00.

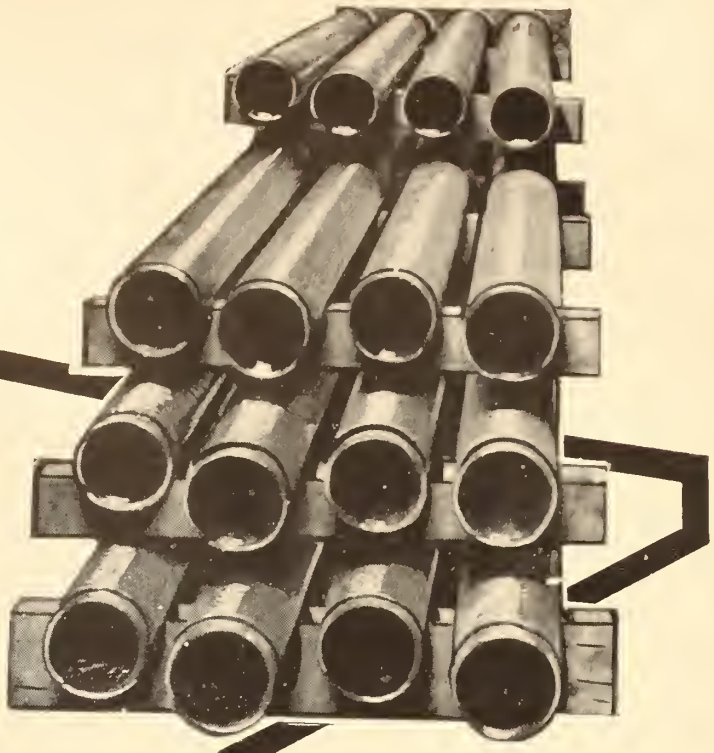
Indirect experiments which are made possible in the engineering and scientific fields by analog computation and simulation are of widespread interest today. This book is an organized treatment of these methods and the author's approach is fundamental and direct, with practical applications supplementing the techniques and theory covered.

The book describes mechanical, electromechanical, electrical and electronic analog components for performing basic mathematical operations then illustrates how these can be used to solve equations. The last three chapters, show how dynamical analogies, finite difference networks, membrane analogies, and conducting sheets of uniform and variable thickness may be used to simulate various physical systems and to solve differential equations.

***Annual report on the progress of rubber technology, v. 18, 1954.** T. J. Drakeley, ed. Cambridge, published by W. Heffer for the Institution of the rubber industry, London, 186 pp., £1.1s.0d.

A critical review of the literature, including patents, covering the most sig-





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nificant advances in the field. A general statistical and historical survey precedes the more specialized reports on developments in synthetic rubber, testing and equipment, machinery and appliances, cable and electrical insulation, etc.

Automatic control bibliography. W. F. Wade and E. N. Kemler. Spring Park, Minn., Summary Reports, 1955. 331 pp., $15.00 (U.S.).

American and British literature is covered in this bibliography for the period from 1900 to 1954. The general arrangement is alphabetically by authors, and alphabetically by magazines for those articles for which an author was not shown. A very brief, descriptive abstract is included on most of the articles.

At the end of the main bibliography is a classified section listing articles by applications and areas of interest, with the author, title and year of the article indicated.

Also listed are 120 books on automatic control, including a few in French and in German, and the main periodicals in the field.

Beton-Kalender, 1955. Berlin, Ernst, 1955. 2 vols., 16 DM per set.

As in previous editions of this well-known handbook all types and conglomerates of cement and concrete are dealt with, and their building potentialities in the various fields are discussed. Each chapter is prepared by a specialist in the particular field.

There are numerous graphs, tables and diagrams and references are made to German standards.

Because of the great strides which Germany has taken in the fields of construction and engineering this up-to-date publication will be a valuable contribution to data on concrete.

Dust is dangerous. C. N. Davies. Toronto, British Book Service, 1954. 116 pp., illus., $3.60.

Since the subject of dust control has become increasingly important in recent years this new book will be of interest to many who are directly, or indirectly, concerned with the problem of dust in industry.

The material is divided into six chapters which stress the understanding of the dangers of dust, the assessment of dust concentrations and the measures taken to eliminate dust hazards. The last three sections deal with radio-active dusts, house and non-industrial dusts (including the problems of allergy and disease caused by these dusts), and dust explosion with material on precautions against these explosions.

Fluid dynamics of jets. Shih-I Pai. Toronto, Van Nostrand, 1954. 227 pp., $5.50.

In a comparatively new and rapidly expanding subject field this book presents an advanced discussion of fluid dynamics and covers jet flow from fundamentals to such topics as the laminar flow of compressible fluid, the turbulent flow of compressible fluid and properties of turbulence fluctuations.

The first three chapters describe the jet flow in the potential core of a jet of gas while the next two chapters discuss the flow in the mixing region of the jet of gas.

Students in advanced university aerodynamics courses and research workers will welcome such a book. Engineers studying the problems of wakes and of cavitation will also find it useful. Bibliographies are included at the ends of chapters.

Le frottement et l'usure des métaux: les anti-frictions. R. Cazaud. Paris, Dunod, 1955. 221 pp., illus., $10.00.

The problems of rubbing and wearing of metal and the subject of antifriction metals are discussed in this book. Different circumstances under which wearing takes place are the subject of the first chapter, followed by the general properties of antifriction metals and alloys. Methods of testing these are also covered. Several chapters are devoted to antifriction materials with bases of copper, lead, tin, zinc, cadmium, aluminum and silver. Among the other subjects in the book is the use of antifriction alloys for bushings.

***Geology in engineering.** J. R. Schultz and A. B. Cleaves. New York, Wiley, 1955. 592 p., illus., $8.75.

The primary purpose of this book is to furnish the civil engineer and engineering student with the background

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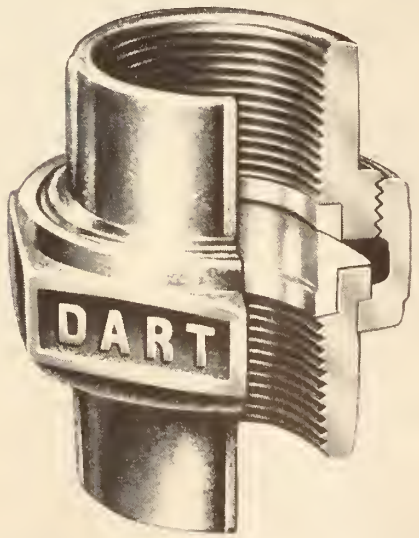

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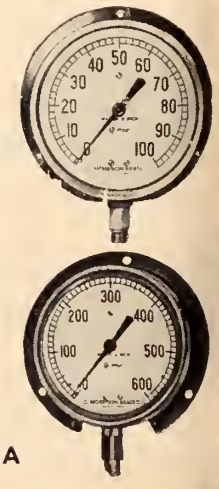

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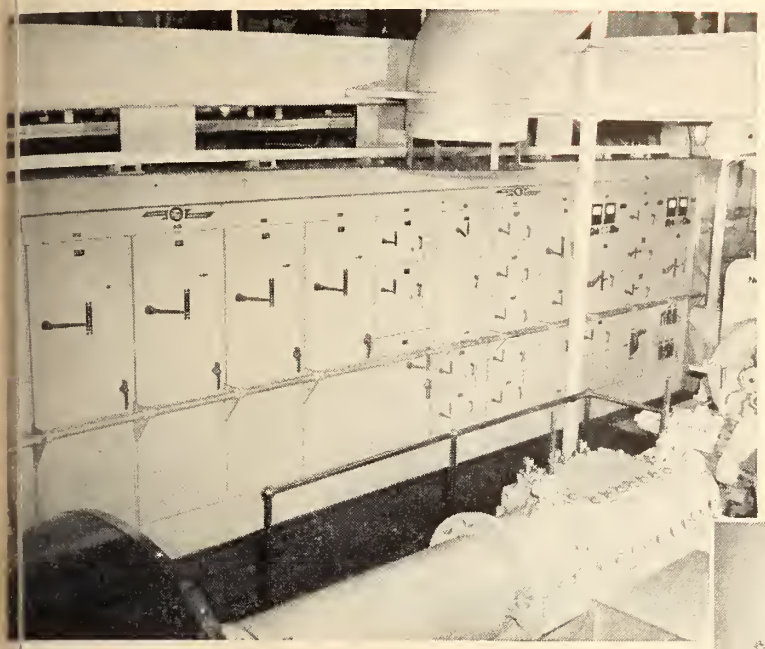

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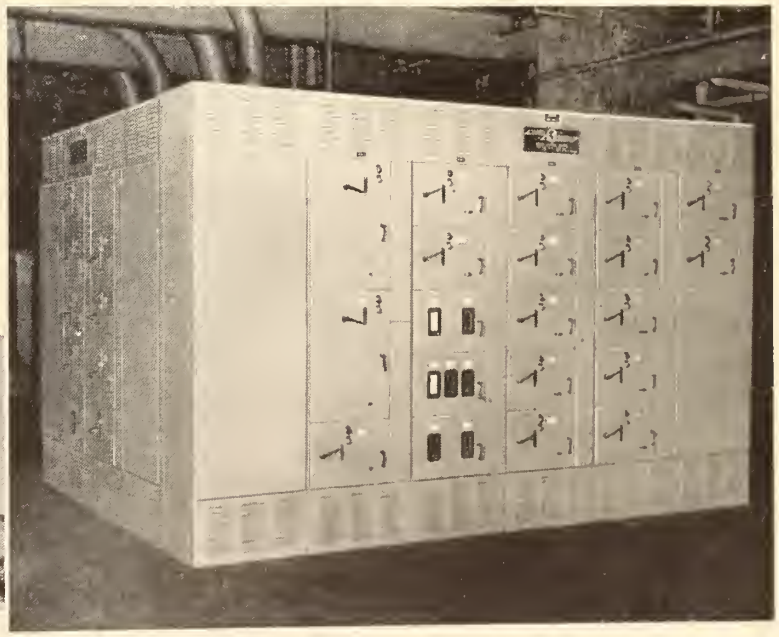

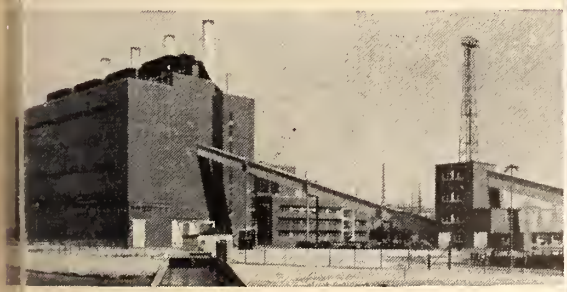

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needed for understanding engineering-geologic reports. The first part of the book deals with various phases of geology most useful to engineers: minerals, rocks, land forms, frost action in soils, earthquakes, etc. Later chapters take up types of engineering projects—dams, reservoirs, tunnels, highways, and airfields—which illustrate the applications of geology to civil engineering. Separate chapters are devoted to soil mechanics and concrete aggregates.

***Glass reinforced plastics.** Phillip Morgan, ed. London, Iliffe, 1954. 248 pp., illus., 35/-.

This book, composed of separate chapters by various British authorities, gives the essential facts on resins and other materials used for bonding glass fibers and on the various forms of glass reinforcement. It also deals with moulding processes, tube and rod production, and applications in the aircraft industry, electrical field, automobile industry, and in other fields. Some chapters include lists of references.

A history of technology, vol. I From early times to fall of ancient empires. Charles Singer, E. J. Holmyard and A. R. Hall, eds. Toronto, Oxford university press, 1954. 827 pp., illus., $22.50.

The growth and history of technology, with its many fascinating and surprising aspects, will be covered in five volumes and will span the centuries from the Old Stone Age through the nineteenth century. An important part of the history are the specially drawn illustrations and the numerous maps, charts, and tables. The book is written in non-technical language, by a wide range of authorities, and is intended to provide students of technology with some humane and historical background for their studies.

Volume I shows man first as a hunter and then as a builder of settled societies. The authors admit that they have not made a global survey but have concentrated on the first civilizations of the Near East which most profoundly affected our western society.

Among the many subjects which are discussed are speech and language, early time-reckoning, food-collecting, graphic arts, such domestic activities as fire-making, animal domestication, plant cultivation, building in brick and stone, use of metals, transport, writing, weights and measures, mathematics and astronomy.

The term "technology" has been used to cover the field of how things are done or made and is only extended in a limited way to describe what things are done or made.

This is a very ambitious work and one of extreme importance, for the role of technology has become an indispensable one in the life and history of mankind. The fact that it has been undertaken by a group of such highly qualified specialists, and that such care has been taken with the physical format of the book, will make it an outstanding and permanent part of the scientific literature of our day.

Industrial waste disposal charges in cities over 5,000 population. Special report 188. Chicago, American public works association, 1955. 81 pp., charts, mimeog., $3.00 (U.S.).

Some two hundred and fifty-six American cities were questioned about their methods of making industrial waste disposal charges. The report divides the charges into those based upon percentage of water bill, upon a schedule of water use, upon flat rates, and upon quantity and quality of wastes. Disposal regulation and such related data as sewage meters, oil and grease separators, and pre-treatment of wastes are also covered.

L'instabilité en mécanique: automobiles, avions, ponts suspendus. Y. Rocard, Paris, Masson, 1954. 239 pp., illus., 1200 fr.

This subject of mechanical instability in cars, airplanes, and suspension bridges is one which will interest many engineers and designers in these fields.

In eight chapters the book discusses such problems as vibration in automobiles, with the author presenting his own theories as well as those of others. Examples of bridge failures are given and in the section on aircraft the critical speed for airplane wings is studied. The limits of stability are explored in connection with all three designs.

An introduction to carrier current communications. J. N. Petrie and H. E. Clapham, eds. Toronto, Automatic electric, 1949. 136 pp., diagrs, $3.50.

This is a simplified text on the basic principles underlying carrier telephony and telegraphy, covering subjects such as wave theory, transmission, filters, electronics, modulators, two- and four-wire carrier systems, carrier on radio, carrier telegraphy, and applications of carrier systems.

Introduction to nuclear engineering. R. L. Murray. New York, Prentice-Hall, 1954. 418 pp., illus., $9.35 (U.S.).

The author's purpose in writing this book was to provide a concept of the over-all problems in nuclear engineering and so to overcome the limitations of specialization which is so prevalent in this field. It will be especially valuable as an introduction to new developments in atomic energy for the university student.

The book covers the following subjects, many of them not yet included in standard engineering or physics texts: isotope separation, reactor design and operation, special requirements on materials, heat transfer by liquid metals, regenerative production of fissionable materials, protection from nuclear radiations, and the application of reactors to transportation and power generation.

Throughout the book a qualitative concept has been first presented, then an elementary mathematical analysis and finally a review of the application and significance of the material.

Irrigation and hydraulic design, vol I General principles of hydraulic design. Serge Leliavsky. Toronto, British Book Service, 1955. 492 pp., illus., $21.50.

As a set of three volumes this book seems destined to become a standard reference work on the engineering aspects of irrigation and on hydraulic design. The author is a well-known international authority in this field and has done extensive work in Russia and Egypt.

The scope of the book is comprehensive and includes both the new ideas of designers like Rouse and the fundamental theories of Terzaghi, Pavlovsky etc. The two volumes which will appear at a later date will be devoted to specific design methods and theory for irrigation works, and to multiple-purpose hydraulic structures from the standpoints of design, execution and economics.

Volume I contains the more general fundamentals of design work, with particular reference to percolation in the

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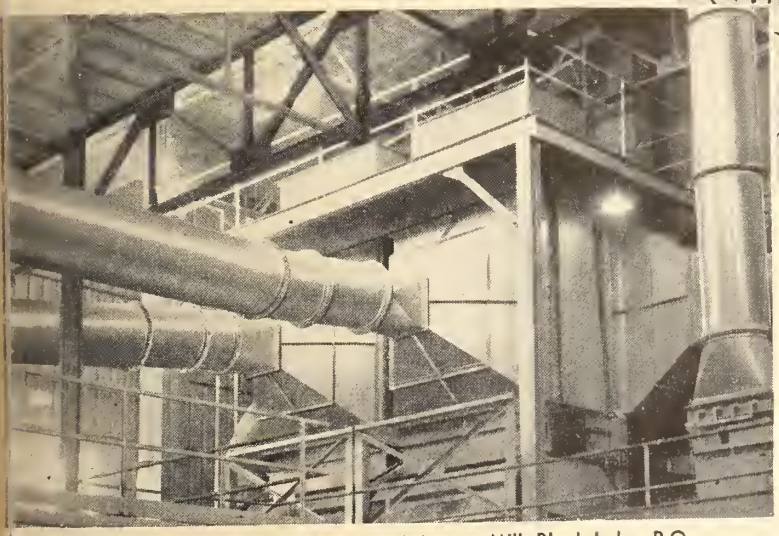

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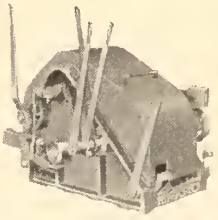

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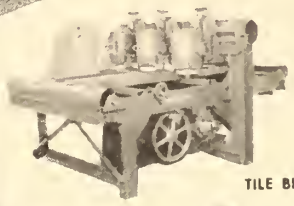

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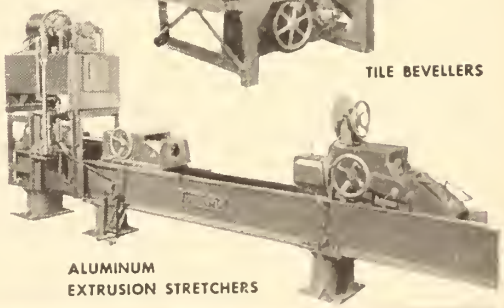

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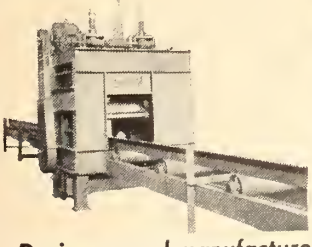

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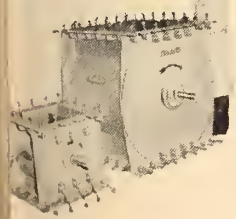

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granular foundations beneath hydraulic structures and in earthen banks, tail erosion in its various aspects, and hydraulic flow in canals and rivers, both uniform and non-uniform.

Within each of these larger subjects there are well-developed sections on all aspects of each design factor and problem. Numerous formulae, methods and design theories are included as well as many diagrams, charts and photographs.

The joint and several responsibility of architects, engineers, and builders. W. S. Johnson. Montreal, Wilson et Lafleur, 1955. 215 pp., $8.50.

The publication of this much-needed book will surely be received with appreciation and interest by members of the law profession of Quebec as well as by architects, engineers and builders.

Written by a member of the Bar of Montreal, it concerns articles 1688, 1689, and 2259 of the Civil Code of Quebec, establishing and regulating the five-year warranty. The author has attempted to present an organized review, both practical and theoretical, of the jurisprudence to date. To this end he has arranged the material by topics and has attempted to reach some conclusions on subjects that are often controversial.

The opening chapters deal with the history of this jurisprudence and define the roles of each profession. Following sections cover more detailed questions e.g. perishing, responsibility for the unfavourable nature of the ground, defects of construction, error, acceptance of the work, and proving the owner's loss.

Many legal cases are cited to further the understanding of this law.

Minerals for atomic energy; a guide to exploration for uranium, thorium, and beryllium. R. D. Nininger. Toronto, Van Nostrand, 1954. 367 pp., illus., $8.75.

The author is the assistant director for exploration of the American Atomic Energy Commission and has written a complete handbook of prospecting for atomic energy minerals.

Divided into three parts, the book first covers the minerals which are sources of uranium, thorium and beryllium, then deals with their location, both known and probable, in various areas of the world, and with their identification. Part III describes prospecting equipment and techniques, the use of Geiger and scintillation counters, evaluation of deposits, and such details as prices, markets and governmental controls.

The appendices give tables for mineral identification, classifications of ore deposits, testing and analysis procedures, and information on prospecting in Canada, Australia and other important areas.

An outline of atomic physics, 3rd ed. O. H. Blackwood, T. H. Osgood, and A. E. Ruark. New York, Wiley, 1955. 501 pp., illus., $7.50.

In a quickly changing field of science this book has been regarded as valuable enough to warrant a greatly expanded and revised third edition. Obsolete material has been replaced by sections on mesons, nuclear magnetic resonance, resonance radiation, Raman spectra, magnetic susceptibility, and electrons in metals. The basic function of the book has not changed, however: to present the fundamentals of atomic and nuclear physics for those who have an elementary knowledge of physics. It does not discuss the subjects of electronics and radar but remains a treatise on the structure of atoms and molecules.

The book spans a great deal of material, from the atomic nature of electricity, the Bohr model of the atom, atomic spectra, the periodic system, and elementary particles to cosmic rays and a simple account of the theory of relativity. In this edition the chapter on astrophysics has been omitted.

***Servomechanisms and regulating system design,** v. 2. Harold Chestnut and R. W. Mayer. New York, Wiley, 1955. 384 pp., figs., $8.50.

The first volume, published in 1951, dealt with basic mathematics, physical problems, and design solutions in a manner suited to the needs of students and engineers without previous training in closed-loop control. The present volume, a more advanced treatment intended for practical designers and graduate students, covers measurement techniques; specifications; methods of selecting power and stabilizing elements; amplifier design; all-a.c. servomechanism design; and non-linearities in control system design. Illustrative problems adapted from actual design projects are included.

Some fundamentals of petroleum geology. G. D. Hobson. Toronto, Oxford university press, 1954. 139 pp., diagrs., $2.75.

The basic principles of petroleum geology are outlined in this text. It begins by describing the nature of an oil accumulation then discusses the composition and properties of such reservoir fluids as natural gas, crude oil and oilfield waters. The origin of petroleum is dealt with as well as the phenomena of migration and accumulation. A fairly detailed chapter is devoted to reservoir pressure and a section in the appendices to compaction in sediments.

The book is not intended to be comprehensive and only a few of the fundamental problems of petroleum geology are covered in detail.

Technique du bâti soudé. F. Koenigsberger. Paris, Dunod, 1955. 119 pp., diagrs., $4.50.

This is a partial translation of the author's book "Design for welding". The first section gives general calculations on end to end and angle welding while the second chapter compares the problems of welding steel and cast iron. The rest of the translation is concerned with welding various components of a structure e.g. beams and floors.

The testing of high speed internal combustion engines, 4th ed., rev. A. W. Judge. Toronto, British Book Service, 1955. 494 pp., illus., $12.75.

Since the publication of the last edition of this work in 1943 many new developments have taken place in the design and production of internal combustion engines, and this revision is intended to keep abreast of these developments.

New engine testing methods and equipment which mean greater accuracy of measurement and more simplified controls are included in this edition. In addition, certain sections have been greatly expanded and others are completely new. There is new data on measurements of fuel quantity and rate, exhaust gas composition, diesel engine smoke density, static and variable cy-

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linder pressure and temperatures. The section dealing with the measuring of brake horse-power now includes descriptions of the most recent types of brakes and dynamometers, as well as new test formulae. The more recent fuel knock rating tests are also described.

The testing of aircraft gas turbine is included for the first time while the section on aircraft piston engine testing has been revised.

***Titanium in industry.** Stanley Abkowitz, J. J. Burke and R. H. Hiltz. Toronto, Van Nostrand, 1955. 224 pp., illus., $5.50.

A treatise on the elementary facts and principles involved in the use of titanium, written for process engineers and research metallurgists. Methods of production, properties, and alloying and heat treatment are discussed, and separate chapters are devoted to hot and cold shaping, casting and powder metallurgy, joining, and machining and grinding. Analytical and metallographic techniques are also described and military and industrial applications are briefly noted. Companies that are the main producers of titanium are listed in the opening chapter.

***Wave diagrams for nonsteady flow in ducts.** George Rudinger. Toronto, Van Nostrand, 1955. 278 pp., figs., $6.50.

Fundamentals and step-by-step procedures for the construction of wave diagrams are presented and applied to general flow problems, and to problems involving boundaries and discontinuities and the interaction of discontinuities. Actual techniques of wave-diagram construction are described, with completely worked-out examples given as illustrations. Intended both as a textbook and reference manual, a familiarity with problems of steady, compressible flow inducts is assumed.

Who's who in world aviation, vol. I, 1955. W. W. Parish, ed. Washington, American aviation publications, 1955. 345 pp., $10.00 (U.S.).

This is a world-wide biographical survey of important members of the aviation field and includes about 2,400 names. Among them are officials and key employees of aircraft and engine companies, airlines and associated industries; officers of air services; members of pioneer pilot organizations; government officials, and individuals who have won renown through their contributions to the science, industry, commerce, literature and development of aviation.

The list of names is arranged alphabetically and gives such information as business affiliations, address, education, military record and personal data of each biographee, and also notes any awards he has received and his membership in fraternal orders.

***The Williston Basin.** E. N. Kemler and W. D. Lacabanne. Spring Park, Summary Reports, 1954. 272 pp., illus., maps, $12.00 (U.S.).

A compilation of information widely scattered in petroleum magazines and professional society publications. It covers the geology of the Basin in general and of the various states and provinces; exploration methods in use in the Basin; drilling practices and problems; production, transportation, and refining activities; and characteristics of oil produced. Brief bibliographies follow some chapters and the appendix gives a general bibliography of 104 references. The authors are members of the engineering faculty, University of Minnesota.

***The world's great bridges.** H. Shirley Smith. New York, Harper, Toronto, Musson, 1953. 180 pp., illus.. $4.25.

Traces the development of bridge building from earliest times to the present. There are chapters on Roman bridges, the bridges of the Orient, and those built during the Middle Ages. About half the book covers the development of modern reinforced concrete, cantilever, steel arch, and suspension bridges. The book is written for both engineers and laymen.

NEW BOOKS RECEIVED

The advanced part of a treatise on the dynamics of a system of rigid bodies, 6th ed., rev. and enl. E. J. Routh. New York, Dover, 1955 [c. 1905]. 484 pp., $3.95 (U.S.) cloth; $1.95 (U.S.) pa.

Almost periodic functions. A. S. Besicovitch. New York, Dover, 1954. 180 pp., $3.50 (U.S.) cloth; $1.75 (U.S.) pa.

American concrete institute manual of concrete inspection, 3rd ed. Detroit, The Institute, 1955. 232 pp. illus., $2.50 (U.S.).

American society for testing materials proceedings, v. 54, 1954. Philadelphia, The Society, 1955. 1412 pp. illus., $12.00 (U.S.)

Les applications pratiques de la luminescence, 3e éd. M. Déribéré. Paris, Dunod, Montreal, Fomac 1955. 399 pp., illus., $14.85.

Applied hydraulics data list, 1955 Cleveland, Applied hydraulics magazine, 1955. 19 pp., mimeog.

Art in science. New York, Simon & Schuster, 1955. portfolio, 32 plates.

Automatic protection of a-c circuits 4th ed. rev. and ed. by C. M. Dodson G. W. Stubbings. Toronto, British Book Service, 1954. 355 pp., diagrs. $8.50.

The case for the UFO: unidentified flying objects. M. K. Jessup. Toronto. McLeod, 1955. 239 pp., illus. $4.00.

The continuum and other types of serial order. 2nd ed. E. V. Huntington. New York, Dover, 1955 [c. 1917] 82 pp., $2.75 (U.S.) cloth; $1.00 (U.S. pa.

Cost accounting and the engineer K. B. Mitchell, London, Iliffe, 1954 126 pp., diagrs., 10/6.

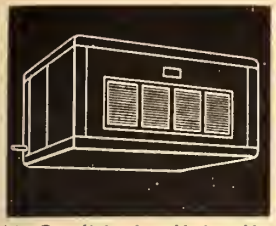
La couleur dans les activités humaines. M. Déribéré. Paris, Dunod Montreal, Fomac, 1955. 242 pp illus., $9.30.

Design of concrete structures, 5th ed L. C. Urquhart, C. E. O'Rourke, and George Winter. Toronto, McGraw Hill, 1954. 508 pp., illus., $9.50.

Dictionary of television, radar and antennas. W. E. Clason, comp Houston. Elsevier, 1955. 760 pp $21.50 (U.S.).

The dynamical theory of gases, 4th ed J. H. Jeans. New York, Dover, 195 [c. 1925]. 444 pp., $2.00 (U.S.) pa.

Dynamics of machinery. A. R. Holowenko. New York, Wiley, 1955. 46 pp., illus., $7.50.



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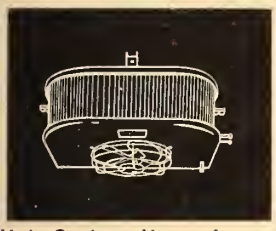

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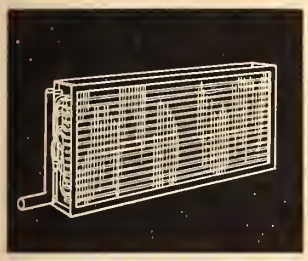

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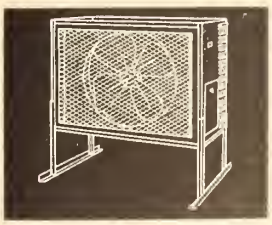

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Elementary theory of nuclear shell structure. M. G. Mayer and J. H. D. Jensen. New York, Wiley, 1955, 269 pp., figs., $7.75.

Engineering cybernetics. H. S. Tsien. Toronto, McGraw-Hill, 1954. 289 pp., figs., $6.50.

Financial Post survey of oils, v. 13, 1955. Toronto, Maclean-Hunter, 1955. 384 pp., maps, $3.00.

Grundbau taschenbuch. Berlin, Ernst, 1955. 2v., 85 DM.

Heating, ventilating, air conditioning guide, 1955, v. 33. New York, American society of heating and air-conditioning engineers, 1955. 1680 pp., illus., $12.00 (U.S.).

Hydrodynamique. G. Birkhoff. Paris, Dunod, Montreal, Fomac, 1955. 228 pp., illus., $8.70.

Ibbetson's electric wiring, 9th. ed. C. R. Urwin, ed. Toronto. British Book Service, 1954. 296 pp., illus., $2.00.

Modern petroleum technology, 2nd ed. E. B. Evans, hon. ed. London, Institute of petroleum, 1954. 702 pp., 35/-.

Les moteurs, diesel; leurs applications industrielles. Technique moderne, numéro spécial. Paris, Dunod, Montreal, Fomac, 1954. 576 pp., illus., $4.00.

L'organisation de l'entreprise et l'imprimé, 2è. éd. C. Duval et J. Lepanot. Paris, Dunod, Montreal, Fomac, 1955. 201 pp., illus., $7.75.

L'organisation scientifique et les relations humaines dans l'entreprise industrielle, 4è. éd. R. Lambert. Paris, Dunod, Montreal, Fomac, 1955. 230 pp., figs., $9.10.

Picture book of TV troubles, v. 3 (Video I-F & video amplifier circuits). J. F. Rider laboratories staff, New York, Rider, 1955. 96 pp., illus., $1.80.

Les poutres en béton armé soumises a la flexion composee. G. Colorio. Paris, Dunod, Montreal, Fomac, 1955. 98 pp., figs., $4.50.

Precast concrete. Kurt Billig. Toronto, Macmillan, 1955. 341 pp., illus., $5.50.

Principles of electric utility engineering. C. A. Powel. New York, Wiley, 1955. 251 pp., illus., $6.00.

Radio and television engineers' reference book. E. Molloy, ed. Toronto, British Book Service, 1954. Various paging, illus., $12.00.

Silent service is not enough: AWWA public relations manual. New York, American water works association, 1955. 152 pp., $1.50 (U.S.).

Standard methods for the examination of water, sewage, and industrial wastes, 10th ed. New York, American public health association, 1955. 522 pp., illus., $7.50 (U.S.).

TV field service manual with tube locations, v. 4. Harold Alsberg, ed. New York, Rider, 1955. 151 pp., illus., $2.40 (U.S.).

Third international conference on hot dip galvanizing, Oxford, 1954. Oxford, Zinc development assoc., Montreal, Consolidated mining and smelting co. of Canada, 1954. 268 pp., illus., $6.00.

Transform calculus, with an introduction to complex variables. E. J. Scott. New York, Harper, 1955. 330 pp., $7.50 (U.S.).

Turboblowers. A. J. Stepanoff. New York, Wiley, 1955. 377 pp., illus., $8.00.

Union decisions in collective bargaining. R. R. France. Princeton, University. Industrial relations section, 1955. 49 pp., $2.00 (U.S.).

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

American society for testing materials. Special technical publications:

No. 56-H—1952 and 1953 supplements to the bibliography and abstracts on electrical contacts. No. 90-C—1954 supplement to the metal cleaning bibliographical abstracts. No. 159—Symposium on radioactivity—an introduction.

Bell Telephone system. Monographs:

No. 2310—Acoustics in communication, by J. B. Fisk. No. 2314—Magnetostriction and anistropy of cobalt crystals, by R. M. Bozorth. No. 2324—Sources and properties of electrical noises, by W. R. Bennett. No. 2330—A new military radio relay system, by J. G. Nordahl. No. 2331—Features of the AN/TRC-24 radio set, by V. I. Cruser. No. 2343—Activation energy of ionic conduction in silica glasses, by O. L. Anderson and D. A. Stuart. No. 2350—New military carrier telephone systems, by J. P. Hoffman, G. H. Huber, W. F. Miller and C. W. Schramm. No. 2352—Passive linear networks in terms of time and energy, by G. Raisbeck. No. 2353—Some recent advances in microwave tubes, by J. R. Pierce. No. 2354—Large-signal behavior of junction transistors, by J. J. Ebers and J. L. Moll. No. 2363—The evolution of modern television, by A. G. Jensen. No. 2365—Distribution of a sum of n sine waves, by S. O. Rice. No. 2383—Large-signal transient response of junction transistors, by J. L. Moll. No. 2384—Miniature lacquer film capacitors, by D. A. McLean and H. G. Wehe. No. 2387—Theory of the thermoelectric power of semiconductors, by C. Herring.

British electrical and allied industries research association. Technical reports:

No. L/T282—The measurement of power loss at temperatures up to 100°C. and frequencies up to 100 Mc/s, by E. Rushton and G. Russell. No. L/T286—The dielectric properties of acenaphthylene styrene copolymers, by J. V. L. Parry. No. L/T292—Further improvements to the vacum torsion balance and sorption measurements on polystyrene, by A. G. Day. No. L/T303—Growing of perovskite-type crystals, by H. F. Kay and J. L. Miles. No. L/T310—Breakdown of solid dielectrics in divergent fields, by J. H. Mason. No. W/T31—Artificial lighting for plant growth, by A. E. Canham.

Canada. National research council:
Review 1954 (N.R.C. No. 3431.)

Canada. National research council Division of mechanical engineering Report:

Quarterly bulletin, 1 January to 31 March 1955 (No. ME. 1955 (1)).

Canadian standards association. Approvals laboratories:

List of approved oil-burning equipment, 2nd ed., March, 1955.

Jaworski, Adam, M.E.I.C.

The effect of standard charges on Canadian airport operations.

Nova Scotia power commission:

Annual report for the twelve months period ended Nov. 30, 1954.

Nova Scotia research foundation:

Annual report, April 1, 1953 to March 31, 1954.

Quebec, Department of mines. Laboratories branch. Preliminary reports:

No. 301—A chemical study of the peats of Quebec—VI—The Small Tea Field bog, Huntington county; VII—Large Tea Field bog; Huntington County, by J. Risi, C.-E. Brunette and H Girard (also in French). No. 305—The use of the thermobalance in analytical chemistry, by Fernand Claisse Florian East and Frederic Abesque (also in French).

Sola Electric Company:

The Sola constant voltage transformer; theory of design and operation.

Steinman, D. B.

Suspension bridges: the aerodynamic problem and its solution.

Underwriters' Laboratories of Canada Standards:

C142—Proposed revision of the standard for aboveground storage tanks for hazardous liquids.

United States. National research council. Highway research board. Bulletin.

No. 99—Parking requirements in zoning ordinances.

STANDARDS REVIEWED

A.S.T.M. standards, American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

***A.S.T.M. standards on paint, varnish, lacquer, and related products.** $6.00 (U.S.).

All the specifications, methods of test, and definitions pertaining to these products have been collected into a single volume in order to provide a convenient reference manual for the industry. A number of the standards included have also been approved by the American Standards Association or by the Federation of Paint and Varnish Production Clubs.

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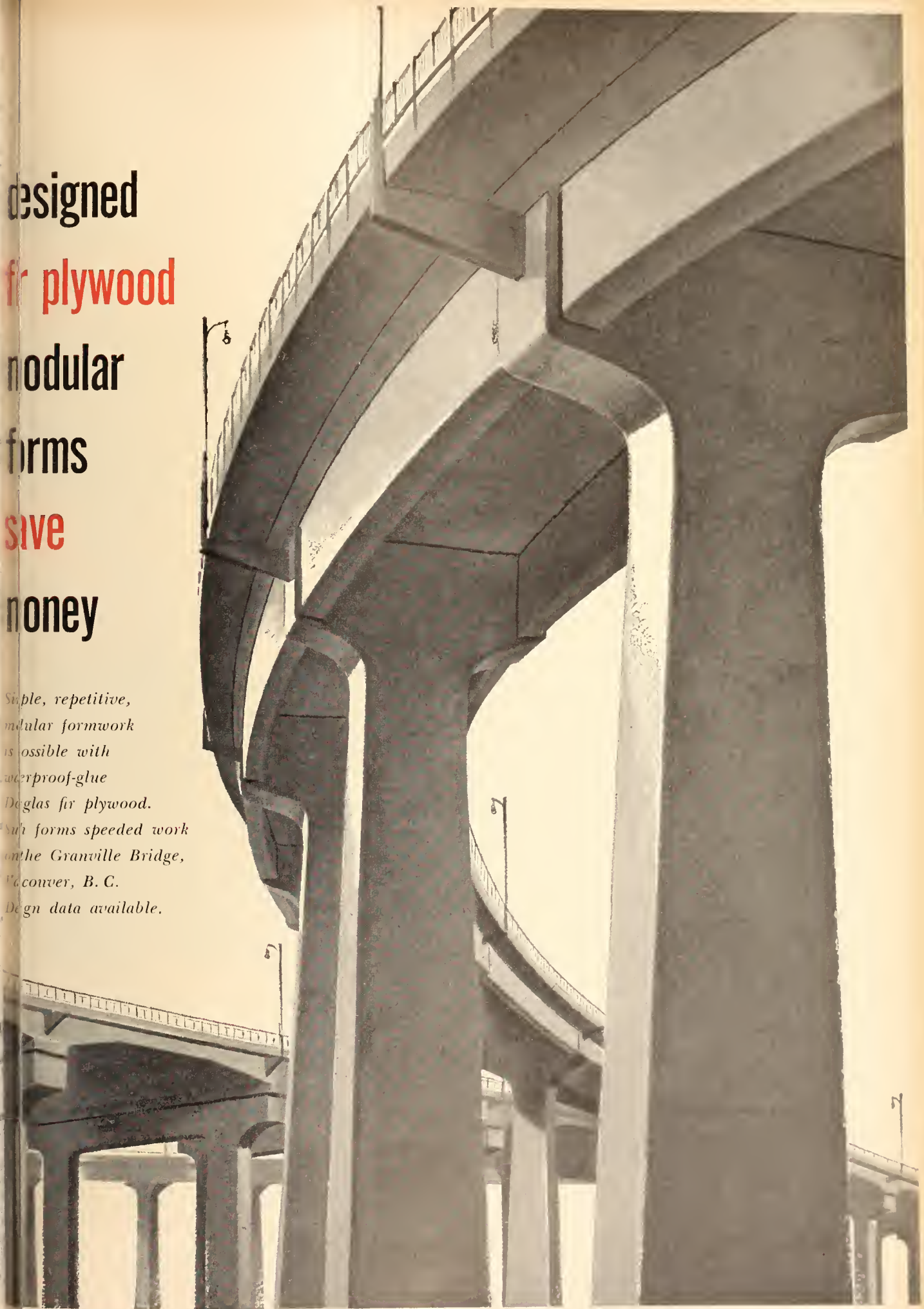

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BUSINESS & INDUSTRIAL BRIEFS

A Digest of Information

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The Editor

Appointments and Transfers

Honour for N.R.C. Vice-President.—The University of Western Ontario has conferred the degree of Doctor of Science *honoris causa* on E. R. Birchard, O.B.E., vice-president (administration) of the National Research Council, for his significant contribution to Canadian science in the field of administration.

A graduate in 1909 in mechanical and electrical engineering from the University of Toronto, Mr. Birchard was awarded the O.B.E. for his world war II services as Motor Vehicle Controller for the Dominion Government. He joined N.R.C. in 1947 in the capacity which has brought him the present recognition.

●

Data Processing Associates.—The election was recently announced of George Glinski, M.E.I.C., as director and president, and of Douglas Peacock as managing director and vice-president of Data Processing Associates, Ltd., Ottawa. A further note of Mr. Glinski's appointment appears under Personals in this issue.

●

C.G.E. Executives.—The board of directors of Canadian General Electric Company have announced the election of Harold M. Turner as chairman of the board. President of the company since 1946, Mr. Turner is succeeded as president and chief executive officer by James H. Goss.

●

Cooper-Bessemer Promotion.—C. R. Jones has been appointed manager, Western Canada, for Cooper-Bessemer of Canada Ltd. Mr. Jones was recently elected vice-president of the company.

●

Canadian Johns-Manville Appointment.—Howard G. Lambe has been appointed commodity manager for three of the Canadian Johns-Manville Company's asbestos-cement building products, which are to be produced for the first time in Canada in a new extension to the Toronto plant.

●

Change of Appointment.—R. H. Stokes-Rees, Affil.E.I.C., is now director of Rubenstein Bros. Co., 50 Craig Street West, Montreal.

●

Canadian Pacific Vice-Presidents.—The appointment of D. S. Thomson of Montreal as vice-president with jurisdiction over all lines of the Canadian Pacific Railway Company was announced recently by N. R. Crump, M.E.I.C., newly-elected president of the company.

Mr. Thomson, who had directed the operation and maintenance of the C.P.R.'s 17,019-mile network since October 1, 1953, had been a regional vice-president for five and one half years before coming to Montreal as vice-president, operation and maintenance. He controlled the eastern region at Toronto from 1948 to 1950 and the prairie region at Winnipeg from 1950 to 1953.

At the same time, Mr. Crump announced the appointment of R. A. Emerson, M.E.I.C., formerly chief engineer and a third-generation Canadian Pacific employee, as vice-president, operation and maintenance, the position formerly held by Mr. Thomson.

●

Foundrymen's Award.—J. E. Rehder, Director of Technology and Research, Canada Iron Foundries, Limited, is the 1955 winner of the Peter L. Simpson Gold Medal "for outstanding contributions to the Society and to foundry knowledge of cast metals". This award by the American Foundrymen's Society is one of the industry's highest recognitions. It is believed that this is the first time a Canadian has won the Simpson Medal.

●

Linde Appointment.—The appointment of Richard A. Schmidt, as General Superintendent, Plants and Distribution, has been announced by David S. Lloyd, president, Linde Air Products Company (formerly Dominion Oxygen Company), Division of Union Carbide Canada Limited. He will make his headquarters at the General Offices at 40 St. Clair Avenue East, Toronto.

●

Eagle Pencil President.—The election of Charles G. Easton as president of The Eagle Pencil Company of Canada Limited has been announced by the board of directors. Mr. Easton, a Canadian, joined the Eagle organization in New York in 1923. The Canadian company has head office in Toronto and factory at Drummondville, P.Q. Mr. Easton has served as Vice-President and General Manager since its inception.

●

Post-graduate Fellowship.—The Canadian Good Roads Association has announced the award of $2,000 fellowship to George O. Grant, of Toronto, for post-graduate study in the United States. Mr. Grant, who is assistant to the deputy minister of the Ontario Department of Highways, will study during 1955-56 at the University of California. The fellowship is made available to the Canadian Good Roads Association by the Armco Drainage & Metal Products of Canada Limited, Guelph, Ontario.

●

Babcock-Wilcox Appointments.—The board of directors of Babcock-Wilcox and Goldie-McCulloch Limited, Gal

J. E. Rehder

Ontario, announced recently that J. S. MacAllister is appointed executive assistant; and F. W. Cranston is appointed sales manager. In the Toronto branch, H. W. Blakley will be assistant manager and David S. Fulton, sales engineer.

Glen W. Crook, Jr.E.I.C., will be sales engineer, eastern branch office, Montreal.

●

English Electric Director Honoured.—Sir George H. Nelson, one of the four new Baronets in the Queen's Honours Lists announced recently, is a director of two Canadian companies, the John Inglis Co. and the English Electric Company of Canada. Both companies are members of the English Electric group

f companies, of which Sir George, who s a frequent visitor to Canada, is chair- an and managing director.

H. S. Jacobsen

John Inglis-English Electric Changes.—Following meetings of the board of directors of John Inglis Co. Limited nd the English Electric Company of Canada, Limited, the president, Humphey B. Style, announced the following hanges: Noel A. Timmins Jr. elected hairman of each company, and John A. Boyd vice-president of each company. Mr. Timmins and Mr. Boyd have been directors of both companies for several ears.

Two new vice-presidents have also been appointed to the two companies: V. A. Montgomery, vice-president, commercial development; and J. M. Sowry, ice-president, manufacturing.

●

Canadian Copco Managing Director.—H. S. Jacobsen, engineer and executive of the international Atlas-Copco group of companies, has arrived in Canada to take over as managing director of Canadian Copco Ltd. He succeeds G. W. Blomdal who launched the Canadian ompany in 1948 and who is going to Norway to assume direction of group operations in that country. Atlas-Copco, manufacturers of compressed air equipment, operate in 41 countries.

●

Montreal Armature Works.—The appointment of Robert F. O'Connell as executive vice-president and plant and field manager, and the appointment of Paul E. Barbeau as vice-president and sales manager, has been announced by David M. Landry, president of Montreal Armature Works Limited.

●

Cominco Staff Appointments.—W. G. Jewitt, assistant general manager and manager of mines for The Consolidated Mining and Smelting Company of Canada Limited, has announced the following appointments, to take effect on the retirement of H. C. Giegerich on August 1. P. T. Bloomer, currently operating superintendent, Sullivan Mine, to general superintendent, Outside

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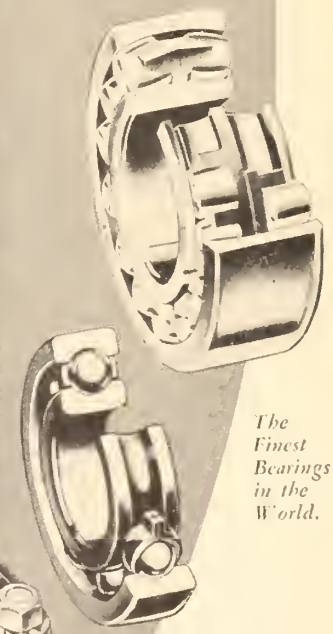

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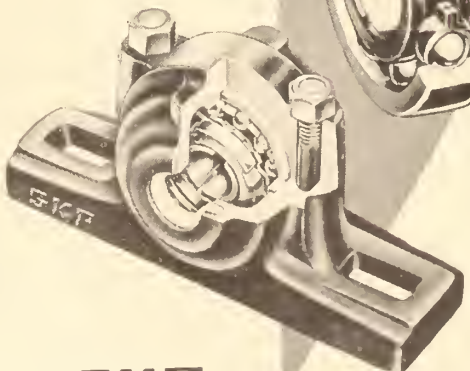

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Bus. and Ind. Briefs

Mines; R. M. Porter, currently acting property superintendent, Tulsequah Mines Limited, to operating superintendent, Sullivan Mine; and J. J. McKay, currently property superintendent, Nong Bhai Mine, Thailand, to property superintendent, Tulsequah Mines Limited. In addition Mr. Jewitt announced the appointment of J. C. MacLean to the position of property superintendent, H. B. Mine. Mr. MacLean's appointment became effective with the recent start-up of the H. B. property.

New Equipment and Developments

Liquid Level Bulletin.—A new 26 page bulletin describing the complete line of liquid level gauges for indicating, recording, controlling and telemetering has been released by The Bristol Company of Canada Limited.

The well illustrated, two colour bulletin shows float-type, pressure-type, differential pressure-type and bubbler-type liquid and water level gauges, in strip and round-chart models. Air or electric controllers are available in several modes.

Copies of bulletin L701 are available on request from The Bristol Company of Canada Limited, 71-79 Duchess Street, Toronto, Ontario.

●

Aluminum Alloy for Electrical Work.—Development of a new high strength aluminum alloy, designated as Revere Alloy 6263, designed specifically to serve the needs of the electrical industry, is announced by Revere Copper and Brass Inc., as the culmination of joint research with the Aluminum Company of Canada.

A magnesium silicide alloy, tailored to satisfy the need for a light weight high strength conductor, the new development has been approved for busway applications by several large electrical manufacturers.

●

Teletype for Data Processing.—A folder showing how Bell teletype facilities can be used for the complete mechanization of data processing shows illustrations of the various machines that carry out the complete clerical processes. Data are fed into the first in a series of machines in a "common language" which can be interpreted by all machines. After the first machine has performed its function, the data are passed on, arriving at the next machine in coded form on punched tape. This process is repeated until the job is completed. The folder is available through offices of The Bell Telephone Company of Canada.

●

Stress-Relieving Reactor Casing.—An unusual and interesting technique was recently employed to carry out the stress-relieving treatment of a reactor casing at Calder Hall, Britain's atomic power station at present under construction. The reactor casing, a large cylindrical steel vessel, made by Whessoe Limited, is 40 ft. in diameter, 60 ft. in height, and weighs 400 tons. As there was no gas-heated furnace sufficiently large to take the vessel, a framework of stainless steal tubing, of a total length of 2,000 ft. was installed inside the vessel and raised to a red heat by the passage of a 1500-kw. current.

Several days were needed to heat the walls of the vessel to the required temperature, at which the reactor casing was maintained for some hours to complete the stress-relieving treatment. After that, the vessel was allowed to cool down very gradually to room temperature. The whole of the outer surface of the vessel was covered with insulating material several inches thick.

●

New Building Technique.—Nearing completion in the North of England is a building covering an area of more than 750,000 sq. ft. with a volumetric capacity of nearly 17 million cu. ft. It has been constructed on a new building technique recently developed by the Tube Investments, Ltd. subsidiary — Metal Sections, Ltd. From start to finish, the project will be completed in approximately 20 months.

The basic design, as applied to buildings, centres around a prefabricated three-pin arch made from cold formed sections. A high strength-weight ratio has been achieved through a design technique which enables stiffeners to be inserted in the main frame sections at the most appropriate points determined by a load analysis of the structure.

Every pound of steel used in the structural framework supports seven and a half times its own weight, under maximum design conditions, and transfers the load directly into the foundations. For other types of buildings, where trusses and purlins are required to rest on load bearing walls, this ratio increases to just over nine and a half. The three-pin arches are manufactured in four parts and, when delivered to the site, all that is needed is site assembly, which, because each component is jig built, is easy and can be done by unskilled labour without the use of special equipment.

All other components—sheeting, rails, purlins, bracings, and so on—are delivered to the site as completed components, and no other work than erection is necessary. Because the structure is light and the arches are spaced at 20-ft. intervals, the foundations are more economical to lay than in other types of buildings.

The building framework can be erected on prepared foundations at the rate of 1000 sq. ft. an hour.

●

New Canadian Marconi Office.—A new sales and service office, with a floor space of 2,000 square feet, was recently opened in Calgary, at 1710 — 3rd St., N. E., by the Commercial Products Division of Canadian Marconi Company.

●

New Interior Paint.—Corosobar, a new rubber-base interior paint of the new styrene-butadiene family has been developed by The Tremco Manufacturing Company (Canada) Ltd., Toronto, Ontario. The new product is said to possess exceptional resistance to severe moisture conditions, chemical fumes and even occasional direct contact with acid and alkali solutions. Corosobar is recommended for use on walls, ceilings and equipment in establishments where severe moisture and chemical conditions prevail.

●

Pump Distributors.—The New York Air Brake Company has announced the appointment of Williams & Wilson Limited as distributors for eastern Canada of Kinney manufacturing division products consisting of Kinney vacuum pumps and equipment, and Kinney liquid handling pumps.

●

Spun Rock Wool.—The history of the development of rock wool from rocks near Thorold, Ontario, and the physical properties, applications, and specifications of currently available ranges of material are described in a technical bulletin published by Spun Rock Wools Ltd., Thorold, Ontario (from whom copies are available). The long fibred wool has an unconfined density of only 3 lb./cu. ft.; blankets are normally made at a density of 6 lb./cu. ft. The material may safely be used for insulation applications up to 1200°F. In addition to thermal insulation, the rock wool has found considerable use in sound-deadening for aircraft testing and wind tunnels.

●

Western Wire and Cable.—Expansion plans of Richmond Electric Company of Canada involve provincial incorporation of Western Wire and Cable Company from B.C. to Ontario. An office and warehouse are open in Edmonton and a manufacturing plant is planned for Alberta, where operations are under vice-president J. A. Kippan. A recent application from the company's range of electrical wire products, in the field of town-planning, is the substitution of small plastic-coated cables for unsightly overhead wires; such cables have been installed at Medicine Hat, Alberta.

●

Canadian Contract in Pakistan.—The Vancouver firm of Sandwell and Company Limited, consulting engineers, have completed a contract with the Pakistan Industrial Development Corporation for the construction of a 35,000-ton annual capacity newsprint mill and complete steam-electric power plant on the Ganges River delta system. Also scheduled is a townsite or colony, to be built over a period of two and a half years. Known as the Khulna project, the cost of the mill and power plant will be about $20,000,000 and of the town development about $1,000,000.

●

Coffin Turbo Pump Agent.—The J. S. Coffin Jr., Company, Englewood, N.J., announces the appointment of the Consolidated Engines & Machinery Co., Ltd., Town of Mount Royal, Que. as the exclusive Canadian agent for Coffin Turbo Pumps, which include steam-turbine-driven centrifugal pumps used in the industrial railroad and marine fields.

●

Change of Address.—The Offices of Wiggs, Walford, Frost and Lindsay, consulting professional engineers, are now

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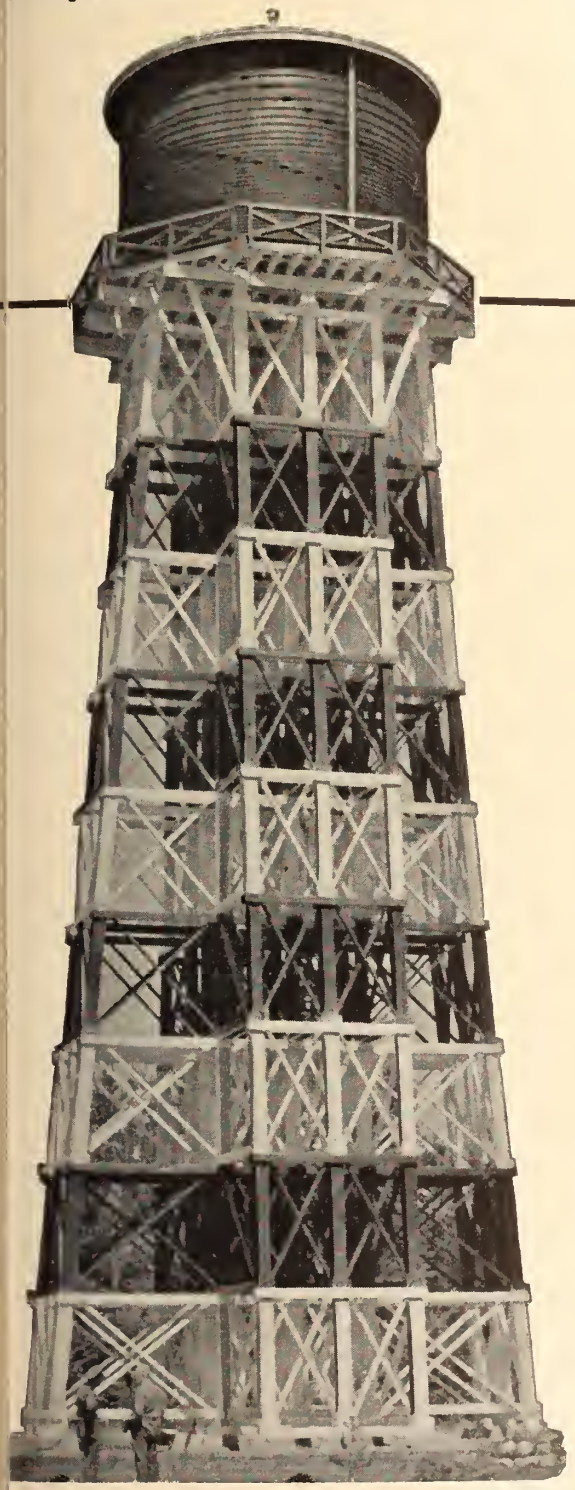

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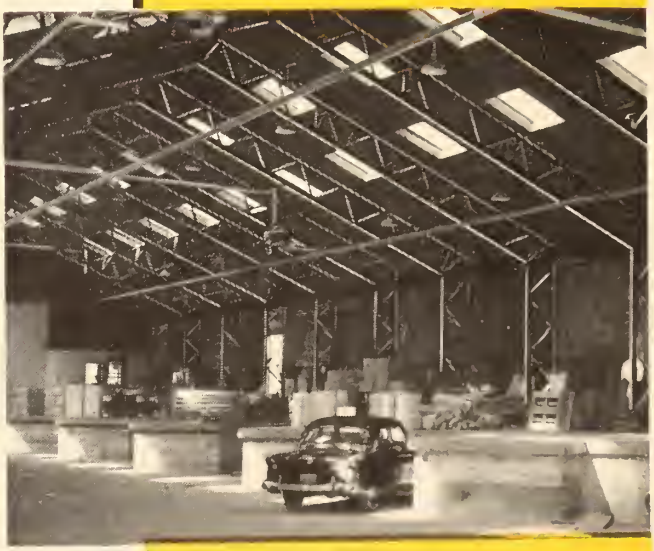

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Bus. and Ind. Briefs

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●

Power Show, 1955.—The Institute of Power Engineers announces that the 1955 annual meeting and technical sessions will be held in conjunction with the Power Show in the Show Mart, Montreal, November 8 to 11. Full information may be obtained from the Institute of Power Engineers, 1176 Sherbrooke Street West, Montreal, Que., or 410 Bloor Street East, Toronto, Ont.

●

Forthcoming Trade Fairs.—Major trade fairs to be held in 1955 include: Belgium—International Fair of Ghent, Sept. 20 to Oct. 9; India—Indian Industries Fair, New Delhi, Oct.-Dec.; Yugoslavia—Zagreb International Trade Fair Sept. 2 to 13.

●

Motorized Mines Locomotive.—Shown at the recent Trade Fair in Toronto was a motorized mines locomotive, Mark 'LBU', of 3¾ tons, representative of the range of small locomotives manufactured by Ruston and Hornsby Limited, Lincoln, England. This exhibit was set-up on rails, driven by an electric motor, and provided with plexi-glass covers on the engine and gear box to give a view of the working arrangement of the locomotive. This locomotive was a standard model, to be fitted with standard parts for sale to the Canadian mining industry.

●

Materials Handling Expansion.—Manufacturers of conveyors and materials handling equipment, C. H. McInnis Co., Ltd., Windsor, Ont., have opened an entirely new building of 29,056 sq. ft. at 2500 Central Ave., Windsor. In addition to the Windsor operation, the company has opened a branch office at 63 St. Clair Ave. East, Toronto, Ont., under the management of Martin J. Kuhn.

●

Atomic Industrial Forum, Inc.—Ontario Hydro has become a member of the Atomic Industrial Forum, Incorporated, a non-profit organization of industry and education engaged in the development and application of atomic energy for peaceful purposes. Representing the Commission in the Forum are Hydro chairman Richard L. Hearn, M.E.I.C., who is also a director of Atomic Energy of Canada Limited, and Harold A. Smith who is heading up the Commission's development work in this field.

Leading industrial and labour organizations, financial and educational institutions in the United States and abroad are members of the Forum, which, although it works closely with the United States federal government in nuclear energy problems, is supported entirely by private industry.

●

Horizontal Vibrating Screen.—Link-Belt Limited announce that a horizontal vibrating screen known as Straightline, is newly designed for dewatering high capacity loads and sizing material where headroom is limited. It has a lower silhouette than usual, although all advantages of high-intensity straight-line action are retained. The screen has two vibrators, one mounted on each side at deck level for ease of inspection. These do not project above the side-plates; thus headroom is held to a minimum. Dimensions for the complete line are available on Data Sheet 2562, available from Link-Belt Limited, P.O. Box 173, Station "H", Toronto 13, Ont.

●

New Anhydrous Ammonia Plant.—A new plant at Millhaven, Ont., for the manufacture of anhydrous ammonia was announced in June by Canadian Industries (1954) Limited. Construction of the plant, estimated to cost $9,000,000, will begin immediately with completion scheduled for late summer, 1956.

Negotiations covering design and construction of the process area have been with the Girdler Corporation of Canada Limited. The remaining portion of the new plant will be engineered by C-I-L engineers and constructed by general contractors. Advantage will be taken of existing installations on the site for steam, water, electricity and other services. At its peak, the project will require an estimated 500 construction workers, practically all of whom will be recruited in the Kingston area. About 60 per cent of the material and equipment for the plant will be purchased in Canada.

Extension of facilities at Beloeil, Que., to manufacture ammonia solutions for agriculture using ammonia from the Millhaven plant will be carried out by plant personnel.

●

New Building Research Station.—Building research in the Atlantic provinces of Canada takes an important step forward with the establishment by the National Research Council at Halifax, N.S., of a maritime regional station of its division of building research.

The new station is housed in the Maritime regional laboratory of the Council which is located on the campus of Dalhousie University. By the end of the year it is anticipated that a new research laboratory will be in operation in this building in which problems of masonry construction in particular will be studied in relation to severe climatic conditions. Important work in this field has already been done at the Nova Scotia Research Foundation.

The purpose of the new regional station will be to keep in touch with the building industry throughout all four Atlantic Provinces, and to make available to the industry in this direct way the information which is now available through the N.R.C. division of building research at its building research centre in Ottawa.

The climate of the eastern part of Canada is a major factor in connection with building problems and it will therefore be carefully studied by the staff of the new regional station in close association with members of the meteorological division of the Department of Transport.

●

New Canadian Westinghouse Plant.—The Canadian Westinghouse Company will locate a plant at Stratford, Ontario, this year for the manufacture of small motors (from one-20th to one-half h.p.), J. D. Houding, manager of the company's Industrial Products Division has announced. When completed and in full production by early 1956, the new plant is expected to employ between 100 and 125 people.

James Hornby, at present general superintendent of Industrial Products Division at Hamilton, will be in charge.

●

Permasteel (Alberta) Ltd.—It was recently announced that the company of Permasteel (Alberta) Ltd. has been formed and incorporated to handle the distribution and erection of Butler Steel Buildings in the northern part of Alberta. The new company, located at 10187 — 103 Street, Edmonton, is to operate under the management of Gordon E. Meneely, who has been territorial manager of the Butler Company for the past four years. John M. Heffernan has been appointed president, and John B. Thomas will serve as director.

●

New Line of Conveyor Belts.—A line of "Automation" conveyor belts, designed to meet the needs of new manufacturing concepts of all industries, has been announced by Howard P. Hawkins, general manager, B. F. Goodrich Industrial Products Division. The four new belt constructions in the line were shown at the National Materials Handling Exposition in Chicago.

The new belts are engineered to assist wherever possible in the automatic manufacture, assembly, inspection, and preparation of products for shipment.

The new line includes a tan Koroseal belt, resistant to abrasion, oils, grease and most acids; a belt in a shade of green said to increase inspection efficiency by reducing glare and eye strain; and a new lightweight conveyor belt fabric, impregnated with special compounds to give high resistance to moisture and long flex life even when operated over small pulleys.

●

Page-Hersey Tubes Expansion.—A $2-million modernization program in the company's seamless pipe mill at Welland will shortly be completed, according to Mr. A. Macfadyen, president and general manager of Page-Hersey Tubes, Limited. It is claimed that the modernization will result in Canada having the most efficient push-bench type seamless pipe and tube plant in the world. Of the available types of seamless pipe and tube mills, the push-bench is considered the most flexible and adaptable to Canadian requirements, having regard to the limits of the market and the need for frequent changes from one size of pipe to another.

The Welland plant is Canada's only producer of seamless pipe, and will be able to manufacture seamless tubular products in a range from half-inch pipe size up to and including seven-inch outside diameter.

●

Federal Public Works Contracts.—Works Minister Robert H. Winters has announced that contracts involving expenditures totalling $6,995,521.12 were awarded by the Department of Public Works during the month of May, 1955.

The amount of new works is $5,463,-864.10; for the repair and maintenance of existing structures, $1,033,085.79 and for dredging $498,571.23.

●

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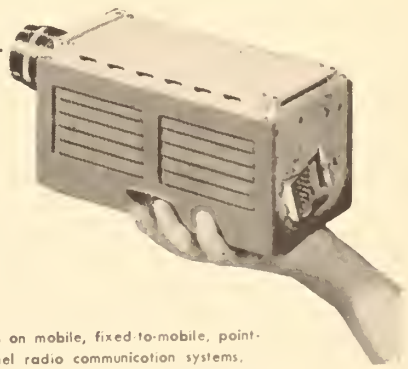

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Bus. and Ind. Briefs

Strip-Chart Recorders.—A new line of general purpose, strip-chart recorders featuring a plastic throw-away inkwell is available from Canadian General Electric Company's Apparatus Division. Designated Type CH, the three models —portable, semi-flush or surface mounted—chart a continuous record of an electrical quantity against time. The devices measure and record current, voltage, power, frequency or speed.

Replacement ink for the recorder is supplied in plastic inkwells containing three ounces. The containers are delivered sealed for quick insertion with no spilling. All the ink is used before throwing away the container because the pen opening has been designed to cut evaporation to a negligible quantity.

The record rolls are 150 feet long; 28 different chart speeds are available, ranging from ¼ inch per hour to 2 inches per second.

●

Resin for Boat Building.—Production of Vibrin F-1, a new polyester resin type, especially developed for boat building and boat covering, has been announced by Naugatuck Chemicals. Vibrin F-1 is supplied with promoter and a thixotropic agent to inhibit run-off in large mouldings or boat coverings, It requires only the addition of catalyst and desired colour to be ready for use in hand-layup room-temperature-cure applications. Other possible applications for Vibrin F-1 include large mouldings, concrete coatings, and floor coverings.

●

Stainless Steel Sealing Rings.—Recently announced is introduction to the Canadian market of hollow, stainless steel "O" rings manufactured under the name of Toruseal. These seals are the product of D. S. D. Manufacturing Company of Hamden, Conecticut, and are handled in Canada by Winnett Boyd Limited, Toronto.

The seals are made from stainless steel tubing by a welding process which, after cleaning and polishing, shows no sign of the welded joint. Applications include the aviation, chemical, hydraulic and allied fields for high temperature work. They have been tested successfully up to 600 p.s.i. and 700° F. Standard sizes are from ¼ inch diameter up. Special sizes have been built as large as eleven feet diameter.

●

New Cable Roller.—Canadian Line Materials' engineers, in collaboration with utilities, have designed and developed an overhead cable roller to simplify the erection of new lines and to equalize the sag.

The roller is mounted on the crossarm; the cable retainer locks the cable and prevents it from rising during stringing. The retainer can swing free when not in use and still remain permanently affixed to the unit. the roller is designed with an adjustable mounting bracket to fit all popular size crossarms.

●

Cables for Empress of Britain.—Launched by Her Majesty the Queen at Govan, Scotland, on June 22 the 24,000-ton "Empress of Britain", uses substantial quantities of cabling supplied by British Insulated Callender's Cables Ltd., including a 230-volt ring main having the largest conductor ever supplied to a merchant ship by this company. The conductor measures 1.4 sq. inches and is made up of 169/.103 strands. The cable is insulated with varnished cambric, has a lead-alloy sheath, and single-wire armouring. The overall braiding is protected by a fire-resisting compound. Altogether some 744 yards of the cable will be installed.

●

Canadian Distributor.—Albern Universal Limited, 2382 Dundas street, West, Toronto, Ontario, has been named Canadian distributor for the Union Asbestos & Rubber Company's air conditioning products.

●

Steel Design Manual.—A new publication by United States Steel, Design Manual for High-Strength Steels, is a practical, working handbook for architects and engineers and was compiled to fill a need growing out of the development and widening applications of high-strength low-alloy steels. (This is a specific class of steels in which enhanced mechanical properties and, in most cases, improved resistance to atmospheric corrosion are achieved by moderate additions of one or more alloying elements other than carbon.)

Written by H. Malcolm Priest, manager of U.S. Steel's Railroad Research Bureau, with collaboration of J. A. Gilligan, senior technologist at the Corporation's new applied research laboratory in Monroeville, Pa., the manual is available to qualified engineers and architects. For information write to U.S. Steel Corporation, 525 William Penn Place, Pittsburgh, Pa., referring to publication number ADVL-215-54.

●

Nuclear Power Development. — A specialized group of firms is associated with a recently incorporated separate company which will concentrate on the research, design, and construction of nuclear power stations in the United Kingdom.

Registered as the associated companies are: C. A. Parsons & Co. Ltd.; A. Reyrolle & Co. Ltd.; Head, Wrightson & Co. Ltd.; Sir Robert McAlpine & Sons, Ltd.; Whessoe Limited; Strachan & Henshaw Ltd.; Alex. Findlay & Co. Ltd.; and Clarke, Chapman & Co. Ltd. The combination of these eight firms is aimed to enable the Nuclear Power Plant Co. Ltd., to design and construct atomic power stations in any part of the world.

The Directors of N.P.P.C. are, president and chairman Sir Claude Gibb, C.B.E., F.R.S., Dr. A. T. Bowden, R. Edwin McAlpine, Richard Miles, Harold H. Mullens, Arthur J. Sayers, and Sir John Wrightson, Bt. The secretary is D. P. Walton.

●

Increased Newsprint Capacity.—It is announced that the Crown Zellerbach Corp. of Canada Ltd. subsidiary, Elk Falls Co. Ltd., is to undertake a plant expansion program involving an expenditure of some $13.5 million. A $7.5 million paper machine will have an annual capacity of 50,000 tons of bleached, semi-bleached, and unbleached kraft paper and newsprint, to increase annual production by 50 per cent.

The program is in addition to the kraft mill already under construction; a bleaching mill and a sawmill are also included in the new development.

●

Wire and Screen Fabricating.—A new plant for the B. Greening Wire Company, at Orangeville, Ont., is due to be completed at the beginning of September. Expanded facilities for the wire-fabricating and screen-manufacturing divisions are to be provided, and products will be woven and crimped wire, vibrator screens, fabricated baskets, guards, and a new movable wire-mesh plant-partitioning called Wire-Wall.

●

New Building for Canadian Oil.—A new $300,000 administration and plant protection building at the Canadian Oil Companies, Limited refinery at Sarnia is part of the three-year $3,000,000 expansion program now under way at the refinery; it is scheduled for completion in about nine months.

Of curtain wall construction, the buildings will have welded steel frames, and be glass-faced—about 80 per cent of the outside walls will be glass panels. The end walls will be brick. Other features include a hot water, convector heating system around the outside walls.

●

Switchgear for St. Lawrence Project.—Brown Boveri high-speed air blast circuit breakers have been selected by H.E.P.C. of Ontario for the 2,200,000 horsepower generators at the St. Lawrence Project Power House near Cornwall, Ontario.

The contract includes 14.4 kv. air blast circuit breakers and associated potential transformer structures to control the output of sixteen 65,000 kva water-wheel generators to be installed in the power house at the Canadian side of the 3,300-ft. dam.

At the American end, thirteen 86,000 kva. single phase generator transformers are being supplied by Brown Boveri Corporation of New York, N.Y., an associated company. These units are being made at the company's main factory in Switzerland.

All the equipment being supplied by Brown Boveri (Canada) Limited will be built in Canada, at their St. Johns Que., factory.

●

Non-ferrous Metals Expansion.—Federated Metals Canada Limited, a subsidiary of the American Smelting and Refining Company, is to construct two new plants, to be located in Toronto and Montreal, according to Paul H. Jackson, general manager of the Canadian operations.

At the new location in Toronto, a modern reverberatory furnace will be operated, while the Montreal plant will expand present lead fabrication facilities, including a rolling mill for producing sheet lead, lead pipe and wire solder presses, lead trap and bend presses and spinning lathes for fabricated lead products. This plant also houses a lead construction department which contracts for a wide variety of outside construction and fabrication work in lead.

E.I.C. TECHNICAL PAPERS

The Institute maintains a fund for the separate publication of high-calibre original technical papers. Interest in such papers is limited to a relatively small audience of specialists in the subjects to which the papers relate, and it is not economically sound to publish them in the *Journal* which aims at the interest of some 15,000 engineers in all branches of the profession.

It is an obligation of the Institute to publish original works which contribute to the reference literature of the profession. The Technical Papers are distributed to the world's major engineering societies and technical libraries. Similarly it is an obligation of those engineers qualified to write these papers to submit them for possible inclusion in the literature. The publications committee invites authors to present such manuscripts for submission to qualified reviewers and publication if warranted. Written discussion will be accepted and published as supplements.

Technical papers issued to date are:—

No. 1—Flow in Conduits and Canals:—*French and Wood.* Comprises tables and diagrams for the solution of problems of flow in open and closed channels. Price $1.50

No. 2—A Revised Manning Flow Formula:—*Blench.* A discussion of the various hydraulic flow formulae in use or proposed. The author, formerly Director of Irrigation Research, Punjab, Pakistan, and now on the staff of the University of Alberta, concludes that the Manning formula, with modifications, is the best now available. Price $1.00

No. 3—Air Entrainment by Water in Steep Open Channels:—*Priest.* A theoretical solution of a problem of interest to hydraulic engineers $1.00

No. 4—Graphical Solution of Partial Differential Equations with Engineering Applications:—*Wood.* Solution by simple, almost automatic, methods, of equations arising from the study of water hammer phenomena, impact, and other common engineering problems. This paper will be of particular value to hydraulic engineers and structural and machine designers. Price $3.00

No. 5—Economy in Rigid Frames:—*Monti.* Charts and diagrams to facilitate rapid preliminary design of the common types of rigid frames, eliminating the cut-and-try methods previously necessary before a final analysis could be attempted. This paper belongs in the library of every structural designer. Price $1.00

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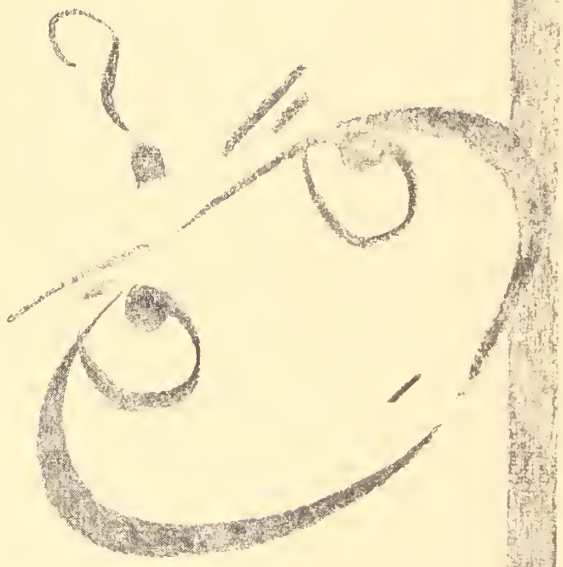

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SIR ADAM BECK No. 2 GENERATING STATION

In this new Niagara River plant of Ontario Hydro, as in most important generating stations across Canada, you find the name "Westinghouse" on machines producing electricity.

CANADIAN WESTINGHOUSE COMPANY LIMITED, HAMILTON

Canada's Petroleum Industry

by

G. M. Furnival, M.E.I.C.,

Vice-President,
The California Standard Company,
Calgary, Alberta.

A paper presented before the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, at Toronto, May 1955.

Drawing upon his intimate knowledge of Canada's oil industry, the author traces its growth and discusses land and leases, geology, exploration methods and Canada's position in relation to world production.

Presenting a careful analysis of the markets available, he shows how western Canadian crude could compete with 85 per cent of the overseas supplies at present being consumed in the Montreal-Toronto market and the many advantages to be gained thereby.

He urges early extension of the Edmonton-Sarnia pipeline to assure this market for Canadian oil against the pressure of rapidly increasing world reserves.

An all-time record was achieved in 1954, when the value of annual production of Canada's entire mineral industry for the year 1954 reached $1,444,196,000. Twenty-five per cent of this annual production was contributed by the oil and gas industry.

The value of the annual production of petroleum in Canada for the first time exceeded that of any other single mineral in 1953, when 80,898,000 barrels were produced at a value of $200,582,000—exceeding the value of nickel produced that year by nearly forty million dollars. In 1954 this margin over nickel was increased to about seventy million dollars, when 97,064,000 barrels of petroleum were produced, having a value of $245,995,000. (Nickel production in 1954 was about $175,000,000.) Further substantial increases in the value of petroleum production are assured for 1955 since the rate of production for the first two months of this year is approximately 17 per cent higher than for the same period in 1954. Comparing the current position of the oil industry to its status in 1947, when it was a mere infant in relation to Canada's economy, producing only 7,304,000 barrels of petroleum, it is obvious there has been phenomenal growth during the seven intervening years.

Exploration History and Petroleum Production

In 1947 Canada produced 20,000 barrels of crude oil daily, or less than 10 per cent of its daily consumption. Most of this was produced from the Turner Valley Mississippian Limestone field southwest of Calgary, the only known major oil field in Canada at that time. Widespread exploration, using modern methods and techniques, commenced in Alberta in 1941, when the emphasis in exploration shifted from the foothills to the plains of Alberta.

During the period 1941 to 1947 a number of small oil fields were discovered on the Alberta plains, of which the most significant was the finding of oil in Devonian limestones at Princess, sixty miles southeast of Calgary. Then, early in 1947, after several hundred million dollars had been spent on geological and geophysical surveys, shallow structure drilling and deep exploratory drilling, the Leduc-Woodbend Devonian reef limestone field was discovered a short distance southwest of Edmonton. Subsequent development of this field indicated recoverable reserves of 300 million barrels of light gravity sweet crude oil. (Fig. 1)

Early in 1948 the Redwater Devonian reef limestone field was discovered, 27 miles northeast of Edmonton, having estimated recoverable reserves of 700 million barrels of light gravity crude. In the following years discoveries of other Devonian reef limestone fields of light gravity crude oil followed in rapid succession in ten major pools and numerous smaller fields, having further estimated recoverable reserves totalling close to a billion barrels.

The stimulus given to exploration by the discovery of these reef limestone fields over widely separated parts of Alberta led to the discoveries of numerous Cretaceous sandstone fields such as the Joarcam Viking sandstone field with 105 million barrels of recoverable oil, and, more recently, in 1953, to the discovery of the Pembina Cardium sandstone field, which, though only in a preliminary stage of development, may well become Canada's largest oil pool, with current estimates of recoverable reserves approaching a billion barrels.

The remarkable discovery rate resulted in total proved recoverable reserves of crude in Alberta at the end of 1954 of 1,900 million barrels. Annual production from Alberta in 1954 was 87.6 million barrels, or an average of 240,000 barrels per day. Already in 1955 significant new developments have occurred. At Clear Hills, northwest of Peace River town, a substantial discovery has been made in a previously unproductive older geological horizon, while continued development of a recently discovered field at Joffre, east of Red Deer, suggests the presence of another sizeable Viking sandstone field. At Sundre, 65 miles northwest of Calgary, an important new Mississippian limestone light crude oil field is being developed. (Fig. 2)

Intensive exploration commenced in Manitoba in 1947 and resulted in the discovery of the Mississippian limestone field at Daly in 1951. This was the first commercial oil discovery in the entire Williston Basin. Subsequently exploration spread westward into the Williston Basin area of Saskatchewan. In the following years additional fields were found

in both provinces, but only one, the Smiley field in western Saskatchewan, has recoverable reserves of light gravity oil estimated in excess of 25 million barrels. Three fields, Fosterton, Cantuar and Success, in southwestern Saskatchewan have a combined total in excess of 100 million barrels of medium gravity. Production of crude in Saskatchewan for 1954 was 5.26 million barrels, nearly double 1953's production. Saskatchewan's total recoverable reserves are estimated to be 222 million barrels.

Manitoba more than doubled its annual production in 1954 when it produced 2.15 million barrels of crude. Average daily production during 1954 exhibited a spectacular 300 per cent increase, while recoverable reserves are estimated at 50 million barrels.

Though substantial gas fields and some oil discoveries have been made in northeastern British Columbia, this area is in its initial stage of exploration. There are indications, however, that the area will receive more intensive exploration in the years ahead. About 300,000 barrels of crude oil are produced annually from each of the other producing areas in Canada, southwestern Ontario and the Northwest Territories at Norman Wells.

The annual increase of proved reserves of crude oil and liquid natural gas, before allowing for current production, since 1947 is as shown in Table I.

In extrapolating these figures into the years ahead, however, it should be noted that the 1954 figure for proved reserves only includes those reserves in the new Pembina field established by the 185 wells drilled there in 1954. It has been estimated that, when this field is fully developed, it will have more than 4,000 producing wells.

It is conservatively estimated that a minimum of 600 wells will be drilled each year in this field for at least the next five years. This means that proved reserves from this one field alone can be added at a conservatively estimated rate of approximately 120 million barrels per year for the next five years. When this figure is merged with the average increase of 370 million barrels per year from the development of other fields and new discoveries, it seems quite safe to predict that the annual increase in proved reserves will be at a rate between 400 million and 450 million barrels per year for the next five years, before allowing for annual production.

The 1954 production of 97 million barrels represents less than 4 per cent of the total reserves. Annual production rates in the United States average 8 per cent of recoverable reserves, while in some states the rates are even higher, such as in California, where it is 12 per cent.

These figures should suffice to confirm that Canada's oil producing industry is quite soundly based, and that a healthy future is assured on the long term basis, even though it is presently afflicted with growing pains arising from its own remarkable achievements which are, in fact, necessary to establish itself and its markets on the long term basis.

Table I. Annual Increase in Proved Reserves of Petroleum (Total Liquid Hydrocarbons)

	Increase in Proved Reserves (Barrels)	Production (Barrels)	Net Increase in Reserves (Barrels)	Total Reserves At Year End (Thousands of Barrels)
1948	344,903,000	12,287,000	332,616,000	512,000
1949	434,305,000	21,305,000	413,000,000	925,000
1950	108,044,000	29,044,000	79,000,000	1,004,000
1951	431,564,000	47,616,000	383,948,000	1,387,948
1952	418,165,000	61,230,000	356,935,000	1,744,883
1953	379,855,000	81,190,000	298,665,000	2,043,548
1954	469,461,000	97,064,000	372,397,000	2,415,945
Yearly Average	369,471,000		319,509,000	

Land Acquisition

A first and most important step in the search for oil is the acquisition of oil and gas rights ("land") in regionally favourable areas. In Western Canada there are some 300 million acres, which might be considered favourable for oil exploration, distributed roughly as shown in Table A.

Of the total, 250,000,000 acres are held by the respective Provincial Governments; 16,000,000 acres by the Federal Government; 23,000,000 acres by the railways; 4,700,000 acres by the Hudson's Bay Company, and the remaining 6,300,000 acres by individuals, insurance companies, real estate companies, etc.

Prior to 1889 the oil and gas rights were granted, along with surface rights, to homesteaders, the Hudson's Bay Company and the railways. After this date the Crown in the right of Canada reserved the oil and gas rights and these were subsequently transferred to the provinces in 1930.

Because Manitoba was extensively settled prior to 1889 much of the oil and gas rights went to the homesteaders and today the Manitoba Government owns only about 20 per cent of the oil and gas rights in favourable areas in that province. By contrast, Alberta was settled much later, with the result that the Alberta Government today owns some 80 per cent of the oil and gas rights in that province.

In the early stages of Western Canada's exploration history individuals or companies interested in searching for oil, therefore, could acquire "land" (meaning oil and gas rights) under lease or reservation from the provincial governments, or by agreement with the railway companies and other large holders, or by leasing individual freehold rights.

Freehold leases vary, but commonly are for a term of 10 years with a gross royalty of 12½ per

Table A. Distribution of Areas Favourable for Oil Exploration

	Total Acreage	Estimated Favourable Acreage
Alberta	163,382,400	140,000,000
Saskatchewan	161,088,000	90,000,000
British Columbia	227,747,200	60,000,000
Manitoba	161,172,290	10,000,000
Total	713,389,890	300,000,000

cent payable to the lessor out of production. The annual rental under the usual lease is $1.00 per acre, and the lease has offset drilling and follow-up drilling obligations. Cash bonuses are paid for the leases and vary widely, depending upon the potential value attributed to the acreage.

Provincial government leases generally have terms of 21 years, renewable for an additional 21-year period, with annual rentals of $1.00 per acre, and sliding scale royalties of from 5 to 16 2/3 per cent of gross production based upon monthly production rates and averaging about 12½ per cent. They include the usual offset and follow-up drilling obligations.

Provincial government reservations are granted for single blocks of land comprising up to 100,000 acres. The reservation holder is required to perform certain minimum exploration work requirements within specified periods and to convert to lease at the end of a definite period—usually three years. Approximately half of the total acreage of a reservation can then be acquired under lease, commonly in a checkerboard pattern.

In Alberta the permissible checkerboard arrangements in such cases have been so worked out that the holder of a reservation, who risks several hundred thousand dollars on exploration work and a like amount on exploratory drilling and is fortunate in finding a commercial crude oil field, is only able in most cases to take under lease a portion of the field he has found.

If it is a substantial field, he may be able to acquire only half of it. The remainder is retained by the Crown and is subsequently put up for sale by competitive bidding, thus yielding the provincial government a large revenue. The discoverer, in addition to surrendering a good portion of it to the government, then is required to give the provincial government about 12½ per cent of the oil produced from the portion retained under lease before payment of the Federal government's income tax on the profits.

Regulations for disposal of Crown rights differ greatly in detail from province to province. It will not be possible to establish uniform regulations for the disposal of Crown rights throughout the Western Provinces because of the differences in the amount and distribution of the oil and gas rights held by each province; the different stages of exploration development, and the differences in topography, accessibility and current land utilization.

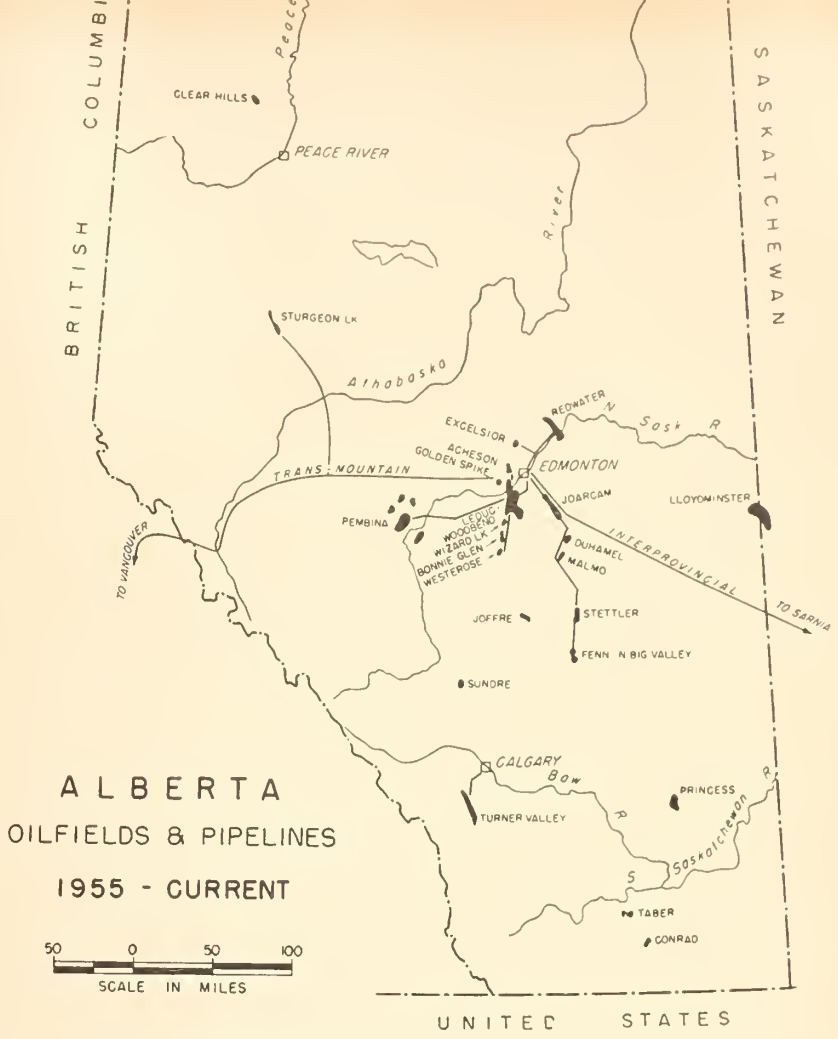


Fig. 1. Alberta Oil Fields and Pipe Lines — 1955-Current.

For example, it would obviously be impossible for Manitoba, where the Crown owns only 20 per cent of the oil and gas rights, which are widely dispersed in small parcels, to adopt Alberta's type of regulations. Similarly, the remoteness of much of Northeastern British Columbia and its very youthful state of exploration has required more lenient regulations than Alberta's in order to interest exploration capital.

Today one might say Alberta has entered the second stage in the disposition of Crown oil and gas rights, in that there is scarcely an acre that has not in the past been committed under reservation or lease. However, contrary to some public statements, acreage is constantly changing hands. In addition to changing hands, reservations taken out since the Leduc discovery in 1947 have gradually matured and have been converted to lease, so that an increasing amount of acreage has been reverting to the Crown.

Today the Alberta Government is by far the largest holder of committed oil and gas rights in the form of Crown Reserves not yet put up for sale. These rights are not available for leasing or reserving in the usual manner. Converting the numerous reservations into checkerboard patterns of leases has created a difficult situation. Land holdings, particularly in Central Alberta, have become so diversified that it is now almost impossible to put together a sufficiently large block of acreage to justify risking the cost of an exploratory well.

This has led to a large increase in joint venture agreements as a result of the need of various land owners to pool their interests and share the cost and risk of drilling a well to test their acreage. It is true that original holders of reservations were permitted under the regulations to take up

leases on geophysical anomalies found within their reservations. However, geophysical surveying is still a very inadequate method for locating reefs and structures in Western Canada.

Furthermore, geophysical methods are constantly being improved. Consequently re-surveying by more refined methods and instruments and the review of previous interpretations frequently shifts or wipes out many previously mapped anomalies and commonly results in the finding of new anomalies. New surveys frequently show anomalies underlying Crown Reserves or lands of such diverse ownership that a satisfactory agreement for drilling purposes becomes difficult.

The Alberta Government recognized this in 1954 by putting up for sale "drilling reservations." After buying a reservation and drilling to a specified depth it is possible to earn eight or nine quarter-sections. However, the land disposed under "drilling reservations" and Crown sales still represents only a small percentage of the acreage presently tied up as Crown Reserves. The Alberta Government's revenue from such sales, from April 1948 to the end of 1954, totalled nearly $195 millions.

It would seem, therefore, that Alberta could now afford to adopt a more generous attitude in the disposal of its rights in the interests of the future development of the industry. This, in turn, would protect the government's other long-term revenues from oil lands in the form of rentals and royalties. These latter, between April 1948 and the end of 1954, aggregated over $153 millions.

Many companies, after exploration, have found structures and seismic anomalies which they cannot justify drilling. This acreage must be evaluated, since no company can afford to continue to pay the standard $1.00 per acre per year rental for many years. Such acreage, therefore, is "farmed-out" under agreement to assign upon the drilling of a well to a predetermined objective or depth.

The party undertaking this obligation earns either a part interest, generally half, or the entire interest subject to an over-riding royalty payable out of production to the assignor. The amount of acreage involved in such agreements ranges up to as much as a million acres in some cases, and depends upon the depth to be drilled, location and value of the land, and nature of the seismic anomaly.

"Farm out" agreements are mutually beneficial, since the party taking the farm out obtains at no cost the results of expensive exploration as well as a part interest in the rights concerned, without any acquisition or rental costs. The party granting the farm out obtains a free exploratory test well by which the acreage is evaluated. Acreage unless found productive, may be surrendered and become available for acquisition by other interested parties.

General Geology

In general, the geological formations across Western Canada attain their greatest thickness in the Rocky Mountains and in the thrust-faulted regional monoclinal structure known as the Alberta syncline, which occupies the Alberta foothills region. The formations generally thin eastward toward the Williston Basin in Southeastern Saskatchewan, where thickening of the sedimentary section occurs prior to the final eastward thinning onto the Precambrian Shield.

The major structural features are as follows:

(1) the disturbed belt of Alberta, Northeastern British Columbia, the Northwest Territories and Northern Yukon composed of folded and thrust-faulted sedimentary strata;

(2) the northward plunging Sweetgrass Arch of Southern Alberta;

(3) the buried Precambrian ridge known as the Peace River "High" in northwestern Alberta;

(4) the Cypress Hills anticlinal nose and the northern extension of the Bowdoin Dome separated by the Coburg syncline in Southwestern Saskatchewan;

(5) the Williston Basin of Southeastern Saskatchewan;

(6) the regional monoclinal structure flanking the Southwestern boundary of the Precambrian Shield and extending southeast from the Arctic to Southwestern Manitoba, where it forms the eastern limb of the Williston syncline.

Prior to 1947 geologists were mainly concerned with looking for oil occurrences in anticlinal and stratigraphic traps. The Turner Valley Field is an excellent example of the occurrence of oil in an anticline. A common type of stratigraphic trap is one where the porous beds containing the oil occur on a monocline having an up-dip barrier due to: (i) the pinchout of the porosity, (ii) the presence of a fault, or (iii) the presence of an unconformity or other stratigraphic disconformity. However, most stratigraphic trap oil fields involve a certain amount of local folding as a secondary feature. The oil fields of Manitoba provide excellent examples of this type of oil occurrence.

The new Pembina Cardium sandstone field is also an excellent example of the occurrence of oil in sandstone beds, the porosity of which pinch out up the dip of a monoclinal structure. Estimates of recoverable reserves in this field range up to a billion barrels. The Viking sandstone fields of Joarcam, Smiley and Joffre are examples of the occurrence of oil in bar type sandstones which, though of considerable longitudinal extent, are lenticular in cross section. These fields have combined estimated recoverable reserves of some 150 million barrels.

Reef limestone fields are classified basically as stratigraphic type fields, though some folding results from differential compaction of the beds overlying the reefs with resultant associated lesser oil fields. The discovery of the Leduc-Woodbend reef limestone field in 1947 coincided with the discovery of another major reef limestone field, the Snyder Field, in Scurry County, Texas. These two discoveries of large quantities of crude oil in biohermal type reefs focused attention upon the importance of such occurrences as a major source of oil. (See Fig. 3)

Exploration efforts were immediately concentrated upon the search for reef limestone fields. The subsequent discovery of eight additional major reef limestone fields in Alberta which, together with the Leduc-Woodbend field, have combined proven recoverable reserves in excess of 1,500 million barrels, attests to the great importance of this type of occurrence and resulted in the introduction of a new objective in geological thinking and further refinement of exploration methods.

Exploration Methods

Some modern exploration methods may be considered here.

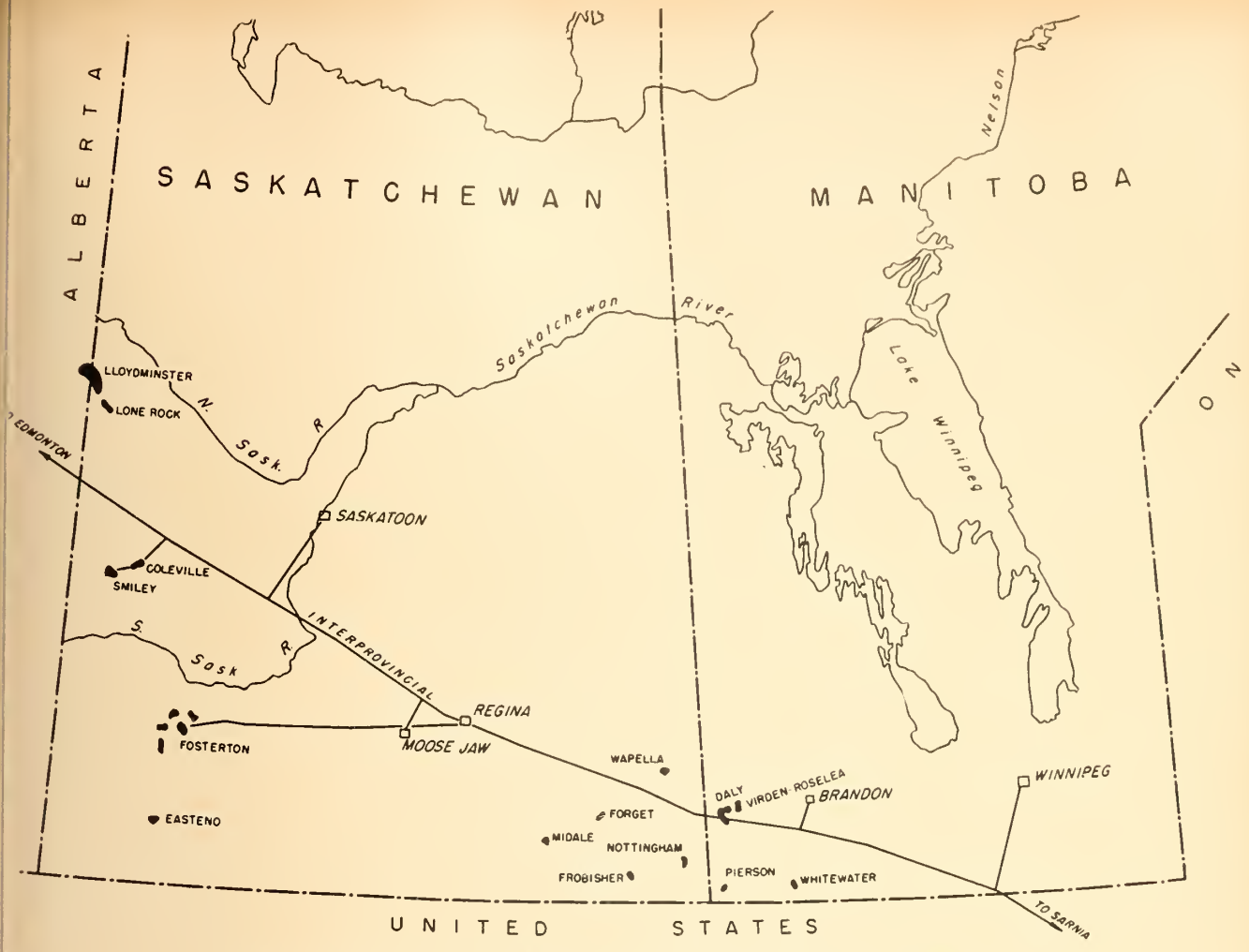


Fig. 2. Saskatchewan and Manitoba Oil Fields and Pipe Lines — 1955.

Geological Surveying

Because of the paucity of outcrops in the plains of Western Canada, geological surveying has definite limitations. Nevertheless every small rock outcrop is carefully studied for each minute piece of information that may provide a clue to the underlying structure and stratigraphy.

On the other hand, extensive geological field mapping is conducted in the foothills belts of Alberta and British Columbia, in the Northwest Territories and in the Rocky Mountains themselves, where stratigraphic sections and structures can be studied in detail and yield valuable indications concerning the origin and facies of the sediments underlying the foothills and plains areas.

Geological survey parties cost from $3,000 to $20,000 per month, depending upon whether they travel by car, pack train, aeroplane or helicopter. Helicopters are now used extensively in the more remote areas, and a geological survey party of 12 men utilizing a helicopter will cost about $20,000 per month.

Aerial Photography

Aerial photography and the study of the photos for geological data, photogeology, is an important adjunct to geological surveying. The amount of geological data and the accuracy of the interpretation of geology from air photos may be considerably improved by the recent adaptation of three dimensional photography to air photos. The use of Shoran and other electronic locating devices has considerably increased the rate of aerial photography, with a consequent reduction in cost.

Subsurface Geological Studies

Subsurface studies, where there is an adequate number of wells, provide the greatest amount of basic geological information in the plains areas and, together with surface geological mapping, supply the fundamental data to which data from all other exploratory methods are supplemental. Samples of drill cuttings are collected generally for each 10 feet of hole drilled. These are studied microscopically, identified and classified, and marker horizons correlated. Sample cuttings are supplemented by cores cut by rock bits and diamond bits at strategic intervals, or at depths where critical information is desired.

The data are compiled diagramatically on strip logs. Depths are plotted to formation contacts and marker horizons and structure contour maps, isopach maps, slice maps, facies maps, sand-shale, shale-limestone and other percentage maps, together with various types of cross-sections are prepared from the sample and core data.

These facilitate the recognition and analysis of subsurface geological structure; the correlation of strata; the identification and correlation of unconformities; the recognition and analysis of sedimentary facies changes, the identification of transgressive and regressive sedimentary cycles, and the relationship of porous zones, which may contain oil, to such unconformities, facies changes, sedimentary cycles and structures.

The subsurface departments are important components of all successful companies engaged in oil

exploration. They are well staffed by highly trained geologists and other specialists, since these departments are responsible for many of the new ideas and new geological plays that keep their respective organizations in the forefront in the highly competitive exploration business.

Well Logging Devices

Electric logging of wells and other continuous well logging devices provide important supplementary tools for the subsurface geologist. Electric logging has become a highly specialized field, requiring special training courses for those wishing to derive maximum benefits from its interpretation.

There are numerous types of continuous well logging devices, each measuring different physical and chemical properties of the strata intersected by the well bore. Each serves a special purpose, though several may yield confirming evidence for the same geological data. The formation evaluation specialist today is required to interpret the data from many types of continuous well logging instruments.

These instruments consist of various types of sondes which are lowered in the well bore on cables and are connected through electrical circuits to continuous recording instruments mounted in trucks. Photographic records are made during the logging. From such logs, provided under contract, it is possible to calculate porosity and permeability; to identify the fluid content of the strata; to identify formations, faults and unconformities; to correlate strata from well to well; to determine the seismic wave velocities, the structural attitude of the strata and variations in hole size and temperature gradient.

The cost of running such logs varies with the type and number of logs, the depth of the well and the length of time the drilling rig is immobilized while running the logs. Average costs for a 5000 foot well run from $1200 to $5,000.

Another useful tool for the subsurface geologist is the mud logging unit. This unit consists of a compact group of instruments mounted in a truck and staffed by experienced geologists and engineers, and is provided by special service companies. Continuous records are obtained of the gas content of the drilling fluid and the drilling rate for each foot of hole drilled. The cost for the services of a unit of this type ranges from $5,000 to $10,000 per month.

One other device which yields positive information for the subsurface geologist is the sidewall sampler. This consists of a "gun" which is lowered into the well bore on a cable and at selected depths fires hollow cylindrical "bullets" laterally into the formation. From the bullets are recovered samples of the formation sufficiently large to permit porosity and permeability determinations and the identification of oil saturation, if present. Analyses of water samples from the porous horizons in a well are also used in identifying and correlating strata.

Shallow Structure Drilling

Shallow structure drilling has been used extensively in Western Canada in mapping surface geological structures. Small diameter holes are drilled by light truck-mounted drills to depths of a thousand feet or less, electric logged and marker horizons correlated. This service is provided by contractors at a cost ranging from $1.25 to $1.75 per foot of hole drilled and logged.

Geophysical Surveys

The seismic survey is by far the most accurate and popular geophysical method used in Western Canada. Out of an average of 150 geophysical parties currently operating in Canada, 140 are seismic survey crews. These range in cost from $15,000 to $40,000 per crew month, depending on accessibility of the area, season of the year and topography. However, the interpretation of seismic data is by no means unique. Irregularities introduce variable factors which are extremely difficult to correct with an accuracy necessary to detect the low relief type of structures which characterize Western Canadian oil fields.

A number of important improvements in instrumentation and techniques during the past year or so give promise of aid in resolving some of the current problems. Probably the most publicized development is the magnetic tape reproducible recording equipment, whereby the seismic waves are recorded on magnetic tape rather than on film, so that the magnetic tape record can subsequently be played back under many different combinations of filters and amplifiers until the most optimum combination is determined that will yield the maximum information.

Gravity meter surveying in no way compares with the seismograph in the accuracy of results in detail. Costs, however, are much lower than for a seismic survey, ranging from $5,000 to $8,000 per crew month. The gravity meter, therefore, provides a cheap reconnaissance survey method. Interpretation is extremely difficult in the plains area where only some 6,000 feet or less of sediments overlie the Precambrian basement rocks. The gravity meter is capable of yielding more useable data in the foothills belt, where a much greater thickness of sediments exist and where thrust faulted limestone blocks provide detectable density contrasts.

Exploratory Deep Drilling

The culmination of all exploratory work by all other methods is, of course, the drilling of the exploratory test well; this provides the most positive evidence and generally the final answer.

F. H. Lahee,[1] in 1951, published success ratios for wildcat drilling in the United States. Based upon a three-year total of 8,696 wildcat wells 92 per cent were failures. He further determined that:

(a) One well out of 44 wildcats discovered a million-barrel field;

(b) one out of 243 wildcats discovered a ten-million barrel field;

(c) one well out of 967 discovered a field with more than fifty million barrels of recoverable reserves.

Lahee, in a recent review of these ratios, states that the past ten-year average indicates one in every nine new field wildcats has found some oil or gas, and one wildcat out of every 44 drilled discovers a field with as much as one million barrels of total ultimate reserves.

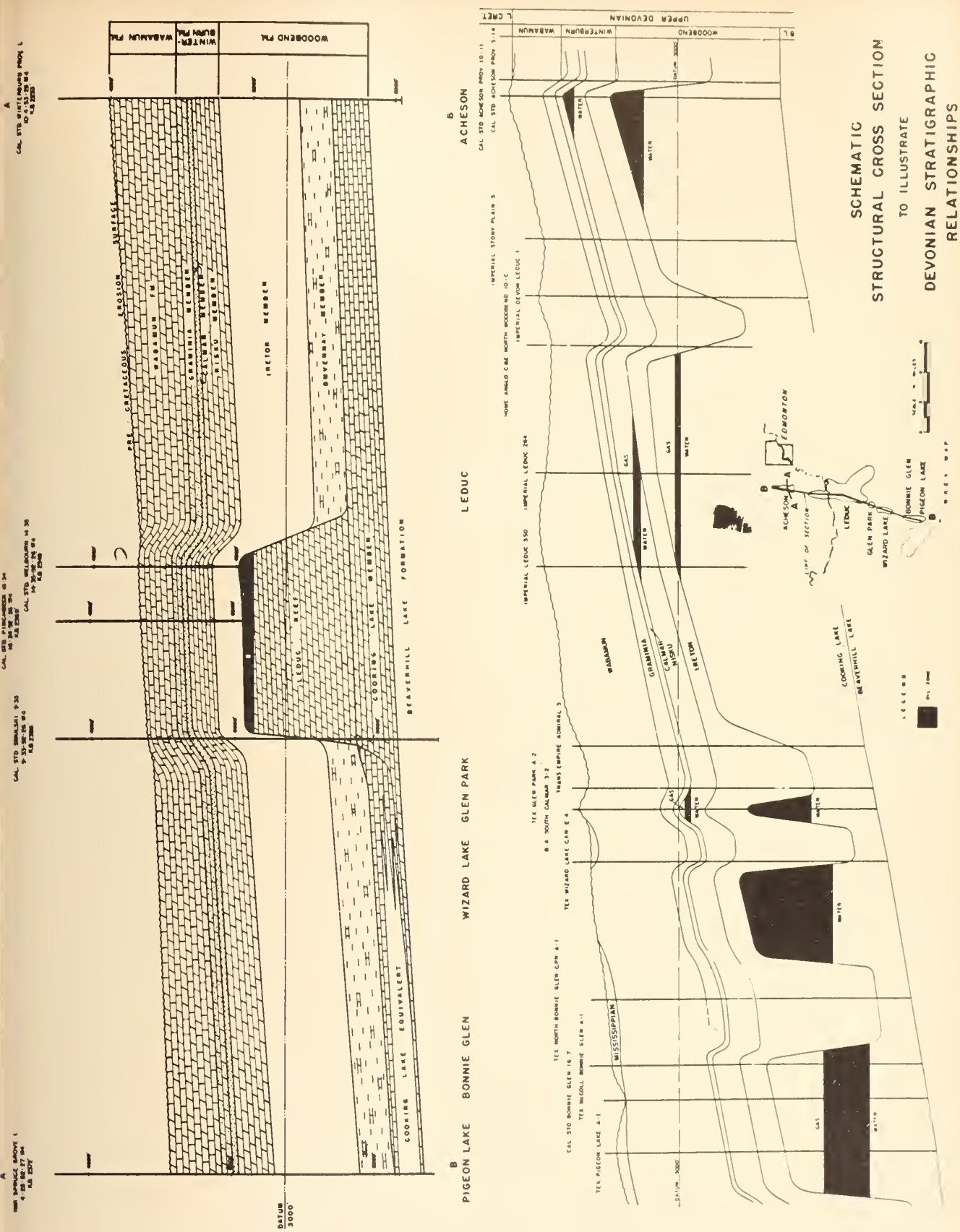
Figures recently compiled by the Canadian Petroleum Association over the seven-year period from 1948 to 1954 show that for exploratory wells drilled in Western Canada:

(a) Four out of every five are dry holes;

(b) one out of every 54 found a field of a million barrels;

(c) one out of every 137 found

[1]F. H. Lahee, "Degrees of Success in Wildcat Drilling", Amer. Assoc. Petrol Geol., 1951, 35, p. 138.



a field of ten million barrels.

(d) one out of every 336 found a field of fifty million barrels; and

(e) one out of every 504 found a field in excess of one hundred million barrels.

Comparing these two sets of figures, it would seem that the odds are poorer in Canada than in the United States for finding a million-barrel field, but better for finding ten-million-barrel fields and decidedly better for finding fifty-million-barrel fields.

Fig. 3. Schematic structural cross-section to illustrate Devonian stratigraphic relationships. (Alberta oil-bearing reef.)

Almost all exploratory drilling in Western Canada is performed by drilling contractors. Contracts are arranged on a footage basis, on a day-work basis and on a combination footage and day-work basis, depending upon depth of hole, formations to be penetrated and accessibility of the well site. Costs can be estimated fairly accurately for shallow wells but become less accurate with increasing depth and for exploratory wells over 10,000 feet in depth vary quite widely. The ranges in costs for exploratory wells are approximately as follows:

Depth of Well (Feet)	Approximate Cost (Dollars)
1,800 - 2,500	20,000 to 30,000
2,500 - 3,500	30,000 to 50,000
5,000 - 5,500	70,000 and upwards
8,000	170,000 and upwards
10,000	225,000 and upwards

Relation of Canada in World Oil and Gas Industry

The developments represented by the statistics presented herein have sufficed to elevate Canada in terms of proved reserves of recoverable oil to the position of third largest in the Western Hemisphere following the United States and Venezuela, and eighth in the world. (Table II.) Likewise, in terms of annual production, Canada now ranks third in the Western Hemisphere and seventh in the world.

It is of interest to note here some significant changes which have occurred in recent years in the world oil picture and which, as will be discussed later, may have a direct bearing on the future growth of the Canadian petroleum industry.

During 1954 the world, excluding the U.S.S.R. and satellites, consumed 12,840,000 barrels daily on an equivalent crude basis. This is an increase in world consumption of 4.3 per cent over 1953. The United States used 7,744,000 barrels per day (b/d) or 60 per cent of the total, representing an increase of 1.5 per cent over 1953, whereas the aggregate percentage increase for all other countries was 6.9 per cent. Canada increased its consumption 8 per cent over 1953.

The Free World's production of crude oil and natural gas liquids in 1954 was 12,427,000 b/d (excluding the U.S.S.R. and satellites), an increase of 3.5 per cent over 1953. The United States produced 7,008,000 b/d, or 56 per cent of the free world total. However, U.S. production *decreased* 2.1 per cent from 1953 in contrast to an increase of 8 per cent in Venezuelan production; 12 per cent in the Middle East; 17 per cent in Mexico and 19 per cent in Canada.

More significant, however, are the comparative figures for the world's proved reserves of crude oil in 1939 and 1955. On January 1st, 1939, world proved reserves were 37.4 billion barrels, and in January 1955 they were 153.3 billion barrels, an increase of 310 per cent, even though this period included the World War when the Allied Nations consumed seven billion barrels of oil, and the post war period of rapidly increasing world consumption.

However, in spite of the increase in United States reserves from 17.3 billion barrels in January 1939 to 29.5 billion barrels in January 1955 (34.8 billion barrels if natural gas liquids are included), the percentage position of the United States had shrunk from 46 per cent of the world's reserves in 1939 to 20 per cent in 1955. Also, whereas the Western Hemisphere formerly held nearly two-thirds of the world's reserves, it now has less than one-third, even though the Western Hemisphere's reserves approximately doubled in the interim.

In contrast, the reserves of the Middle East countries increased 1200 per cent, from 7 billion barrels in 1939 to almost 92 billion barrels in 1954, and now account for 60 per cent of the world's reserves. Saudi-Arabia, with more than 35 billion barrels, now has the largest reserves of any country, replacing the United States for the first time in 1954. Crude oil reserves in Venezuela are now 10.7 billion barrels.

Now, with this summary of the recent major changes in the world oil picture in mind, let us revert to the youthful Canadian oil industry and consider its number one problem—markets.

Table II. Estimated World Petroleum Reserves and Annual Production 1954

Petroleum Reserves Dec. 31, 1954			Production for Year 1954		
Country	Thousands of Barrels	Per Cent of World	Country	Thousands of Barrels	Per Cent of World
Saudi Arabia ..	35,000,000	22.83	United States..	2,257,119	45.50
United States..	29,561,000	19.25	Venezuela	691,106	13.94
Kuwait	28,000,000	18.27	U.S.S.R.	412,750	8.32
Iraq	14,000,000	9.13	Kuwait	347,955	7.02
Iran	13,000,000	8.48	Saudi Arabia ..	347,845	7.01
Venezuela	10,700,000	6.98	Iraq	252,722	5.09
U.S.S.R.	10,000,000	6.53	**Canada**	96,065	1.95
Canada	2,208,000	1.44	Mexico	82,436	1.66
Indonesia	2,100,000	1.37	Indonesia	77,318	1.55
Mexico	1,650,000	1.08	Rumania	47,450	0.96

Note: Crude oil only; does not include natural gas liquids.

Markets

Refinery capacities are a rough measure of the available markets in the areas they serve. Throughputs generally average 85 per cent of rated capacities. In Canada, refinery capacities at the beginning of 1955, by regions are as follows:

	Capacities, b/d (Beginning 1955)
Northwest Territories	1,250
Maritimes	18,300
Quebec	196,000
Ontario	135,000
Prairie Provinces	172,150
British Columbia	53,500
Total	576,200

Total Canadian refinery receipts, domestic and imported, for 1954 were 169,491,000 barrels In addition, 33,600,000 barrels of refined products were imported. Total consumption, therefore, was 203 million barrels, an average in 1954 of 556,000 barrels per day. Canadian production of crude oil and natural gas liquids was 97 million barrels, or a daily average of 266,000 barrels. (Fig. 4)

In other words, Canadian producers supplied only 47.8 per cent of Canadian domestic consumption in spite of having a potential productive capacity equal to 75 per cent of the total Canadian consumption. The major portion of Canada's domestic market not yet converted to Canadian crude is the Montreal area, which today could use close to 200,000 barrels of crude per day.

Canadian oil is transported to market through two great pipe line systems; the Interprovincial Pipeline from Redwater to Sarnia, and the Trans-Mountain Pipeline from Edmonton to the Vancouver and Washington markets. Trans-Mountain has an initial capacity of 120,000 b/d, and Interprovincial was transporting out of Edmonton 205,000 b/d at the end of 1954. Deliveries at Sarnia averaged 97,000 b/d during 1954. Both

lines, by increasing their capital investment in additional pumping capacity and line loops, can increase their throughput to ultimate capacities of 300,000 b/d, or a combined total of 600,000 b/d.

Crude oil delivered by Interprovincial Pipeline is refined at Sarnia and reaches the Toronto market area via two products pipelines — the Imperial Pipeline Company's Sarnia Products 39,000-barrel (12-inch) line, and the Sun Canadian 17,500-barrel line. The Toronto area is also supplied by a third products pipeline, the Trans-Northern 40,000-barrel (10-inch) pipeline from Montreal refineries which operate exclusively on imported oil, chiefly from Venezuela.

In 1954 Canada imported into Quebec and the Maritimes 66 million barrels of crude from overseas countries. In other words, overseas producers supplied Canada with more than two-thirds of the amount of oil Canada's domestic producers supplied. Another 7.9 million barrels of crude were imported from the United States in 1954, chiefly into the Sarnia and Toronto areas.

Price Structure

Field prices for Canadian crudes are determined by the price at which crude of comparable quality from the Mid-Continent fields of the United States can be delivered at Sarnia. This price today is $3.23 per barrel for 35° API crude. After deducting 66 cents for pipe line tariff from Redwater to Sarnia and 1 per cent line loss, this results in a terminal price at Redwater of $2.543.

Gathering charges and line loss in the field are respectively 4c and 1.3c per barrel, yielding a field price of $2.49 per barrel. That this price is barely competitive with United States Mid-Continent crudes is demonstrated by the fact that one Sarnia refinery continued to import 15,000 barrels per day of Mid-Continent crude through 1954 rather than use available Canadian crude.

Puget Sound Area

Redwater crude not routed direct to Ontario is subject to a 2c tariff and 1.3c line loss charge from Redwater Terminal to Edmonton, so that the price delivered at Edmonton is $2.576 per barrel. The price at which Redwater crude is delivered at Vancouver is then derived by applying the Trans-Mountain tariff of 45c per barrel plus 2.6c for 1 per cent pipe line loss, to give a delivered price at Vancouver of $3.052 and a price of $3.224 per barrel at Ferndale, Washington, and close to Anacortes, where Shell's 50,000 barrel per day refinery is under construction.

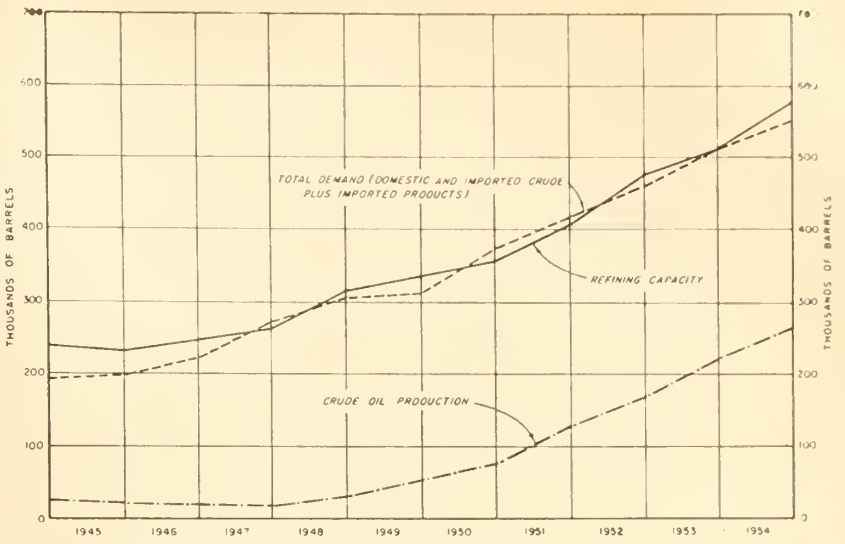


Fig. 4. Canadian Crude Oil Production — Total Demand and Refining Capacity, 1945 to Present.

General Petroleum's 35,000 barrel per day refinery is now taking 26,500 barrels of Canadian crude daily and Shell is expected to be taking 20,000 barrels of Canadian crude by the end of 1955. It seems reasonable to expect that, if present price relationships continue, the combined 85,000 barrels per day required by these two refineries may eventually be supplied by Canadian crude.

Minneapolis-Lakehead Area

This area has an estimated market of 225,000 b/d in 1955. Canadian producers are expected to increase deliveries to refineries at Wrenshall, Minnesota and Superior, Wisconsin to nearly 15,000 b/d this year. The Minneapolis-St. Paul area has, in the past, been supplied chiefly by Mid-Continent crudes and products. However, the recent increasing crude production from the Rocky Mountain states is forcing entry into this market.

Competition is further increased here by cheap river transportation up the Mississippi. It is anticipated that at least one refinery may be using 20,000 to 25,000 b/d of Canadian medium gravity crude by the end of 1955, but the probability of obtaining any substantial market for Canadian light crude in this highly competitive area is remote.

Detroit-Michigan Area

The present crude market in the Detroit-Michigan area is currently 375,000 b/d. However, this is a most highly competitive market with supplies coming chiefly from the Mid-Continent and Gulf Coast fields. Competition will be further increased if a projected new pipeline from the Atlantic Coast to Toledo is built. The probability of obtaining any part of this market in the near future appears even more remote than for the Minneapolis area.

Factors Limiting United States Markets

Four factors which have a decided bearing on the problem of extending markets for Canadian crude into the United States are: (a) Crude oil prices; (b) Currency exchange rates; (c) Import duties; and (d) Proposed U.S. legislation or, alternatively, voluntary control designed to restrict foreign crude imports into the United States.

Crude Oil Prices

The price of Canadian crude at Sarnia in competition with United States crudes has determined the field price Canadian producers now receive. Table III shows the posted field prices of crudes of comparable quality and gravity elsewhere on the continent.

Canadian crude today, from these figures, is priced 27c lower in the field than the lowest priced comparable crude elsewhere in North America. The current reduced price for Canadian crude has already caused concern

amongst exploration companies operating in Western Canada, particularly those who derive most of their income from production.

Currency Exchange:

When the Canadian dollar stands at a premium in relation to the United States dollar, Canadian oil producers are severely handicapped by the additional premium against their products. This situation has been rectified to some extent in recent months. A continuation of the present trend in exchange rates will materially assist Canadian oil producers.

Import Duty

The duty on Canadian oil entering the Unites States is 10½c per barrel for crude oil of 25° API gravity and higher, and 5¼c per barrel for crude below 25° API gravity, whereas United States and other foreign crude oil enters Canada duty free. It has long been felt by Canadian producers that Canadian oil entering the United States should be given preferential exemption. The United States, of course, is unwilling to give to Canada what it is unwilling to grant Venezuela and other countries.

Table III. Field Prices for North American Crudes

	API Gravity	U.S. Funds Per Barrel	Canadian Funds Per Barrel After Adjusting For Gravity
Redwater	35°	....	$2.49
Oklahoma-Kansas	35°	$2.80	$2.76
Texas Gulf Coast	35°	$3.13	$3.08
California (Signal Hill)	32°	$3.12	$3.13

United States Import Restrictions

Independent producers in the United States have been actively agitating for a law curbing oil importations into the United States. A group of Senators proposed a bill to Congress known as the Neely Amendment which would have amended the Reciprocal oil imports into the United States Trade Agreement Act by limiting to 10 per cent of U.S. domestic demand. This amendment was voted down on April 26th last. However, President Eisenhower's administration requested the importing companies to voluntarily restrict their imports to the 10 per cent figure.

The Canadian Government submitted a formal note of protest to the State Department in March, objecting strongly both to compulsory quotas and the voluntary arrangement recommended by the President. The note argued that the United States should restrict oil imports from overseas countries as a method of making the American oil industry self-sufficient as a defence measure, but that this thesis would not be valid if applied to imports from Canada.

Such an argument seems rather inconsistent when Canada itself is currently importing at the rate of 75 million barrels of crude and products annually from overseas producers, an amount equivalent to nearly one-third the amount imported by the United States from overseas countries. Though the proposed legislation has been voted down, the Administration has refused to alter its stand in favour of "voluntary" import quotas.

It seems most unreasonable to assume that Canada will be permitted to export to the United States much more than the markets it has captured to date on a competitive basis. In 1954 the United States imported 654,000 barrels per day of crude only, and the estimate for 1955 is 707,000 b/d. United States exports to Canada of crude and petroleum products are currently about 50,000 b/d. Viewed, therefore, on the most optimistic basis, the total United States market available to Canadian producers probably will not exceed 125,000 b/d within the next five years.

Thus with an annual discovery rate of between 400 and 450 million barrels per year for the next five years, it is clear that domestic and foreign consumption of Canadian crude will only absorb approximately half of Canadian potential production, with little chance of overtaking it as long as the Montreal refineries are supplied by imports from overseas.

The Petrochemical Industry

The petrochemical industry, though enjoying a spectacular growth, is nevertheless a negligible factor in the consideration of markets for crude oil. Today a fourth of all chemicals in the United States are produced from petroleum. The consumption of petroleum for this purpose is only 3 per cent of the total U.S. annual production of crude oil and two-thirds of this amount is used for fuel, so that only 1 per cent of crude production in the United States is used as raw material for petrochemicals.

The Toronto-Montreal Market

The largest single marketing area available to Canadian producers lies entirely within Canada. It is the combined Toronto-Montreal market area, served by the Montreal refineries and other overseas imports of petroleum products. This is a rapidly expanding market. Consumption in 1954 averaged 211,000 b/d and is expected to average a minimum of 225,000 b/d throughout 1955, the gross value of which delivered in Montreal in 1955 is estimated, at current prices, to exceed $250 million.

Figure 5 shows the estimated growth in demand for Canadian crude and imported products in the markets available to Canadian producers during the next five years. This figure in particular illustrates the estimated growth of the Toronto-Montreal market in relation to the demand in the other markets supplied by Canadian crude and in relation to potential production. Also shown is the probable industry production by years prorated to probable market demand but excluding the Toronto-Montreal market.

The Figure also emphasizes the vital part the Toronto-Montreal market could play in permitting Canadian producers to produce the oil they would normally be allowed to produce under good engineering and conservation practice. The conversion of this market to Canadian crude oil would, without doubt, solve the marketing problem of the Canadian producers.

Pressure From Overseas Supplies

It has been suggested that Canadian producers should take the long range point of view and hope that 20 years hence the continental supply and demand picture will be such as to assure markets for all of Canada's potential production. But let us be realistic and refer back to the world supply picture and its future trend.

The enormous all-time record

high in world oil reserves and the shift of the center of gravity of oil production from the United States to the Middle East countries should not be overlooked in the consideration of our market problems, and particularly in the consideration of the Toronto-Montreal market. The great reserves developed in these countries and in Venezuela must find an outlet somewhere. It is true that production in the United States in 1954 decreased by 2.1 per cent from 1953 during a period of minor economic recession. However, crude oil reserves are now the highest ever recorded.

How will Canadian producers with their rigid transportation system compete for the big United States markets against overseas producers? As already stated, the world's crude oil reserves have increased rapidly in recent years to the enormous figure of 153 billion barrels at the end of 1954, due largely to the staggering increases in the reserves of the Middle East countries. These reserves are continuing to increase. Venezuela's daily production topped 2 million barrels early this year.

One, of course, can point to the large potential future demand in Europe as it continues on its course of economic recovery, as well as in the under-developed countries such as for example the Belgian Congo, where new automobile registrations in 1954 were up more than 25 per cent over the previous year, and in Indonesia, where automobile registrations in 1954 similarly were up 40 per cent over the previous year. However, offsetting such gains in potential markets are the increases in crude production made in several European countries recently.

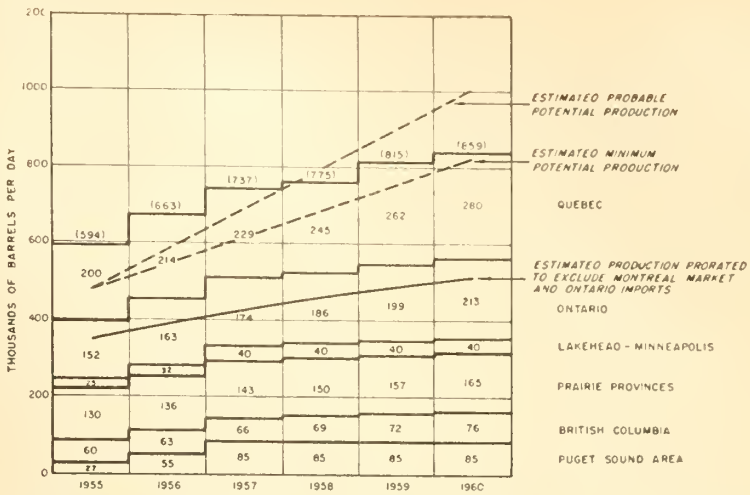


Fig. 5. Relation of Estimated Potential Markets to Estimated Production Canadian Crude — 1955-60.

For example in Germany, where 40 new oil fields have been discovered since the war to yield a current daily production of 54,000 barrels and reserves of 143 million barrels, and in Southwest France, where an important light gravity oil field was discovered in 1954 between Bordeaux and Bayonne. Discoveries of 20° API gravity crude were made in 1954 in Sicily, and more recently a sizeable field of light gravity oil was discovered on the Adriatic Coast. In addition, both Iranian and Rumanian production will be brought back into the world market in increasing quantities in the years ahead.

It is evident, therefore, that world-wide potential production has built up to an all-time high of quite large proportions. Much of this potential is located in a few overseas countries and would probably be available to move in upon any shortages developing in the United States markets. A duty-free market accessible to ocean tankers, such as the Toronto-Montreal market will, of course, also offer a prime target for excess overseas production. How, therefore, can Canada afford to sit back for 20 years and complacently expect markets to develop for its excess crude oil?

Table IV. Analysis of Ontario Market, 1954

		Year 1954 (Barrels)	Barrels Daily
Canadian Crude Receipts		35,284,938	96,671
Foreign Crude Receipts (U.S. and Trinidad)		8,808,162	24,132
Total Crude Receipts		44,093,100	120,803
Inventory Changes—Opening	3,661,150		
Closing	3,460,987		
Net		200,163	
Total crude Consumed		44,293,263	121,352
Products Transfers from Quebec to Ontario		16,112,498	44,144
Imported Products		7,957,565	21,802
Product Inventory Changes—Refineries		—1,106,021	
Total Products Consumed		22,964,042	62,915
Total Crude and Products Consumed		67,257,305	184,267

Recent Trends in Toronto-Montreal Market

There have been indications that there is an increasing shift of population and industry westward from Montreal towards Toronto, which might imply this market may be served to an increasing extent by Canadian crude moving via the products pipe lines from Sarnia to Toronto, with a consequent reduction in the rate of new refinery construction in Montreal. However, let us examine what has been taking place in the Toronto-Montreal market in the past year, from D.B.S. reports on refinery operations and Customs Entries under the External Trade Section, (Table IV), which shows crude oil and products movements in the Province of Ontario for 1954.

Canadian crude, therefore, in 1954 still only supplied about one-half of the total Ontario consumption. During the past years the Montreal refineries have been supplying an increasing proportion of the Ontario market. That this trend is continuing in spite of the increasing amount of Canadian crude being utilized in Sarnia becomes obvious upon examination of the rate of refinery expansion in the Montreal area, as well as the new retail outlets in the Toronto area being supplied by Montreal refineries.

One 45,000 barrel per day refinery will complete this year a

$3 million addition to increase its capacity for straight run naphtha to 13,000 b/d. Another refinery has announced a $14 million expansion program to raise its capacity 25 per cent. A European company will complete this summer its first refinery in Canada, at Montreal, with an initial capacity of 20,000 b/d, to be operated on Middle East crude.

Table V shows the rate of growth of refinery capacity for Ontario and Quebec since 1946. The rate of increase of refinery capacity in Quebec is greater by 122 per cent than the rate of increase in Ontario during the period 1946 to 1955.

In addition to the completion of its refinery this year, the European company referred to will have by year end 45 bulk plants and terminals in New Brunswick, Quebec and Ontario, and 925 retail stations, of which 474, or more than half, will be in Ontario. The object of this company is to "blanket" the market from eastern Quebec to London, Ontario, with products which, when its refinery is completed, will be derived from overseas imports.

Now that the Canadian dollar is again approaching parity with the United States dollar, the differential between Alberta crude and Venezuelan crude at Montreal is considerably reduced. The comparative prices at Montreal can be seen in Table VI.

The Sarnia-Montreal Pipeline

From a risk capital point of view the Sarnia-Montreal pipeline offers the following advantages over the Trans-Mountain pipeline:

(1) It would be only two-thirds the length of the Trans-Mountain line.

(2) It would cross flat, easily accessible terrain.

(3) Construction costs should be less than two-thirds those for Trans-Mountain.

(4) It would terminate in a faster growing market with a possible greater potential, having in mind not only the Toronto-Montreal market but also the increasing industrialization of Quebec.

(5) The economics for Canadian crude in the Toronto-Montreal market are definitely no poorer now than were the economics for Canadian crude in the Pacific Northwest when plans were finalized for building the Trans-Mountain Pipeline.

There are, furthermore, important intangible advantages for the Montreal refiners in having the Sarnia-Montreal pipe line built. They will be assured a supply of crude oil of uniform quality and stable price. The constantly changing tanker transportation costs, which are notoriously erratic and subject to alternating periods of over-supply and shortages, will be eliminated. Political stability at the source of supply of their raw material, as well as economic stability at the source of supply and freedom from the complications of international economics will be assured. And finally, a well protected assured supply in the event of an emergency will be available.

Advantages to Canada

The construction of the Sarnia-Montreal pipe line and the conversion of the Toronto-Montreal market to Canadian crude would have enormous beneficial effects on the Canadian national economy. Among other things, it would:

(1) Bring Canadian crude oil production up to 80 per cent or more of potential production.

(2) Save Canada during the next five-year period (assuming a 7 per cent annual increase in consumption) $1,500,000,000 paid out to foreign countries, diverting this to Canadian producers and pipe line companies during the next five years for continuation of exploration for and development of Canada's natural resources and thereby promote Canada's industrial development.

(3) Provide additional revenue to Provincial Governments through gross royalty payments on oil, which would not otherwise be produced, of approximately $150 million, not to mention additional revenues from increased bonus payments on Crown reserves.

(4) Provide additional revenue to the Federal Government by way of royalties on Federal lands, corporation taxes, duties, sales taxes and other indirect taxes of a sum estimated to be at least $150 million.

(5) Provide Canada with greater means to ward off the effects of a depression.

(6) Reduce Canada's vulnerability to adverse changes in the economy of the United States, a matter of considerable concern to Canada's economists.

The above figures are based on a five-year period. Calculation of the corresponding figures for the long range 20-year period is left to the reader.

Table V. Refinery Expansion in Ontario and Quebec

	Ontario Capacity (barrels)	Quebec Capacity (barrels)
1946	77,950	71,000
1948	88,700	107,000
1950	75,200	143,000
1952	104,500	164,000
1953	135,000	176,000
1954	135,000	190,000
Proposed 1955	158,000	230,000
Overall increase 1946 to 1955	80,050 or 102%	159,000 or 224%

Table VI. Competitive Position, Redwater Crude, Montreal Market

Oficina Crude 32°		Redwater Crude 35°	
Posted Price	$2.82 (U.S.)	Posted Price	$2.49 (Canadian)
Marine Loss and Insurance	.03	Gathering Charges	.053
U.S.M.C.—40%	.23		$2.543
	$3.08	(1) Estimated Tariff	.675
Portland Pipeline Charge	.11	Line Loss—1%	.025
Line Loss—1%	.015		$3.243 (2)
	$3.205		
Quality Adjustment	.04		
	$3.245 (2)		
Exchange—1.6%	$3.195		

(1) Estimated tariff Redwater to Montreal based on rate of 3c per 100-barrel-miles for 2,250 miles.
(2) Note comparable prices when Canadian and U.S. dollar at parity.

Colour Television

by

R. G. Anthes,

Television-Radio Division
Canadian Westinghouse Co. Ltd.,
Brantford, Ontario.

A paper presented at a joint meeting of The Engineering Institute of Canada and the Institute of Radio Engineers, at Winnipeg, October 1954.

After dealing with some pertinent general information on colour television, the paper deals principally with the basic colour signal. Brief mention is made of the shadow mask picture tube and a typical receiver. Changes in picture tube and receivers will occur, but the signal processing considered in this paper will not be changed.

Few developments in the field of electronics have created such a tremendous interest as has colour television. For years industry has been looking forward to the day when the dream of colour television would be a reality. That day has now come. Regular scheduled programs in colour have been broadcast in the United States since August, 1954, and the number is increasing steadily. Approximately 60 hours per month will be broadcast on U.S. networks by the new year. Many transmitters have been modified to retransmit these broadcasts. In addition, some of the stations have colour cameras and equipment necessary to originate their own colour programs. Many of these broadcasts are of exceptionally high calibre.

Mass production of colour receivers has not yet arrived, but forecasts indicate quantity production of colour television receivers will occur during 1955. The greatest factor holding back large-scale production is the colour picture tube which is small and very costly. Complex circuitry also adds to the cost. However, 21-inch colour picture tubes are on the way, along with some simplification of circuitry.

The first production of colour receivers early in 1954 used 15-inch tubes. This was followed by 19-inch receivers which are now just coming on the market in limited production; 21-inch tubes will be appearing in small quantities early in 1955, with quantity production expected to follow later.

A colour television receiver will always cost more than a black and white receiver. The reason for this is that a colour receiver is basically a black and white receiver to which additional circuitry and equipment is added to give colour. At present, a colour receiver uses about twice as many tubes as a black and white receiver, and has more than twice as many service man adjustments. It also has three or four more customer controls than the conventional black and white receiver. The 15-inch tube, for example, requires 20,000 volts at 1 milliampere to operate it. The 19-inch tube requires 27,000 volts at 1 milliampere. A 21-inch black and white tube, by way of comparison, requires about 15,000 volts at about 250 microamperes.

It is not anticipated that all television broadcasts will eventually be in full colour; rather it is expected that black and white, and colour broadcasts will co-exist. Colour motion pictures have been in use for many years, but there are still many black and white movies. The same is expected to happen in television, with both colour and black and white broadcasts (and production), being carried on simultaneously.

Special receiving antennae are generally not required to receive colour. If a particular installation gives good pictures on black and white, it will usually give satisfactory performance on colour. However a few cases have been reported where this has not been true. In fringe areas where very high gain antennae are used, the colour may be degraded. Sometimes, if colour is degraded, a slight reorientation of the antenna will minimize the degradation. An antenna installation, for colour, must be carefully and properly made.

Colour television should be viewed in a darker room than is advisable for black and white. Colours are diluted if light shines on the screen. Any light used should be placed at the side of the receiver, so that light does not shine directly on the picture tube.

Basic Principle—Additive Colour

The basic principle on which colour television operates, is a very simple one.

Any colour can be matched as far as the eye is concerned, by adding together, three primary colours in suitable proportions. By definition a primary colour cannot be matched by any combination of the other two.

There is not a unique set of primary colours. In colour television green, red and blue are the three primary colours used. With these primary colours, practically the full range of colour to which the eye responds, can be reproduced.

Newcomers to the colour television field are always very confused about these primary colours. The phenomena observed, seems to be contradictory to past experience with colour. For example, mixing together yellow and blue, in paints, gives green. In colour television, we get yellow by adding together red and green. If this yellow is added to blue, grey or white is produced. Why all this confusion and contradiction?

In colour television, the principle is additive colour. In mixing of paints, in Kodachrome film, and in most colour experience, the principle is subtractive colour. What is the difference between subtractive and additive colour?

An experiment in high school physics, shows that so-called white light is actually a combination of light of many colours. This experiment is performed by passing white light through a glass prism, and then shining it on a screen. The colours of the rainbow appear, giving bands of colour fading from one to the other. The main colours are red, orange, yellow, green, blue and violet in that order.

Suppose now this white light shines on a red object. Why does the object appear red? The reason is, that only the red component of white light is reflected by this coloured object; the other colours are absorbed. This is subtractive colour. Now if this red object were looked at under, say, a blue light, it would not appear red; it would be black because there is no red

light in the light source to be reflected by the red object. In subtractive colour, the colour is always produced by removing some components from the incident light.

In the Newton disc experiment in physics, a circular disc is divided into a number of segments, and each segment is painted with one of the colours, red, orange, yellow, green, blue and violet. When this disc is rotated fast enough, the eye cannot distinguish the individual colours, and it interprets the result as a specific colour; the colour being white or grey. This is additive colour, in which two or more different colours are *added* together.

The additive principle as applied to colour television, can be easily demonstrated by setting up three projectors; one projecting red, one blue, and one green, and projecting the colours simultaneously on a screen. Red and green add to give yellow; blue and red add to give magenta; blue and green add to give cyan. The three together add to give white or grey. By varying the intensity of each primary a multitude of colours is possible.

The relative brightness of the three primary colours is different for each colour. Green is very bright, red is less bright, and blue appears quite dark.

Televising a Coloured Scene

To televise a coloured scene, three cameras are used. One responds to the amount of green in the scene, one responds to the amount of red, and one responds to the amount of blue. Each camera provides video signals of the same general character as the video signals in an ordinary black and white or monochrome camera. At the receiver, a colour picture tube is used on whose face is deposited three colour phosphors. These phosphors are green, red and blue respectively. At present, these phosphors are deposited in dot trios; each trio containing one green, one red and one blue dot in an equilateral triangle. These dots are so tiny that the eyes cannot distinguish them as tiny sources of light, except under a microscope, and it interprets the result as a particular colour. Each colour phosphor is excited by its own associated electron gun in the picture tube. The output from the green camera at the televised scene must ultimately operate the green gun at the picture tube, the output of the red camera must operate the red gun, and the output from the blue camera must operate the blue gun. The principle of colour television is just that simple, but the process of carrying it out is rather complex. A sketch showing the principle of the shadow mask tube appears in Fig. 1.

Processing Colour Signal Complex

The complications involved in the processing of colour television signals are due to two main reasons. First is that the bandwidth used in colour television is exactly the same as that for black and white or monochrome television. Colour information has been added without any increase in bandwidth. This is important since space in the frequency spectrum is limited. A second very important reason is that colour television is fully compatible with existing monochrome television. This means that a present monochrome receiver will respond to a colour broadcast and give a black and white picture. This in turn means that the millions of black and white receivers now being used will not be made obsolete by colour. Compatibility also means that a colour receiver will give a black and white picture on a monochrome broadcast. The advantage of compatibility is so obvious that it need not be elaborated further here. It is most important to realize that colour television is compatible with black and white. This feature was necessary before colour television was accepted by industry.

The development of a method of transmission of colour whereby no increase in bandwidth over monochrome was required, and where compatibility with black and white television was achieved is a magnificent engineering triumph.

In order to achieve compatibility, the television standards used in monochrome television must also be used in colour television. The number of lines in the picture, the field frequency, the frame frequency and all the standards of transmission must also be used in colour. The only areas of change are that the tolerances may be held more closely in colour and additional signals may be added provided they do not interfere with monochrome operation. Both of these changes have been incorporated in colour standards of transmission.

Subjective Aspects of Colour

Before considering the formation of colour signals for transmission, the subjective sensation of colour should be considered. What properties of colour do we sense? The sensation of yellow for example, may be produced by adding together green and red. The eye does not sense that this yellow is caused by these two primary colours. It is correct to say that a certain part of a coloured scene is made up of a certain amount of green, a certain amount of red, or a certain amount of blue, but the eye does not interpret the scene that way. The eye interprets three attributes of colour. These are brightness, hue and saturation.

Brightness is quite familiar to all. It is brightness variations only that are reproduced in monochrome television, and in ordinary black and white photography. The various shades of grey are merely differences in brightness. Black is of course zero brightness. An object that is grey or white, is considered to lack colour. Any scene whether coloured or grey, displays brightness.

Hue is that property of colour which indicates whether the colour is green, red, blue, yellow and so on.

Saturation is that property which distinguishes between vivid and pastel shades. It may be considered as dilution by white light, and this can be shown by projecting say red light on a screen and then projecting white light on top of it. The hue does not change, but saturation and brightness do. White or grey may be considered to be completely desaturated colour. Fully saturated colours are very vivid and rarely occur in nature. The term chrominance is often used to indicate hue and saturation.

Luminance Signal

In monochrome television, the output from the camera consists of video signals which cause the brightness variation at the picture tube. These signals are called luminance signals, and obviously contain no colouring information. These signals depend only on brightness of the scene being televised. In colour, the luminance signal must be formed since none of the three video signals of the green, red and the blue camera give the correct luminance.

The sensitivity of the eye for brightness depends on hue. Of the

three primary colours, green, red and blue, green appears brighter than red, and red appears brighter than blue. The correct luminance signal is formed by taking 59 per cent of the output of the green camera, 30 per cent of the output of the red camera, and 11 per cent of the output of the blue camera and adding them together. This is done by simple resistance networks called matrix networks, of which a typical example is shown in Figure 2.

Colour Signals

At the receiver, the green, the red and the blue video signals must ultimately be recovered. The luminance signal must be transmitted to satisfy compatibility. It is known from a study of algebra, that if three equations are given containing three unknowns, the equations can be solved for each of the unknowns. This can be done electrically. The luminance signals contain three specific portions of green, red and blue video signals. If two additional signals are transmitted, each signal containing specific amounts of green, red and blue video signals, it is possible, at the receiver, to extract the required red, green and blue video signals. This is done by matrix circuits.

The two additional signals contain hue and saturation information and are called colour difference signals. They are formed by taking the red video signal and subtracting the luminance signal from it, and by taking the blue video signal and subtracting the luminance signal from it also. The luminance signal is abbreviated E_Y, the green, red and blue video signals are abbreviated E_G, E_R, and E_B respectively. These colour difference signals are referred to as the R-Y signal and the B-Y signal. R-Y is actually E_R - E_Y and B-Y is actually E_B - E_Y.

Since $E_Y = .59\,E_G + .30\,E_R + .11\,E_B$ simple algebra shows that

$E_R - E_Y = -.59\,E_G + .70\,E_R - .11\,E_B$

and

$E_B - E_Y = -.59\,E_G - .30\,E_R + .89\,E_B$

Note that the sum of the coefficients of the colour difference signals equals zero. These colour difference signals contain saturation and hue information only. On white or shades of grey E_R, E_G and E_B are equal, since equal amounts of R, G and B will produce grey; the magnitude merely changes the brightness. When E_G, and E_R and E_B are equal, the colour difference signals vanish.

The G, R and B signals each contain frequency components from DC up three or four Mc. per second. Therefore, the Y or luminance signal and the R-Y and B-Y colour difference signals also contain frequency components up to three or four Mc. per second.

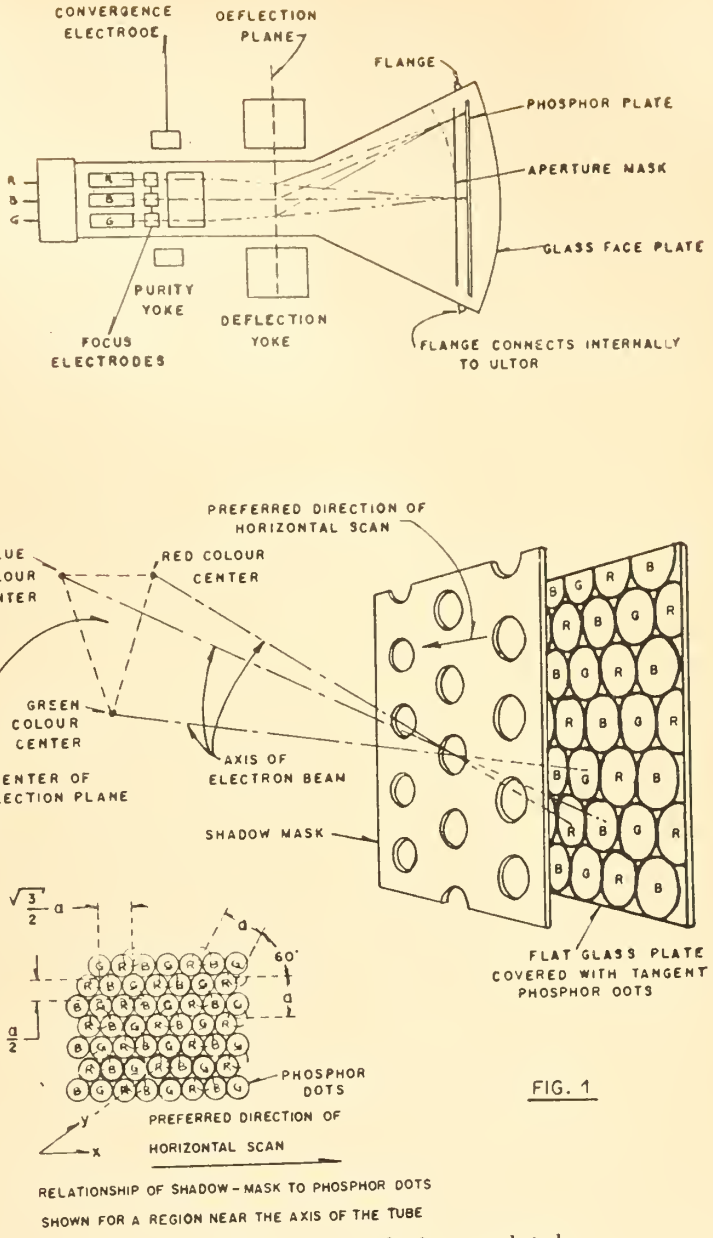
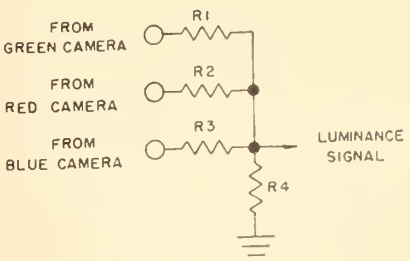


FIG. 1

Fig. 1. Principle of the shadow mask tube.

Fig. 2. Typical matrix network.



Experiments with the eye show that it is very sensitive to detail in brightness, but is relatively insensitive to detail in colour. This is most fortunate in transmitting colour television signals, because it means that the colour difference signals can be transmitted with restricted bandwidth without impairing colour rendition. Actually excellent colour rendition can be obtained even though the bandwidth of the colour difference signals is restricted from D.C. to 500 or 700 kc. per second. Although somewhat wider bandwidth than this is transmitted, tests have indicated that excellent colour quality will occur even if colouring information is restricted from D.C. to 500 kc. per second. It will be assumed here for simplicity, that

the colour difference signals are equal in bandwidth and extend up to 500 kc. per second although frequencies up to 1.2 Mc. per second are partially transmitted. This assumption does not invalidate what follows.

Modulation, Sidebands, Subcarrier

The principle of ordinary AM radio broadcasting is well known. Suppose, for example, it is desired to transmit a pure 1000 cps. tone. This tone is converted to 1000 cps. electrical signal and then this signal is superimposed on the radio frequency carrier by a process called modulation. The carrier is, say, 1 megacycle per second. This carrier voltage is caused to vary up and down in magnitude, by the low frequency or modulating 1000 cps. signal. This variation occurs 1000 times per second. Now this modulated carrier is transmitted over the air, received by a radio receiver, amplified by the receiver, then in a process called detection or demodulation, the original 1000 cps. is extracted. This 1000 cps. is then further amplified and finally operates the loudspeaker.

Although it is correct to think of a modulated carrier as though it were one frequency varying in amplitude, this effect is actually the result of a number of frequencies present simultaneously. For the example given the frequencies present are:

1. A 1 Mc per sec. frequency.
2. A 1,000,000 + 1000 cps. or 1,001,000 cps.
3. A 1,000,000 — 1000 or 999,000 cps.

If the low frequency had been 2000 cps. rather than 1000 cps. the modulated carrier would consist of 3 frequencies. They would be 1,000,000; 1,000,000 + 2000; 1,000,000 — 2000 cps.: i.e., 1,000,000; 1,002,000; and 998,000 cps. These new frequencies which appear in the modulated carrier are termed sidebands. If the low frequency consists of more than one frequency component, there will be a pair of sidebands for each one of these components, e.g. if the 1000 cps. and 2000 cps. appeared simultaneously, the 1 Mc. component in the modulated carrier along with 1,000,000 + 1000; 1,000,000 + 2000; 1,000,000 — 1000; and 1,000,000 — 2000 cps, would appear.

There is no reason why this process of modulation cannot be carried out twice. For instance, the 1000-cycle modulated carrier mentioned above could be used to modulate say a 40 Mc. carrier. This 40 Mc. modulated carrier could be transmitted, picked up by a receiver, demodulated or detected *twice* and the original 1000 cps. would be reclaimed. If this were done, the 1 Mc. carrier would be called a subcarrier, and the 40 Mc. frequency would be called the carrier.

Frequency Components In Video Signals

A critical analysis of the red, the green, the blue, the Y, the R-Y and the B-Y signals, reveals that they consist chiefly of many components which are multiples of line scanning frequency. It takes approximately 63.5 microseconds to scan 1 horizontal line in a picture. This corresponds to a fundamental frequency for the line scanning frequency of 15,750 cps. Actually in colour, it is 15,734.264 cps. The energy in these video signals appears in bundles clustered around multiples of 15,750 cyc. per second, i.e. 15,750, twice 15,750, three times 15,750 and so on up to many hundreds of times 15,750 cps. with spaces in between containing little or no energy. It was conceived that since there is frequency space going to waste between these signals, why not sandwich in the colouring information in the spaces in the luminance signal, and amazingly, this is what has been done. The colour standard of transmission has been set up to achieve this.

Fig. 3. Colour bar test patterns and signal waveforms — luminance signal.

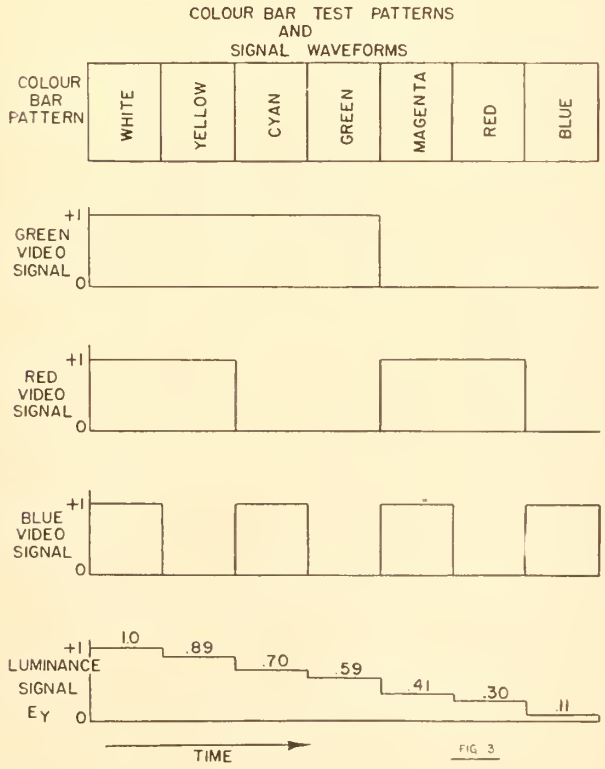
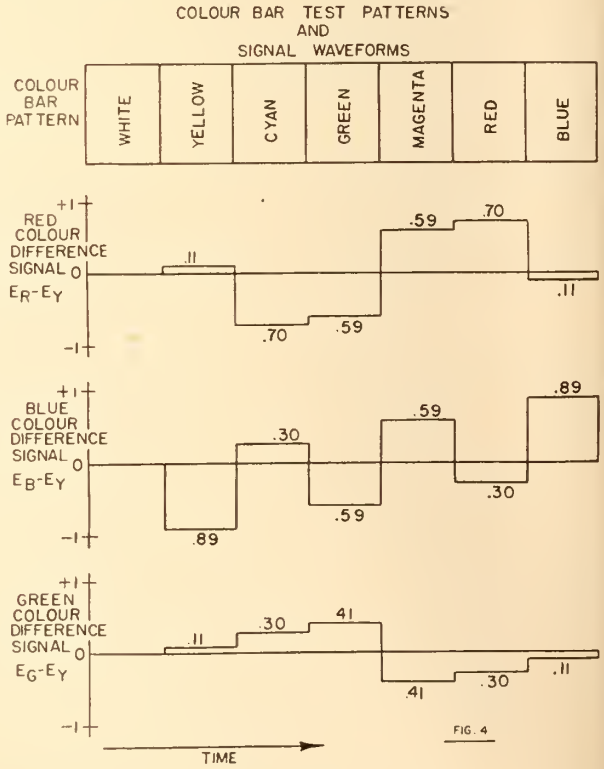


Fig. 4. Colour bar test patterns and signal waveforms — red, blue, and green colour difference signals.



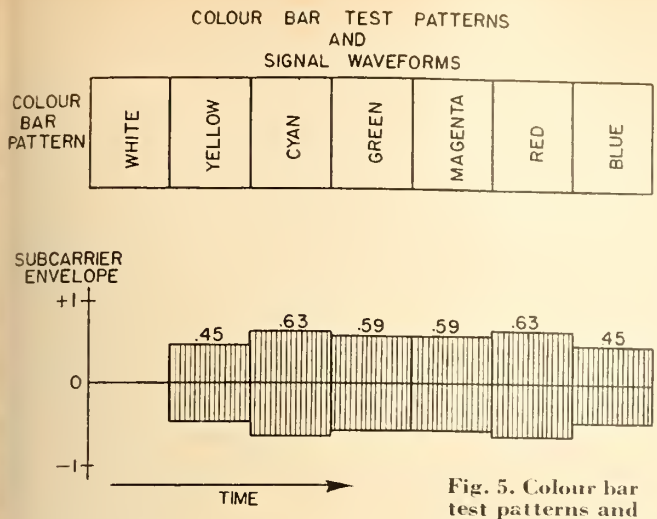


Fig. 5. Colour bar test patterns and signal waveforms — amplitude of modulated subcarrier.

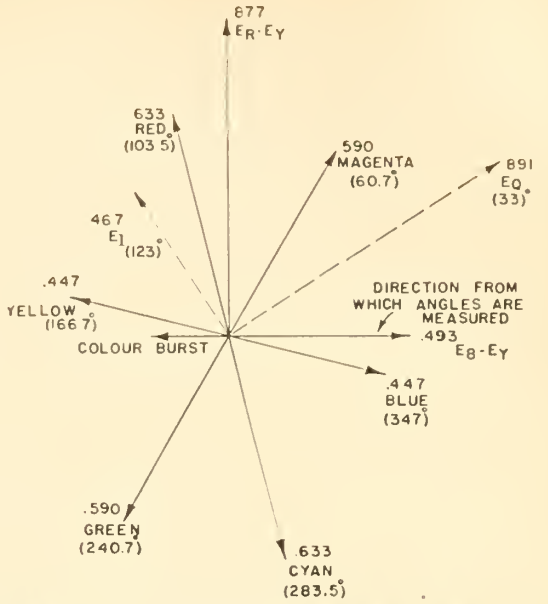


Fig. 6. Colour subcarrier phases and relative magnitudes for saturated colour bars.

Colour Subcarrier

To transmit colouring information, a colour subcarrier is chosen which lies between two possible adjacent frequency components of the luminance signal. The frequency chosen is 455/2 or 227.5 times the line scanning frequency. The colour subcarrier therefore is 3.579545 Mc. per second.

The colour difference signals, which are also video signals, contain frequencies which are principally multiples again of line scanning frequency, and the side bands associated with the modulated subcarrier, lie between the frequency components contained in the luminance signal. These sidebands are called chrominance signals. By this ingenious method, the colour sidebands which contain the chrominance information will sandwich in between the spaces in the luminance signal. The luminance signal, along with the modulated subcarrier, is used to modulate the radio frequency carrier of the television picture transmitter. At the television receiver, the signals are amplified and detected. After detection, chrominance signals and luminance signals are separated by tuned circuits. The chrominance signals must be detected again to recover R-Y and B-Y components. Now Y, R-Y and B-Y are recovered. It is a simple matter with resistance matrix networks to extract G, R and B signals from Y, R-Y and B-Y. The question now is, how is the colour subcarrier modulated?

The two colour difference signals R-Y and B-Y modulate the colour subcarrier. Consider first the B-Y signal. This is used to modulate the 3.58 subcarrier in a process similar to that used in conventional radio broadcasting, except the carrier is suppressed; only the side bands are transmitted. To do this, a balanced modulator is used.

The simplest way to visualize a balanced modulator is this. When there is no low frequency or modulating signal being applied to the balanced modulator, the carrier output voltage is zero. Suppose the modulating voltage goes one volt positive. This may produce 10 volts of carrier at the output of the balanced modulator. If the modulating voltage were increased to two volts positive, the carrier would increase to 20 volts output. Now suppose the low frequency voltage were made 1 volt negative. Again 10 volts of carrier would appear at the output, but it would be 180° out of phase with the output that occurred when the modulating voltage was positive. If the modulating voltage were 2 volts negative, the carrier voltage would be 20 volts and with 180° phase shift. Thus a positive modulating signal gives one phase at the output, a negative signal gives a reversed phase. The voltage or amplitude of the carrier at the output varies linearily with the modulating voltage. Actually, the balanced modulator produces sidebands and suppresses the carrier. The sidebands combine to give as a resultant, a signal having the characteristics just mentioned.

Each colour difference signal may be positive or negative, and of varying amplitude. When the B-Y signal is applied to a balanced modulator the produced carrier will have either zero phase or 180° phase and the amplitude may be from zero to some maximum finite value.

To transmit R-Y information, a second subcarrier is used. This subcarrier is also 3.58 Mc. per second, but it is advanced in phase by 90° from the carrier used for the B-Y modulator. It is very simple to shift the applied carrier by the 90°. The carrier being supplied to the B-Y modulator may also be applied to the primary of a double tuned transformer. The voltage across the secondary, when properly tuned to resonance is, of course, also 3.58 Mc. per second, and exactly 90° out of phase with the primary voltage. The polarity at the secondary is chosen, which causes the carrier, being applied to R-Y, to lead the B-Y carrier by 90°. This carrier is then applied to a second balanced modulator identical to that used for B-Y.

The outputs of the two balanced modulators are exactly the same frequency and they can be combined and passed by one set of tuned circuits and amplifiers. The B-Y modulator output will be either zero or 180° phase, and the R-Y will be either 90° or 270° phase. The amplitudes of each may be from zero to some finite value. The resultant modulated subcarrier may have any phase from zero to 360° and any amplitude from zero to a finite value.

With any transmitter, overmodulation cannot be tolerated. This means there is a definite maximum modulating signal that

can be applied to the modulator. The modulated subcarrier should be as great as possible without overmodulating the picture transmitter. It can be shown that to accomplish this, the R-Y signal fed to the R-Y balanced modulator can be 78 per cent greater in magnitude than that applied to the B-Y modulator. This is done, and at the receiver the correct balance is restored by a simple means of an adjustable gain control in a suitable circuit. (B-Y demodulator.)

It so turns out that the phase of the modulated colour subcarrier depends on the hue. Experience has shown that an error in phase of 10 degrees causes a very noticeable change in hue. Therefore, it becomes important that the phase of this 3.58 Mc. signal be maintained within very close limits which is not the simplest thing to do. The chroma amplifier, in a colour receiver, is tuned to 3.58 Mc. It selects the colour subcarrier and rejects the other signals. The output from the chroma amplifier feeds the R-Y and B-Y demodulators.

Colour Bars and Associated Signal Waveforms

In testing colour circuitry extensive use is made of signals which produce vertical colour bars on the face of colour picture tubes. The order of colour bars can be changed at will. An order sometimes used is progressing from left to right, white, yellow, cyan, green, magenta, red, blue and black. (See Figure 3.) In the green, red and blue video waveform shown, the maximum voltage is taken as +1 volt for convenience. The video waveform shown follows logically, when it is recalled that red, blue and green gives white, green and blue produce yellow, green and blue produce cyan, and red and blue produce magenta.

The luminance signal is readily obtained when it is recalled that it consists of 59 per cent of the green video signal, 30 per cent of the red video signal and 11 per cent of the blue video signal. On white, the luminance signal will also equal +1 volt. Note that the luminance signal progressively decreases from 1 volt to .11 volts on blue, and will be zero on black. The black bar is not shown in this figure. A particular order of colour bars used here provides a signal that can be very readily used to check adjustments on either monochrome or colour receivers, for proper shades of grey.

Figure 4 shows the red, the blue and the green colour difference signals. These are readily calculated by referring to the value of the luminance colour signals shown on the Figure 3 for the value of Y. G-Y colour difference signals are required at the receiver, and it is produced there as will be shown later.

Figure 5 shows the amplitude of the modulated subcarrier. Note that complementary colours have the same amplitudes.

Figure 6 indicates the magnitude and relative phase for the various colour bars. In modulating the colour subcarrier .877 of E_R-E_Y is applied to the R-Y demodulator and .493 of E_B-E_Y is applied to the B-Y demodulator. These two are shown with R-Y leading B-Y by 90°. From this diagram it is seen how important phase is in determining hue, and why phase shifts are very important in colour television. Note that complimenttary colours occur 180° out of phase with each other and the magnitude of subcarrier is the same.

At the receiver, a local 3.58 Mc. signal is generated to be used in the detection of the R-Y and the B-Y signals. To accomplish this, the local 3.58 Mc. oscillator must be locked to a fixed phase with respect to the 3.58 Mc. oscillator at the transmitter. In order to do this, a reference 3.58 Mc. signal is required at the receiver. Where does this signal come from?

Colour Burst

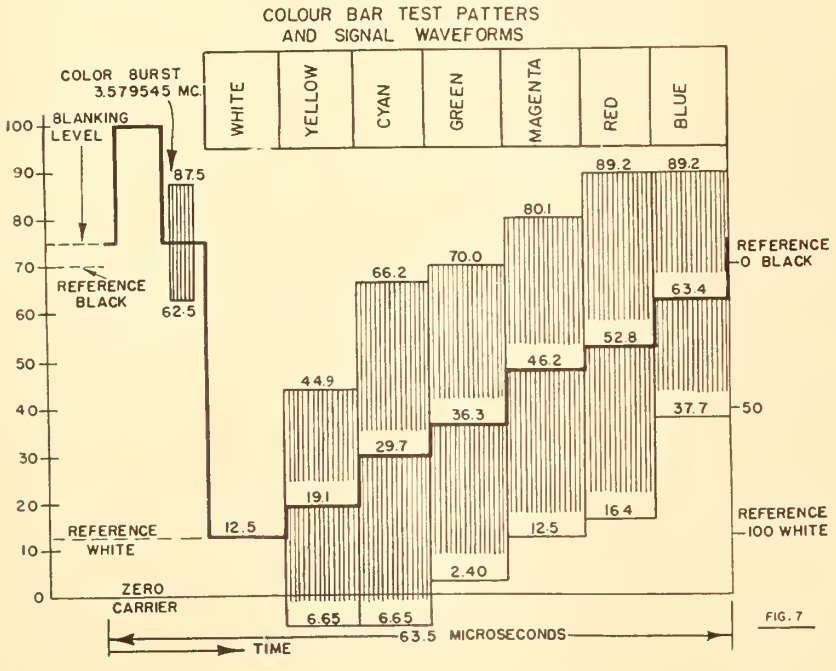
This 3.58 Mc. reference signal must come from the transmitter, but how is it prevented from interfering with the 3.58 Mc. modulated subcarrier? It is time shared with the modulated subcarrier. It is sent during part of the horizontal blanking period, and it is called the colour burst. It lies on the back porch of the synchronizing pulse. During the blanking interval, the colour subcarrier is turned off, and only the burst is transmitted. The colour burst is located 180° from B-Y, and is shown in Fig. 6.

Modulating Signal for Picture Transmitter

Figure 7 shows the complete modulating signal that is used to modulate the picture transmitter during one horizontal line. Notice the blanking level, and reference black. Refereuce black occurs at 70 per cent of the maximum synchronizing pulse amplitude. Note the position of the burst; also the front porch and the back porch. The space between the trailing edge of the synchronizing pulse and the start of the colour burst is called the breezeway.

The information contained in the preceding figures has been scaled accurately, both in amplitude and in time. Figure 7 represents the ideal waveform that

Fig. 7. Colour bar test patterns and signal waveforms — complete modulating signal.



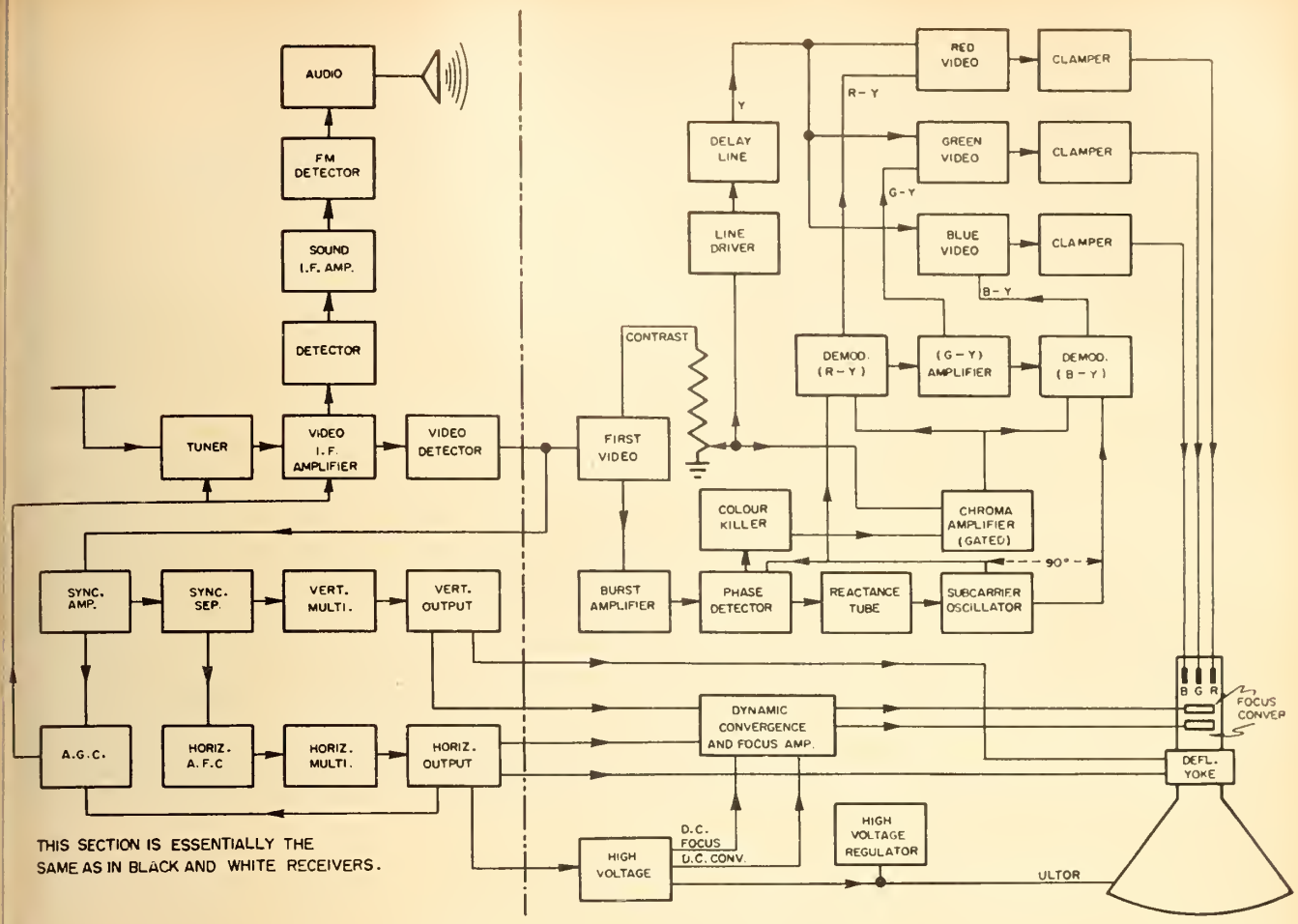


Fig. 8. Block diagram of colour receiver.

should be observed on an oscilloscope screen.

The heavy lines in Figure 7 show the wave form that operates the monochrome receiver. These receivers automatically reject the 3.58 Mc. due to the action of the intermediate frequency circuits preceding the video detector. The "boxes" show the added 3.58 Mc. colour signals.

On saturated yellow and cyan, the 3.58 Mc. subcarrier swings below zero, which would cause trouble at the picture transmitter. This is not as serious as it might appear because, in actual broadcasting, saturated colours rarely occur. During field testing of proposed colour television standards it was determined that the signal specification could be set this way to advantage.

Typical Colour Receiver

Figure 8 shows a block diagram of a typical colour receiver. The section to the left of the horizontal line is very similar to a monochrome receiver. The tuner, however, has a wider bandwidth and the I.F. amplifier is critical. Note that the sound is taken from a separate detector. The 4.5 Mc. I.F. following this detector responds only to the desired 4.5 Mc. sound I.F. frequency. Between the video I.F. and the usual video detector and not shown on the block diagram, is a large trap which attenuates the sound carrier to a very low level. This minimizes a 920 Kc. beat note that would otherwise occur between the I.F. sound carrier and the I.F. colour subcarrier. Note the burst amplifier, phase detector, the reactance tube and the local 3.58 Mc. oscillator. This oscillator is locked in fixed phase to the 3.58 Mc. oscillator at the transmitter. Output from the contrast control contains the complete signal similar to that shown in Figure 7. The chroma amplifier is tuned to 3.58 Mc. It selects the colour subcarrier and rejects the other signals. The output from the chroma amplifier feeds the R-Y and the B-Y demodulators.

The B-Y and the R-Y demodulators are called synchronous demodulators. They are similar to mixers as used in ordinary superhetrodyne receivers except the injected frequency is the same frequency as the signal frequency. A peculiar property of synchronous demodulators is that they extract the modulation of the signal that is in phase or 180° out of phase, with the injected voltage. Consequently by injecting into the R-Y demodulator, 3.58 Mc. signal of exactly the same phase as that modulating the R-Y balanced modulator at the transmitter, the R-Y signal is recovered without any B-Y interference. The B-Y demodulator works in a similar manner. The injected voltage here must again be exactly in phase with the injected 3.58 Mc. into the B-Y balance demodulator at the transmitter. The injected 3.58 Mc. is produced in the receiver.

It is necessary to form a G-Y signal at the receiver to recover the green video signal. It can be shown that:

$$-[.51\,(E_R - E_Y) + .19\,(E_B - E_Y)] = E_G - E_Y.$$

This can be readily proved by direct substitution. Feeding the correct amount of $E_R - E_Y$ and

(Continued on page 1069)

Ontario Hydro Completes

Harnessing of Niagara

by

Dr. Richard L. Hearn, M.E.I.C.,

Chairman,
The Hydro-Electric Power Commission of Ontario,
Toronto, Ontario.

Dr. Hearn traces the amazing growth in demand for power in Ontario since "Hydro" was created in 1906, and tells how Hydro engineers have kept pace with the demand. Outlining the terms of the Niagara Diversion Treaty of 1950, he shows how this treaty made possible the undertaking of Hydro's latest and greatest development, the Sir Adam Beck — Niagara Generating Station No. 2. Some of the special features of the project are listed and a summary of progress on construction to date is given.

At the beginning of this century, Southern Ontario industry was faced with the problem of finding a low-cost dependable source of power to assure Ontario's future expansion and to improve living conditions. Timber lines were receding rapidly and the import of fuel for thermal plants was costly.

The one answer to this problem lay in the utilization of dependable river flows for hydro-electric development. The main source of this "white coal" was, of course, the Niagara River, and construction was started on three large power stations, namely those of the Canadian Niagara Power Company, the Ontario Power Company, and the Electrical Development Company.

There is no doubt that these large-scale projects and other proposed works on the Great Lakes system, were mainly responsible for arousing interest in the control of water diversions for power purposes, and for the subsequent formation of the International Waterways Commission in 1902.

Extensive studies and recommendations by the new body relating to this and other international waterway problems resulted in the Boundary Waters Treaty of 1910, and the appointment of the International Joint Commission. The Boundary Waters Treaty, as it related to Niagara River power development, permitted Canada the permanent daily water diversion of 36,000 cubic feet per second.

Early Years of Hydro

At the same time as construction was being carried out on the three new Niagara plants, industrialists and businessmen in Toronto and Western Ontario were meeting and discussing the problems of bringing this power to Southern Ontario at lower cost than small local thermal and water power plants.

As a direct result of this movement for low-cost hydro power, The Hydro-Electric Power Commission of Ontario was created by a special act of the Provincial Legislature in 1906.

After initially purchasing power and transmitting it to its municipal customers, Ontario Hydro, in order to avoid duplication of facilities, began acquiring generating stations. In addition it started constructing its own plants at key points which, with the subsequent extension of transmission facilities, would serve as the basis of a grid system.

At Niagara, the Commission purchased the plant of the Ontario Power Company in 1917, and in 1922 it acquired the Electrical Development Company's plant which was re-named the Toronto Power Generating Station.

The Commission's first work in the construction field in Southern Ontario was undertaken in 1913 at Wasdell Falls Generating Station on the Severn River. Next, came construction of Eugenia Falls G.S. on the Beaver River in 1915, followed by the start of construction, in 1917, of the Queenston-Chippawa development —now known as the Sir Adam Beck-Niagara Generating Station No. 1.

Apart from its capacity, which was to be greater than the combined total for the three other Canadian plants, the new Sir Adam Beck No. 1 plant was planned to develop the maximum economic head between Lake Erie and Lake Ontario. This was achieved by incorporating a power canal which would carry water from the intake above the Falls to a point on the Niagara escarpment, some six miles downstream, where a drop of some 300 feet could be utilized. This compared with a maximum available head of about 200 feet for plants located directly at the Falls.

An idea can be gained of the actual benefits of the higher head when it is considered that the Toronto Power G.S., with a normal operating head of 137 feet, produces 7.1 kilowatts per c.f.s., and The Ontario Power G.S., with a normal operating head of 180 feet, produces 16.9 kilowatts per c.f.s. By comparison, the Sir Adam Beck No. 1 plant, with a normal operating head of 294 feet, produces 22.0 kilowatts per c.f.s.

On completion of the new station, further Canadian developments at Niagara were not possible with the water diversion permitted by the 1910 Treaty. However, through the construction and acquisition of additional generating stations, followed by major power purchase agreements, we were able to maintain a reasonable margin of reserve on our systems—that is until the start of World War II.

With Ontario playing a vital role as a wartime workshop for the production of essential armaments and other goods, we experienced yearly upsurges in demands which were over double the pre-war average. Indeed, the load growth from 1938 to 1941 eliminated the reserves on our system and, with few exceptions, our power requirements continued to exceed system dependable peak capacity until well after the end of the war.

To alleviate at least a part of this difficult situation, and in order to maintain this important "arsenal for democracy", we made applications and obtained agreements with the United States to make additional temporary water diversions at Niagara. These amounted to 13,000 c.f.s. Also, with the construction of the Long

Lac-Ogoki diversion, we were able to obtain an additional 5,000 c.f.s.

The new diversions enabled us to operate all our Niagara plants at full capacity and thus provide the maximum amount of power for essential war work. Late in 1948, following further developments at DeCew Falls, an additional 2,500 c.f.s. was made available during the non-navigation season.

It was predicted by many that the high demand for power experienced during the final period of World War II would ease following the cessation of hostilities. Such was not to be the case, however, and the expected reduction in power requirements sufficient to restore a desirable margin of reserve power, did not materialize.

Even the most optimistic, in fact, failed to visualize the full extent to which Ontario's economic upsurge would bring fresh demands upon the electrical utilities. Ontario Hydro was certainly made aware of this economic boom, for instead of having a badly-needed respite to catch up with construction, it was faced with an accelerated load growth which called for the greatest expansion in its history.

In Southern Ontario, in spite of the construction of new stations on the Ottawa and Madawaska Rivers; the installation of both small emergency thermal plants and the first large thermal stations, and additional power purchase contracts, the Commission was still confronted with the possibility of power deficits. The obvious solution was development of the St. Lawrence River, but this was held up by lack of international agreement. Once again, Ontario Hydro's sights were turned to Niagara.

Niagara Treaty of 1950

To provide the background for the signing of the Niagara Diversion Treaty of 1950, we must return to the wartime agreements to divert additional water from the Niagara for power purposes. The initial phase of remedial works recommended by the Special International Niagara Board had been accomplished by construction during the period 1942 to 1947 of a submerged, rock-filled weir above the Horseshoe Falls.

The weir substantially compensated for the lowering effect of the power diversions, greatly increased the flow over the American Falls and consequently improved winter conditions at the power intake. It did not, however, improve the conditions on the flanks of the Horseshoe Falls.

It was known that works could be designed to enhance and preserve the beauty of the Falls and at the same time permit increased diversions for power development. Because of this, studies were made and a comprehensive report compiled by the Federal Power Commission of the United States. This report formed the basis for discussions leading to the signing between Canada and the United States of the Niagara Diversion Treaty of 1950 to provide for the preservation of the Falls and additional power developments.

A significant feature of the new treaty is that the water diversion for power purposes is variable while flows over the Falls are established at certain minima. By comparison, the 1910 treaty permitted a constant water diversion for power with variable flows over the falls. The amount of water which must flow over the falls under the 1950 treaty is as follows:

April 1st to September 15th
8 a.m. to 10 p.m.—100,000 c.f.s.
10 p.m. to 8 a.m.— 50,000 c.f.s.
September 16th to October 31st
8 a.m. to 8 p.m.—100,000 c.f.s.
8 p.m. to 8 a.m.— 50,000 c.f.s.
November 1st to March 31st
— 50,000 c.f.s. — at all times.

The balance, after 5,000 c.f.s. has been allocated to Canada for the Long Lac-Ogoki Diversion, is divided on an equal basis between the two countries.

In addition to setting minimum flow schedules, the Niagara Diversion Treaty calls for remedial works in order to enhance the beauty of the falls by distributing the waters so as to produce an unbroken crestline. In this connection, Ontario Hydro is working jointly with the Corps of Engineers, United States Army, as a result of recommendations made by the International Joint Commission which was vested with the supervision of these important new works. The level of the Grass Island Pool will also be maintained.

Sir Adam Beck-Niagara No. 2

Within a few months from the ratification of the treaty in October, 1950, Ontario Hydro started construction on a new major plant at the falls—the Sir Adam Beck-Niagara Generating Station No. 2.

There were naturally many changes in design from the old plant due to advances in engineering, but I should like to point out an important factor which influenced the design of the new project. Hydro naturally desired to obtain the maximum economic head possible—this indicated a powerhouse location closely paralleling the older station—and it was faced with the necessity of carrying a large volume of water through a highly developed area. This necessitated the construction of hydraulic tunnels.

The initial layout therefore included one 45-foot diameter tunnel—with provision for a second tunnel—which carried water under the City of Niagara Falls to an open-cut canal leading to the headworks of the new powerhouse. Construction was first started on a single tunnel scheme. This included one intake, one tunnel with a capacity of 20,000 c.f.s., an open-cut canal section and headworks, penstocks and power works for six 75,000 kilowatt units.

However, it soon became apparent that additional resources would be required to meet system growth and it was decided to install a seventh unit. It was found that this could be carried out at comparatively low cost, and did not require further tunnel work. Subsequently, authorization was given for extension of the canal to carry the capacity of two tunnels.

Work proceeded on this initial part of the development until mid 1952, when continued growth of power demands and further delays in obtaining approval for the St. Lawrence development dictated extension of the project, and authorization was given to proceed with a second tunnel, a second intake and an additional five 75,000-kilowatt units.

Pumped-storage Scheme

By mid-1953, additional steps had to be taken to overcome deficits which were forecast for 1956 and 1957, for although prospects for St. Lawrence development looked considerably brighter, it was by no means assured. As a third step in the major expansion program at Niagara, authorization was given to proceed with a 170-000-kilowatt pumped-storage scheme. The installation of an additional four units in the main plant was also authorized—these units to be added when required. This brought the total ultimate installed capacity for the station to 1,370,000 kw.

The pumped-storage scheme incorporates a storage reservoir of about 750 acres and a pump-turbine plant to raise the water from the canal to the reservoir. The overall plan involved enlargement of the forebay of the new plant; widening of portions of the power canal; and construction of a short off-take canal to connect the pumping station to the main canal. In addition, extension of certain parts of the main plant were required in order to make provision for the ultimate installation of the four additional units.

To operate the pumped-storage phase, water will be lifted by the pumps from the main canal just before it reaches the forebay of the new plant. This will be done at periods of low demand. At times of high demand, the flow will be reversed and the pumps will act as turbines driving the six motor-generators having a total maximum capacity of 170,000 kilowatts. The water will then flow down the canal to the main power station where it will in turn generate power under 300 foot head. This operating procedure will permit the best use to be made of the allowable diversion under the Niagara Treaty.

With the exception of the last four additional units, installation of which will be deferred for a time, excellent progress is being made on all phases of the project. Ten units are now in operation at the main plant, and the remaining two will be brought in this year. The pumped-storage scheme is scheduled for initial operation late next year with completion in 1957.

Special Features

In addition to being the largest installation Ontario Hydro had undertaken, the new plant created many interesting engineering problems.

First, in order to draw water from above the Falls, the intake would have to incorporate two main features:

(a) Ability to gather a large amount of water from a comparatively shallow river.

(b) Ability to prevent surface ice from entering the conduits.

Second, our initial studies indicated that the economical location for the new powerhouse was to the South of the older plant, and that it was desirable to operate the forebays of both plants at a common level. The location of the new powerhouse thus called for a crossing between the new power canal and the existing canal of the Beck No. 1 station, as well as interconnection of the forebays.

Third, in order to comply with the terms of the Niagara Diversion Treaty of 1950, certain works had to be constructed to ensure the following:

(a) To distribute the flow of water over the Falls in such a manner that an unbroken curtain of water will be produced at all times.

(b) To check the erosion now taking place in the deep notch of the Horseshoe Falls.

(c) To control the level of the Chippawa-Grass Island Pool so that present conditions in the pool and river upstream will remain unchanged; the American Falls will remain unimpaired, and the most effective use of water for power production will be assured.

Each of these three main features required detailed study by our engineers. These and other investigations were the subject of three additional papers given at the 1955 meeting by members of the Ontario Hydro staff. √

A Review of Flood Problems

In The Wake Of Hurricane Hazel

by

R. L. Clinch and H. J. Saaltink,

H. G. Acres & Company Limited,

Niagara Falls, Ontario.

The severe flooding, which resulted from hurricane "Hazel", caused loss of life and extensive property damage. The occurrence emphasizes the need for engineers concerned with hydrology and hydrometeorology to see that essential basic information is extended, and that the appropriate authorities, and the public, are properly advised of inherent dangers. The paper traces the course of events up to the disaster and makes constructive recommendations for future action.

On October 15, 1954, southeast Ontario was struck by an extremely heavy rainstorm which together with accompanying high winds, marked the progress of Hurricane Hazel. The severe flooding which followed caused serious loss of life and extensive property damage and so can be described as a national disaster.

It should be emphasized that the loss of life and the damage to property were not caused by the failure of any engineering structure; however, we would be remiss in our duty as engineers if we did not, at this time, examine very closely the events of those two days. Following such an examination; it should be possible to suggest a course of action whereby information concerning possible river flooding can be made available to the general public and to those whose concern it is to see that river valleys are developed only to the extent that is safe. It is to this end that the authors have prepared this paper.

Hydrologic Phenomena

It will be of help in describing some of the more important aspects of the events of October 15, 1954, if the hydrologic phenomena which occur during a major flood are first described. When the science of hydrology was in its infancy flood estimation was carried out by what might be described as "rule-of-thumb" methods. For example, a cross section through many of the older dykes of Holland would show that the crest elevations of those dykes have been increased repeatedly over the years, every increase in elevation being associated with a dyke breach and in all probability with loss of life and property. Thus, the maximum water levels which had occurred in the past were used hopefully as a guide to maximum water levels which would occur in the future, the mechanism by which floods occur being unknown.

An obvious extension of this technique is the application of probability methods of analysis to stream flow records, the assumption being that stream flow is the result of a number of random events, an assumption which is probably correct. The method is somewhat complicated in that peak flows of most rivers do not follow a normal statistical distribution; instead, the distribution is generally skewed. By using this method, it is, of course, possible to give a fairly accurate estimate of the probability of occurrence of any flood of less magnitude than the maximum experienced flood. But it is generally conceded that a 15-year or 25-year period of record is not a sufficient basis to estimate accurately the magnitude of a flood having a probability of occurrence, on the average, of perhaps once in ten thousand years. The idea behind probability methods of estimation is basically sound; but in the application to flood estimation, the number of recorded floods is generally insufficient to obtain reliable estimates. Again in this method, no attempt is made to analyze the actual phenomena which occur during a flood.

Probability methods of flood estimation are normally applied to the records of flow in one river at a time and no use is made of flow records of adjacent rivers, the drainage areas of which may, however, experience meteorological conditions which are almost identical. Information in this respect may be obtained by the use of graphs on which the maximum recorded floods for nearby rivers, expressed in terms of c.f.s. per square mile, are plotted against the corresponding values of drainage area. When sufficient points have been plotted on such a graph, enveloping curves may be drawn from which it is possible to estimate what the peak flow in the river in question would have been had the drainage area of that river been subjected to the worst storm which had occurred over other nearby drainage areas in the past. The obvious disadvantage of this procedure is that drainage basin characteristics, other than area, are not taken into consideration. The limited usefulness of such a graph will be indicated shortly when consideration is given to the storm which occurred over southeast Ontario on October 15, 1954.

In the methods of flood estimation which have so far been described, river flows form the only basic data which is employed. On this account the methods are essentially limited, since no attempt is made to assess and treat the various underlying hydrologic and meteorologic phenomena. However, in 1932 the understanding of certain hydrologic phenomena was increased considerably when Leroy K. Sherman found that for any drainage area all hydrographs resulting from isolated storms of a given duration have approximately the same length of time base, and that when these hydrographs are reduced to correspond to an equal volume of runoff, their

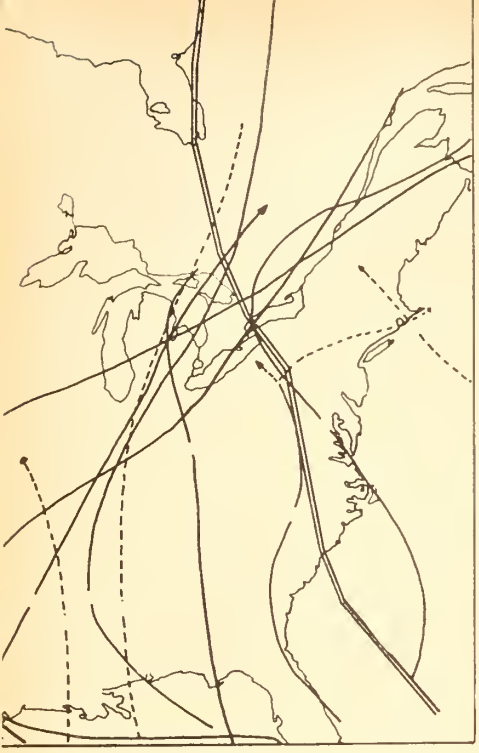


Fig. 1. Paths of important tropical storms in Ontario. That of Hazel is shown by a double line.

shapes are very similar. He, therefore, proposed the use of the unit hydrograph, or the hydrograph resulting from precipitation occurring in a unit of time and representing a volume of runoff equal to a 1-inch depth of water over the drainage area.

The unit hydrograph is, in fact, a means of defining on one simple graph the time taken for precipitation to arrive at a given point in a river from all parts of the drainage basin above that point. It shows the effects of such characteristics as the shape and topography of a drainage area, the extent of natural storage, etc., and, hence, describes some of the most important hydraulic phenomena which occur during river flooding. Other characteristics, such as evaporation, transpiration, infiltration, and the variation of precipitation both in time and from one part of a drainage area to another can be estimated either directly or indirectly.

To obtain the hydrograph for any storm of unit duration and for which rainfall measurements are available, the ordinates of the unit hydrographs are multiplied by the inches of rainfall after due allowance has been made for estimated losses. Similarly, by dividing any storm period into a number of time intervals of unit duration and by applying the method for each time interval, the resulting hydrographs when added together will give the complete hydrograph for that storm.

From this brief history of the methods of flood estimation, the trend towards more detailed examination of hydrologic phenomena is apparent. The unit hydrograph method which deals with these phenomena in the greatest detail enables all of the important variables to be taken into account and hence can give the most accurate results. In addition, use of this method simplifies the problem of estimating the magnitude of possible future floods in that recorded storms can be transposed and adjusted to give accurate estimates of possible future runoff. It is, therefore, of considerable importance that measurements of runoff, precipitation and drainage basin losses throughout Canada be made in such a way as to be of maximum use in application of the unit hydrograph method. In the next two sections of this paper, the information actually obtained during Hurricane Hazel is described and taken as an example to show whether or not this is the case at the present time.

Significant Aspects of Hurricane Hazel

An excellent summary of the meteorological conditions during the Canadian phase of Hurricane Hazel is given by A. H. Mason, M. K. Thomas and D. W. Boyd in a report published by the Meteorological Division of the Department of Transport, and from which the authors have obtained a substantial amount of information. The meteorologists of the Toronto office are to be congratulated on the excellent report which they have produced in spite of the fact that their duties do not normally allow them to devote much attention to the problems of hydrometeorology.

Hurricane Hazel was first discovered in the eastern Caribbean Sea on October 5. It moved in a north-westerly direction across the United States through Virginia and Pennsylvania, reaching a position south of Buffalo by 7:30 p.m. on Friday, October 15. At the same time, a cold front had moved across Ontario on October 15 and by 2:00 p.m. it had reached a north-south line running just east of Toronto where it stalled for the afternoon. It was the interaction of this cold front and the air masses associated with Hurricane Hazel which caused the very heavy precipitation in the Toronto area during the evening of October 15.

It is important to dispel any idea which may exist in people's minds that the high precipitation in the Toronto area was in the nature of a freak occurrence which could not happen again, or for that matter, could not be exceeded. The Meteorological Division of the Department of Transport state that during the 50-year period from the year 1900 to the year 1949 inclusive, a total of 25 hurricanes passed over or close to Ontario, and that eight of these hurricanes were accompanied by high winds or excessive rainfall, or both. The paths of these eight hurricanes together with the path of Hurricane Hazel are plotted on Fig. 1. It can be seen that practically the whole of southeastern Ontario has been subjected to the effects of hurricanes at one time or another, and that in this respect, the area may be considered meteorologically homogeneous. The passage of Hurricane Hazel over the Toronto area was merely a quirk of fate; it may just as well have passed over any other part of southeastern Ontario. The fact that in August 1915 a total of 7.06 inches of rain fell at Kitchener, Ontario, in one 24-hour period during a storm similar to Hurricane Hazel, lends support to the above statement. There is also good reason to believe that in 1850 a storm was experienced in the Toronto area causing flooding which might well have been as extensive as that which occurred in October, 1954.

Isohyetals for the 48-hour period October 14-15 show that a maximum of precipitation was recorded in the Brampton area and totalled something more than 8 inches in 48 hours, the greatest recorded amount being 8.41 inches at Snelgrove. (Fig. 2) There is reason to believe that Snelgrove might not have been at the point of heaviest precipitation and that more intense rainfall occurred elsewhere but was not recorded. Furthermore, the true rainfall may be greater than the measured amounts in that rain gauge measurements in exposed locations can be affected by wind. Some people believe that a very considerable error can be introduced in this way. It is, therefore, safe to say that rainfall was not less than is indicated by the isohyetals.

A rainfall equal to, or greater

experienced over an area of approximately 350 square miles and it would appear that the storm of October 15 produced the heaviest general rainstorm ever recorded in southern Ontario. In general, flood damage occurred in those areas where the October 15 rainfall exceeded four inches and particularly in the valleys of the Humber, Credit and Don Rivers, the Etobicoke and Mimico Creeks and the Holland Marsh area.

It is not proposed to give any extensive comment in this paper on the reasons why loss of life and property was so great during the flooding. Speculation in this regard has already been extensive. But one remark concerning the development of river valleys in southern Ontario is sufficiently important as to bear repetition. It could have been demonstrated clearly by any competent hydrologist that the habitation of flood plains of many of the rivers which flooded was dangerous. This remark is equally applicable to parts of the flood plains of many other rivers in southern Ontario, the danger of loss of life being sometimes increased by building out into the rivers and reducing the area available for discharge during floods. There is no doubt whatsoever that, to prevent future loss of life during flooding, many flood plains of southern Ontario rivers should be evacuated permanently and dangerous constrictions of the rivers should be eliminated.

The occurrence of the major storm of October 15, 1954, gave an opportunity to obtain more accurate unit hydrographs for the Grand, Conestogo and the Thames Rivers on which various flood control dams have been or are being built and, for that matter, for many other rivers in southern Ontario. Examination of runoff into the Grand and Conestogo Rivers has been completed and the results are, therefore, used in this paper to demonstrate what can be done with available records and to indicate what should be done in the future to improve the accuracy of work of this kind.

The Grand River Drainage Basin

The Grand River rises about 30 miles from Georgian Bay in the neighbourhood of Dundalk at an elevation of approximately 1,700 feet above sea level, and runs for about 180 miles to its mouth at Port Maitland on Lake Erie, the elevation of which is around 572 feet above sea level. Its main tributaries are the Conestogo, Speed and Nith Rivers with drainage areas of 320, 275, and 430 square miles respectively, the total drainage area for the entire system being approximately 2,600 square miles. The river has an average slope of approximately six feet per mile and drains a gently rolling countryside which, although well timbered originally, is now mainly farmland. It so happens that the various parts of the drainage area have widely varying infiltration characteristics, as will become apparent when figures for runoff coefficients are given later; soils of the Conestogo River drainage area and of part of the Grand River drainage area above the Shand Dam are London clay, a very impervious material; the remaining portion of the drainage area is composed generally of morain deposits of sands and gravels having good infiltration characteristics.

It is only during the last ten years that effective, or partially effective, measures have been taken to reduce flooding of the Grand River. The Shand Dam, which was constructed in 1939 to provide storage whereby summer flows of the Grand River could be increased, gives some measure of protection against flooding as does the Luther Marsh Dam constructed farther upstream in 1952. Contracts have now been let for construction of a third dam on the Conestogo River for the specific purpose of flood control.

The Grand River ranks as one of the best measured rivers in Canada. From the map on Fig. 3, it can be seen that there are a total of nine gauging stations on the river and its tributaries, five of these stations being equipped with automatic water level recording gauges. However, the picture is not so bright when it comes to measurement of precipitation. There are, within the drainage area, only six stations at which measurements of precipitation are made, none of these stations being equipped with an automatic rain gauge, an instrument which is very necessary in the detailed analysis of flood problems. Rainfall measurements at these stations are made either once or twice a day, and there is some variation in the actual time at which measurements are made.

For the purposes of calculation of unit hydrographs, the drainage area of the Grand River above Galt has been considered in three parts.

(1)—The drainage area above the Shand Dam on the main stream.

(2)—The drainage area above the site of the Conestogo Dam, on the Conestogo River.

(3)—The drainage area above Galt and below the two points referred to above.

Unit hydrographs have been produced for each of these three partial drainage areas, and when computing the hydrograph at Galt

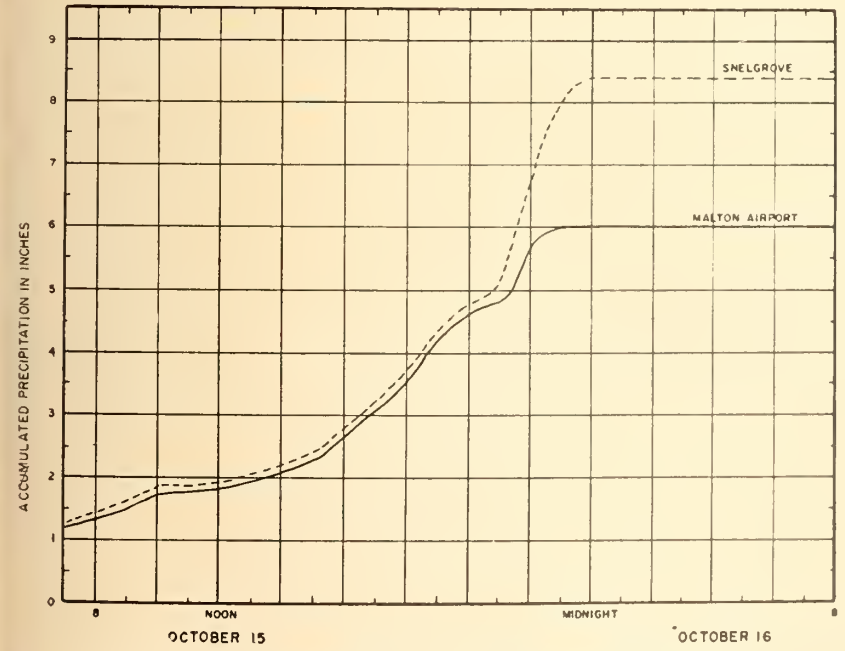


Fig. 2. Mass curve of precipitation at Snelgrove and Malton; period from 8 a.m. October 14 to 8 a.m. October 16, 1954.

for any given flood, due account has been taken of the effect of valley storage between the three points. Hydrographs for any other gauging stations in the lower reaches of the river can equally well be obtained by a similar process of computation. By dividing the drainage area into three parts in this way, the accuracy of the calculation is increased in that it is possible to allow for the variation in average precipitation over the three areas, and for varying rates of infiltration. Greater accuracy could, of course, be obtained by further subdivision.

The isohyetals used for the calculations were plotted for 12-hourly intervals, there being insufficient rainfall measurements at shorter intervals to enable accurate curves to be drawn. Figures of average precipitation, runoff and losses for the storm period are given in Table I.

The degree of accuracy which was obtained in these calculations can be seen clearly from Fig. 4. Curve A shows the actual recorded hydrograph for the Grand River at Galt, after subtraction of base flow, whereas curve B shows the hydrograph obtained by applying values of observed precipitation to the calculated unit hydrograph. The curves are fairly close together except at the beginning of the storm, the error here being attributable almost certainly to inaccurate estimates of precipitation. The peak flow at Galt, including base flow, was in the neighbourhood of 48,000 c.f.s., this being greater than any previously recorded flow at this point. It might be mentioned that if the Shand Dam had not been in operation, the peak flow at Galt would have been greater by about 13,000 c.f.s., and the stage of the river would have been approximately three feet higher.

The question now arises as to

Fig. 3. Map of South-East Ontario, showing Grand River drainage area.

Fig. 4 (left). Flood hydrographs of Grand River at Galt. Curve A gives observed flows (baseflow subtracted); curve B gives computed flows.

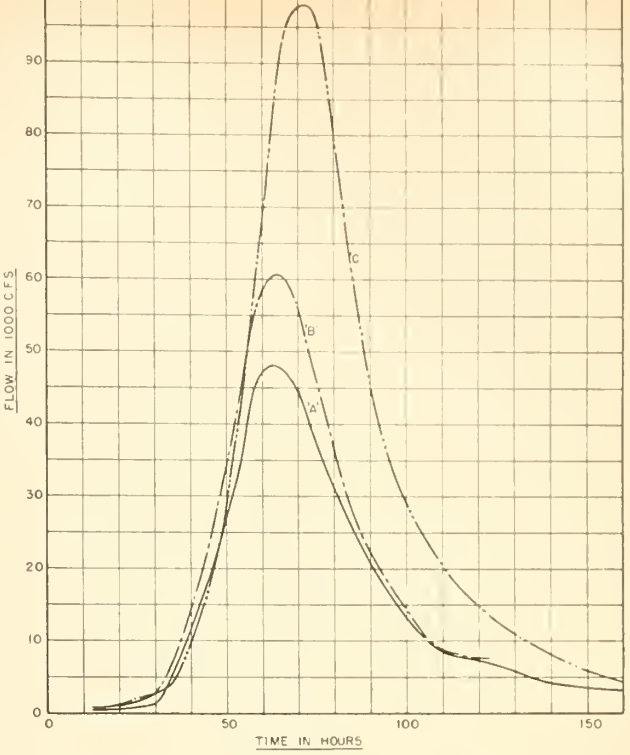


Fig. 5 (right). Flood hydrographs of Grand River at Galt. Curve A gives recorded flow during Hazel; curve B gives flow which would have occurred without flood regulation at Shand Dam; curve C gives flow due to Hazel transposed over the drainage area.

what the flow in the Grand River at Galt would have been if the storm centre had been located over the Grand River drainage area. The isohyetals representing the storm were, therefore, moved to a position over the drainage area and rotated slightly to give maximum values of precipitation, and the unit hydrograph derived from the actual recorded precipitation and flow has then been used to derive the estimated hydrograph given by curve C on Fig. 5. It can be seen that the peak flow at Galt would have been 98,000 c.f.s. if the storm centre had been located over the Grand River drainage area and it is probably true that serious loss of life and great property damage in many of the towns along the lower reaches of the Grand River would have resulted. It should again be emphasized that precipitation equal to or greater than these values is well within the bounds of possibility for the Grand River or for that matter any other river in southern Ontario.

Although the results given above are believed to be reasonably accurate, there is no doubt that the type and extent of measurements, especially measurements of precipitation, could be considerably improved. Even for such a populated area as the Grand River drainage basin, the records of precipitation during Hurricane Hazel were insufficient to compile isohyetal maps for six-hour intervals of time, and the absence of any records from automatic rain gauges made it very difficult to estimate the mass curves of precipitation. Although five of the nine gauging stations on the Grand River are equipped with automatic water level recorders, sufficient meterings of the flow at the gauging stations during previous floods have not been made and it was necessary to extrapolate the rating curves to some considerable extent.

Table I. Average precipitation, runoff, and losses

Drainage Area	Average Precipitation	Runoff	Losses	Runoff Factor
				per cent
Above Shand Dam on Grand River	5.1	3.6	1.5	70
Above Conestogo Dam site on Conestogo River	5.2	3.9	1.3	75
Above Galt and below dam sites referred to above	5.0	2.4	2.6	48

Precipitation and losses are all measured in inches of water on the drainage area.

Estimates of Possible Future Precipitation

In the preceding discussion, an attempt has been made to demonstrate the extent to which the characteristics of any drainage area can be determined. It has been shown that, provided sufficient measurements of runoff and precipitation are made during moderate to heavy storms, the unit hydrograph method will give results which are sufficiently accurate for all practical purposes. However, in order to determine the magnitude of possible future runoff in such rivers, it is still necessary to decide what amount of precipitation can occur. It is in this field, sometimes referred to as the field of the hydrometeorologist, that so little information is available.

One method of approach is to apply a frequency analysis to past records of rainfall. It might be thought at first that the results obtained would be no more useful than the results of a similar analysis of runoff records. However, advantage can be taken of the fact that when rainfall measurements are made at a number of stations in an area which is considered meteorologically homogeneous, the records for those stations can be treated as one record of length equal to the sum of the periods of record at each of the stations. The accuracy thus obtained is not as great as would be possible if measurement had been made at one station for a time equal to the sum of the periods of record at

each individual station; but nevertheless, estimates of future possible precipitation obtained in this way are more accurate than could be obtained for any given rainfall station. Computations of this type have been made by Yarnell and by the Miami Conservancy District and the results of these calculations are available for most parts of the United States.

But the question still arises as to what probability of occurrence of precipitation should be employed in designing engineering structures of different types. It is here that sound engineering judgment is the only safeguard against serious mistakes at the present time.

It would appear that the United States have not only appreciated the necessity of having more accurate estimates of future possible precipitation but have taken active steps to remedy the situation. In 1947, the hydrometeorological section of the U.S. Weather Bureau published their generalized estimates of maximum possible precipitation in the United States, and in doing so, gave some information concerning precipitation in Canada. However, as they themselves admit, the estimates for the Great Lakes region are subject to error in that the modifying effect which the Great Lakes have on weather conditions has not been taken into account.

It might be interesting at this point to draw a parallel between the early development of methods of estimating runoff and present developments in methods of estimating precipitation. Just as, in past years, methods dealing with runoff were replaced by others which consider in detail the actual hydraulic phenomena occurring on a drainage area, so now the flow of air masses during storms is being considered in detail to estimate maximum precipitation.

Essentially, the method involves the transposition of recorded storms over any area in which it is considered that they can occur, i.e. in areas which are meteorologically homogeneous, and the adjustment of the dew point of the incoming air masses in the upward direction to a point which is considered to be the maximum possible. Corrections are made for variation in the altitude of the ground over the area and the maximum possible precipitation from such a storm is then calculated. The method is rational in that it deals, as far as is possible, with the detailed phenomena which are known to occur; however, there is no doubt that more work along this line needs to be done before too much reliance is placed upon the results. So far, no attempt has been made in Canada to extend the work already done in the United States to take care of special Canadian problems and Canadian engineers are thereby handicapped in their work.

The need for additional work is obvious from the following:

(a) During Hurricane Hazel, the maximum 48-hour precipitation, recorded at the storm centre near Toronto, was 8.41 in.

(b) From a frequency analysis of precipitation records up to the year 1953, the 48-hour precipitation having a probability of occurrence of, on the average, once in one thousand years, is estimated to be 7.1 inches for the same location.

(c) The estimated maximum possible 48-hour precipitation over an area of 500 square miles in southern Ontario, is given by U.S. Weather Bureau as 18.5 in.

Thus, from a frequency analysis of rainfall records available up to the year 1953, the possibility of getting 8.41 inches of rainfall in the Toronto area would have been considered as rather remote; on the other hand, the U.S. Weather Bureau suggest that precipitation more than twice as great as actually occurred during the hurricane is possible for this area.

The events which occurred during the severe storm on October 14 and 15, 1954, have served to emphasize once again that people who continuously take chances with nature are liable to lose in the end. It is, therefore, the duty of everyone and especially of engineers to see that the general public are fully informed of the possible dangers of indiscriminate development of river valleys and to make sure that the information given is the best that can be provided at the present time.

Although substantial progress during the last ten years has been made in southern Ontario to increase the extent of basic data available, there is still much to be done especially in the field of rainfall measurement and of hydrometeorology; and it is the experience of the authors of this paper that available information for the whole of Canada is certainly no more extensive than for southern Ontario. Furthermore, unfortunately, existing information is not necessarily of a type which we now know is most suitable for use in detailed analysis of drainage area characteristics.

Recommendations

To improve the situation, it is suggested that one or more of the representative engineering bodies take an active interest in the matter by setting up a committee to correlate the ideas of engineers who are vitally interested in the problems of hydrology and hydrometeorology and to make a submission to the Dominion Government and possibly to the Provincial Governments, recommending that suitable measures be taken whereby the quality and quantity of information on possible river flooding can be extended and improved. The following suggestions might be included:

(1) That, in co-operation with the aforementioned committee, experiments be made on a suitable drainage area to determine what extent of records are needed to produce accurate estimates of drainage basin characteristics. Obvious suggestions are that automatic devices for measuring both runoff and precipitation should be employed to a greater extent than is now the case and that measurements of ground water level and soil moisture should be made. The drainage area of the Grand River might be a fine proving ground.

(2) Parallel with the work described above, it would appear necessary that a research program should be initiated to improve the accuracy of rain gauges, especially when high winds accompany the precipitation.

(3) That results of experimental work of this nature be used in revising the present program of rainfall and runoff measurement throughout Canada.

(4) That hydro-meteorologists be appointed by the Government to extend present knowledge of possible future precipitation over the whole of Canada and thereby to minimize as far as possible loss of life during future floods.

Acknowledgment

Much information in this paper has been obtained from work done in the offices of H. G. Acres & Company Ltd. The authors wish to thank the management for their encouragement and support, and the members of the staff who participated in the work.

Hydraulic Design of Outlet Basin for Single Culverts*

by

C. D. Smith, M.E.I.C.

Hydraulic Engineer, Design Division, Department of Agriculture of Canada, Regina, Sask.

This report describes the theoretical background and experimental procedure used in a study of conduit outlet transitions and stilling basins. The study was undertaken by the Hydraulics Section of the Design Division, PFRA, for the specific purpose of evolving and standardizing a hydraulic design procedure for this type of structure. The design evolved proved entirely satisfactory within the limitations specified.

An outlet works, consisting of an inlet, conduit, gatewell, and some form of outlet structure, is built at practically every earth dam. In many cases the conduit is a single-barrelled one. At the outlet end of this conduit the flow occurs as a highly concentrated, fast moving jet which has considerable potential for causing damage. (Fig. 3, 4, 5.)

There are several cases within the experience of the PFRA where such a jet with its associated eddies has caused erosion of the downstream toe of the dam, undermined the outlet structure, and formed out a wide deep scour hole in the discharge channel. In order to prevent this, some form of structure is required to dissipate the energy of the jet before the flow is released to the downstream channel.

The most effective means of dissipating the excess energy is by the hydraulic jump. It is a comparatively simple matter to design a rectangular parallel-sided stilling basin to provide for the formation of this jump. However, in order to insure that the jump will occur as calculated, the flow entering the basin must be reasonably uniform in depth and velocity across the width of the structure.

The problem then, is one of spreading the concentrated jet from the conduit into a uniform relatively shallow sheet at the basin. This spreading must occur in the transition. If the transition is long and gradual, the structure will usually perform well, but will be unnecessarily costly. If, on the other hand, the transition is too short, uniform spreading will not be obtained and a hydraulic jump in the conventional sense will not form. Jetting and eddy action can be almost as bad with an improperly designed structure as with no structure at all.

In this paper, information is given for the design of the outlet transition and stilling basin for a single barrelled circular conduit. The design, based on model experiments, is believed to be the most suitable in the interests of economy and performance.

The problem of supercritical spreading is one of the most difficult in the field of hydraulics, principally due to the great number of variables involved. For example, the initial width, depth, and velocity of flow, the final width, and the drop in floor elevation, each play an important role in determining the degree of spreading which will be obtained in a given length of transition. However, for the special case of no drop in elevation, it is possible by deductive reasoning to set up a relationship containing the other variables.

The necessary length of transition L_T to obtain a given degree of spreading will depend first upon the affinity of the jet to spread laterally, which, in turn is directly proportional to the Froude number $\frac{v}{\sqrt{gd}}$ of the flow at the start of the transition.

That the Froude number indicates the potential of the flow to spread laterally, in a given length, is evident from the fact that the numerator is the longitudinal velocity of flow and the denominator is a measure of the lateral velocity, actually the velocity of a small surface wave. If F is doubled, the transition length must be doubled to obtain the same degree of spreading. Further, L_T must depend upon a size factor such as W_1, the initial width.

This simply means that for dynamic similarity we must maintain geometric similarity; i.e., length varies directly as width. Finally, the final width, W_2, to which the jet is to spread, must be incorporated into the relationship, and done so dimensionlessly in order to maintain dimensional homogeneity.

This is conveniently done by using the width ratio $\frac{W_2}{W_1}$ in the form $\left(\frac{W_2}{W_1}-1\right)$. Since L_T will be zero when $W_2=W_1$, the need for the term "-1" is obvious. Whereas L_T will vary directly with F or W_1, it will vary to some fractional power of $\left(\frac{W_2}{W_1}-1\right)$. That this must be so is evident from the fact that the lateral velocity of flow is not constant, but accelerates from zero at the start of the transition. The jet fans out with a steadily increasing angle of divergence with the centre line. Therefore, if the quantity $\left(\frac{W_2}{W_1}-1\right)$ is doubled, it is not necessary to

*Design Bulletin No. 2 of the Prairie Farm Rehabilitation Administration, Engineering Services Branch, presented by the author for publication in *The Engineering Journal* by permission of the Department of Agriculture, Ottawa.

double L_T to achieve the same degree of spreading.

The equation resulting from this deductive reasoning is, then,

$$L_T = CFW_1\left(\frac{W_2}{W_1}-1\right)^f$$

where C and f are constants.

Rouse and Bhoota* performed a series of experiments on supercritical spreading which would indicate that $f=\frac{2}{3}$. This was further verified in the PFRA experiments. It must be emphasized that this is purely an empirical value and has no theoretical derivation. The equation proposed by Rouse and Bhoota may be converted by algebraic manipulation to the form

$$L_T = FW_1\left(\frac{W_2}{W_1}-1\right)^{2/3}$$

where arbitrarily the constant C is unity.

This equation defines a curved wall transition, which at any length L_T is of width W_2. The degree of spreading obtained with this arbitrary choice of C is not adequate to get a good hydraulic jump. The depth at the centre line is more than twice as great as the depth at the edge in any cross section. This type of distribution is highly conducive to setting up a flow condition characterized by a central jet with twin side eddies.

The consequent lack of sufficient velocity reduction may lead to failure of the structure. Also, as determined by Rouse and Bhoota, any increase in tailwater, decrease in discharge, or increase in floorslope (drop) in the transition further accentuates the jetting condition. Since all of these conditions will usually obtain in PFRA structures, it is evident that designs based upon the above equation will often be unsatisfactory.

For practical reasons it is highly desirable to keep the structure simple, preferably with straight walls. Despite this, it was proposed to use the same basic approach to the problem of supercritical spreading as heretofore discussed. Hence, if the rate of straight wall flare is designed by R, we may write

$$R = \frac{2L_T}{W_2-W_1} = \frac{2CFW_1\left(\frac{W_2}{W_1}-1\right)^{2/3}}{W_2-W_1} = \frac{KF}{\left(\frac{W_2}{W_1}-1\right)^{1/3}}$$

where the constant K substitutes for $2C$.

The PFRA experiments then resolved into a determination of K for various values of F and $\frac{W_2}{W_1}$.

Experimental Procedure

In order to get results of practical value they should be applicable to a range of different pipe sizes. For convenience in testing, however, only one pipe diameter was used in the experiments. To extend the range of application, the results on this single pipe were related to $\frac{Q}{D_o^{5/2}}$, since, for a given value of this ratio, flow is dynamically similar, irrespective of the absolute value of Do. This is simply the model law.

To keep the tests within bounds it was necessary to impose some limitations. The design developed is applicable to only a circular pipe from 3 ft. to 10 ft. diameter, with the design discharge between 3 and 12 times $D_o^{5/2}$.

i.e. 3 ft. $< D_o <$ 10 ft.

$$3 < \frac{Q}{D_o^{5/2}} < 12$$

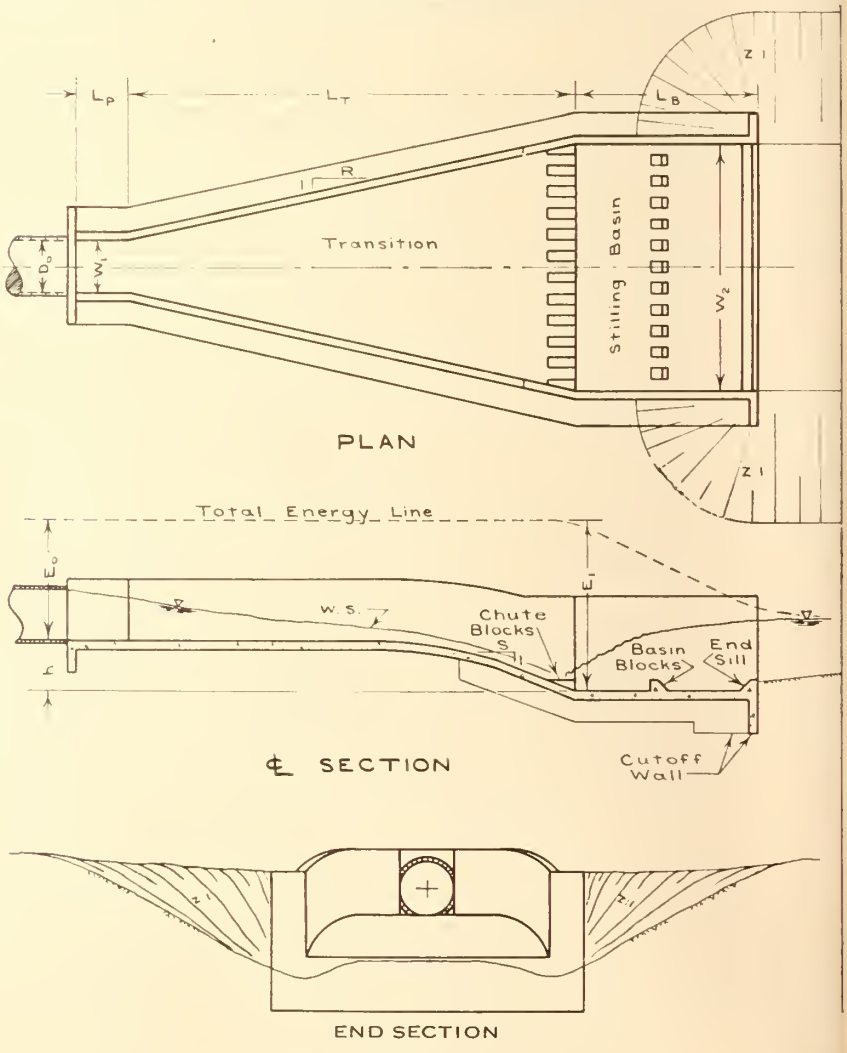
With these limits, discharges from 47 cfs to 3,800 cfs could be simulated.

The limits of 3 and 12 for the ratio of $\frac{Q}{D_o^{5/2}}$ should rarely be en-

Definition of Symbols

d_1,	depth of water jet at start of stilling basin (ft.).
d_2,	sequent depth of flow, after jump (ft.).
D_o,	diameter of outlet (ft.).
E_o,	total energy at outlet (ft.).
E_1,	total energy at start of stilling basin (ft.).
F,	Froude number.
h,	drop in elevation from the conduit invert to the stilling basin floor (ft.).
h_v,	velocity head at start of stilling basin (ft.).
L_P,	length of parallel section (ft.).
L_T,	length of transition (ft.).
L_B,	length of stilling basin (ft.).
q_1,	discharge per ft. of width of basin (c.f.s. ft.).
Q,	design discharge (c.f.s.).
R,	rate of sidewall flare in the transition, expressed as R:1.
S,	floor slope of the transition at the stilling basin, expressed as S:1.
v_1,	velocity of water jet at start of stilling basin (f.p.s.).
W_1,	width of parallel section (ft.).
W_2,	width of stilling basin (ft.).
K, C, and f = constants.	

Fig. 1. Diagram of outlet, transition and stilling basin, with symbols used in the mathematical discussion.



*Supercritical Expansions, Proc. ASCE, 1949.

countered in practice. The lower limit would represent an uneconomical use of pipe, while at the upper limit velocities are higher than those normally desired. To date all PFRA designs fall well within this range, the average being about 8.

Theoretically there should be no need to put a limitation on the size of pipe onee the basic mechanism of spreading in the transition is established. Nonetheless, it was thought advisable to restrict application of the results to within the tested range, which would correspond to an upper limit of 10 ft. diameter. In any case, special model tests are probably warranted for pipe sizes in excess of 10 ft., being for rare and important struetures. The criteria developed here would still be valuable for preliminary design.

It is evident from the equation

$$R = \frac{KF}{\left(\frac{W_2}{W_1} - 1\right)^{1/3}}$$

that for comparable performanee, R should be changed for every change in F. This obviously cannot be done in praetice, since a structure will be built with one R, even though a range of F values will occur. The design is therefore necessarily a compromise, the R selected being the one which will give the best all round performance over the whole range of possible conditions. These include:

(1) Excess tailwater.
(2) Reduced flows (below design flow).
(3) Overload flow.
(4) Gated operation.

A total of 170 tests were run with various values of R, Q, W_2, and h. The effect of gating and variations in tailwater were observed. Depth and velocity traverses were made on the transition flow, and the form and efficiency of the hydraulie jump were observed. The conduit used for all tests was a level 4-inch Lucite cylinder. The transition and stilling basin were modelled with enamelled veneer to facilitate quick modifications in the test set up.

Experimental Results and Discussion

(1) *Parallel Section:* After the first series of tests had been run, it was evident that it was undesirable to have the straight wall flare begin immediately at the end of the circular pipe. Invariably flow separation occurred at the walls at the start of the transition. This resulted in the formation of a high local shock wave on the wall further along in the transition.

It was found that this could be eliminated by the use of a short parallel section between the pipe and the start of the transition. (Figures 6, 7 and 8.) In this parallel section the cavities which normally exist under the jet (when in its circular form) are allowed to fill, and at the start of the transition the jet is essentially rectangular and two dimensional

It can be shown that, with the pipe flowing full, the required length of parallel section Lp must vary direetly as $\frac{Q}{D_o^{3/2}}$

Subsequent testing showed that for equivalent results

$$L_p = 0.1 \frac{Q}{D_o^{3/2}}$$

All subsequent tests were run with this parallel section included. On Fig. 2, a curve of the relationship between $\frac{L_p}{D_o}$ and $\frac{Q^{5/2}}{D_o}$ is given for purposes of design.

(2) *Energy of Flow:* The energy E_o available at the end of the pipe was assumed to be critical energy. This was computed for various flows and eorroborated experimentally. The determination of E_o is neeessary to eompute the elements of the hydraulic jump in the basin. Also, when computing the rating eurve for the conduit, it is convenient to have the energy level E_o at the conduit exit. The relationship $\frac{E_o}{D_o}$ to $\frac{Q}{D_o^{5/2}}$ is therefore given on Fig. 2.

(3) *Transition:* The Froude No. F at the end of the parallel section, of start of the transition, was calculated from the known values of E_o, Q, and W_1. (In all cases $W_1 = D_o$).

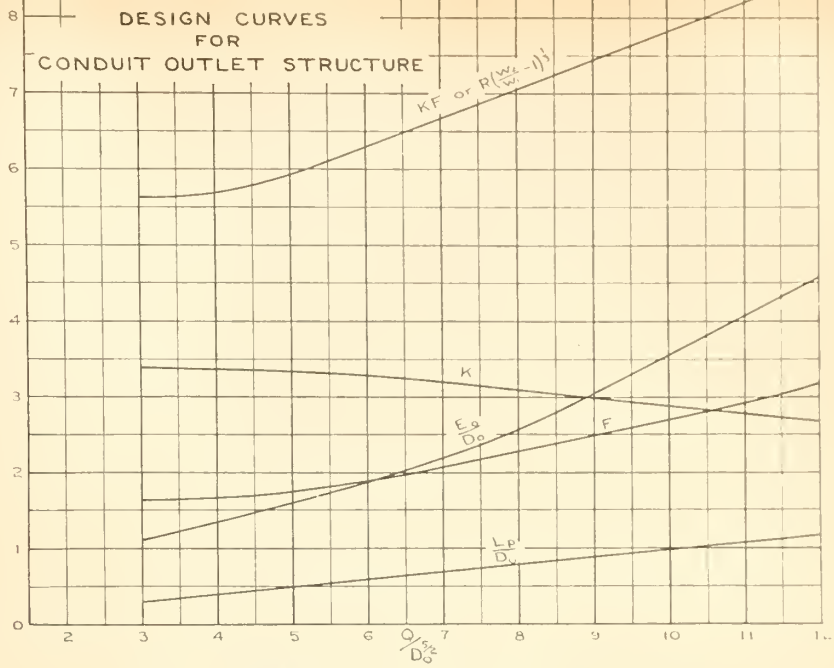


Fig. 2. Design curves for conduit outlet structure.

Since the flow was still somewhat rounded and not precisely two-dimensional at the start of the transition, it was not possible to check these computed values of F experimentally. This check was not essential to the design. F is only a convenient combination of the values E_o, Q, and W_1, which were reliably determined.

A plot of the relationship F to $\frac{Q}{D_o^{5/2}}$ is also given on Fig. 2. The small variation in F (1.65 to 3.20) as compared to the variation in $\frac{Q}{D_o^{5/2}}$ (3 to 12) is fortunate, since the design functions best for a particular F value, and will perform satisfaetorily only within a limited range of that value. The levelling out of the F value at the lower end of the $\frac{Q}{D_o^{5/2}}$ range occurs as the pipe no longer flows full.

The mechanism of spreading in a relatively rapid flaring straight wall transition is unique. The main body of the jet from the parallel section cannot follow the abrupt change in alignment at the start of the transition. The jet fans out in the transition with a delayed but steadily increasing lateral velocity. Eventually the spreading jet "catches up" with the flaring walls and a positive shock wave forms.

This positive wave traverses the transition flow from the wall to the centre line, the deeper flow being between the wave and the wall. Therefore, with the straight wall flare, we have the case of the depth at the walls being greater than the depth at the centre. It is as though spreading (insofar as depth distribu-

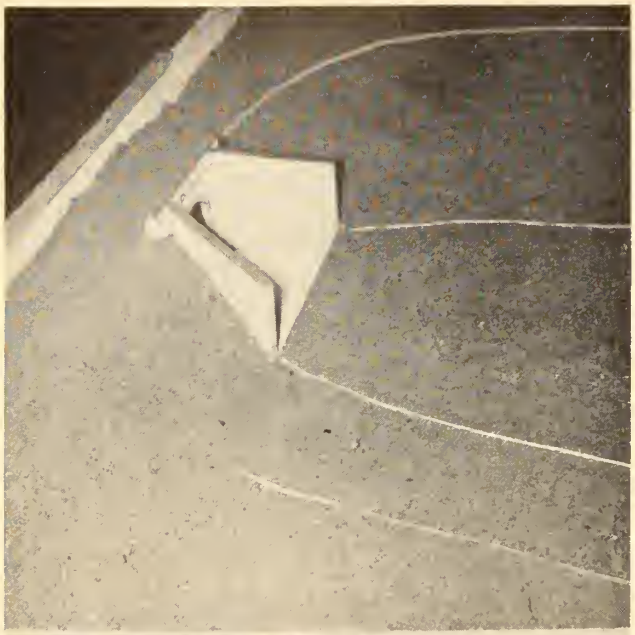


Fig. 3. A typical commonly used type of culvert outlet structure.

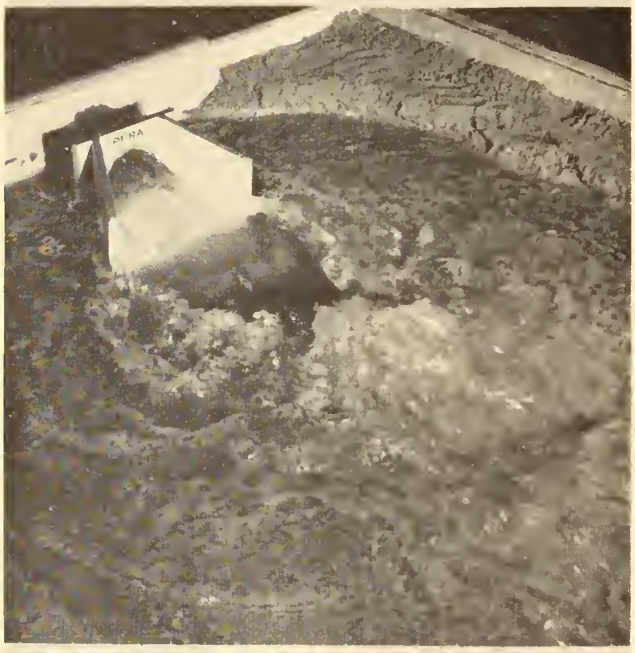


Fig. 4. Jetting action resulting from a simulated flow of 660 c.f.s.

Fig. 5. Severe channel erosion and undermining of the structure.

tion is concerned) was from the wall inward instead of from the centre line outward.

Further, we have the paradoxical situation that the flow will get even deeper at the walls for either an increase in F (R constant), or for an increase in rate of flare (corresponding to a reduced value of R). This is just the opposite to the case of the curved wall transition previously cited.

A natural question is: "How can the expression $L_T = CFW\left(\frac{W_2}{W_1} - 1\right)^f$ be applied to the case of a straight wall flare when the expression itself defines a curve ?" The explanation lies in the fact that at the start of transition where the body of the flow has not yet spread to the walls, the jet is completely unrestrained.

In this unrestrained state, spreading occurs strictly in accordance with the above expression. Although a unique surface pattern subsequently develops in the transition due to the straight walls, this pattern is still wholly dependent upon the mode of spreading at the start of the transition.

It was thought possible, however, that f may have a different value for a straight wall flare, so in the PFRA experiments a series of designs were tested with $f = \frac{1}{2}$ and $f = 1$, as well as $f = \frac{2}{3}$. Consistency of results could only be obtained with the latter value, which more or less corroborated the result of Rouse and Bhoota, and verified the application of the above expression to the straight wall flare.

The K value in $R = \dfrac{KF}{\left(\frac{W_2}{W_1} - 1\right)^{\frac{1}{3}}}$ should theoretically be constant for equivalent spreading. However equivalent spreading does not necessarily give equivalent downstream velocity distribution. This is due to the fact that the flaring straight walls in the transition go abruptly to parallel sides at the start of the basin. This positive change in direction results in some "pile-up" of the spreading flow at the outside walls of the stilling basin, the "pile-up" naturally being greater for sharper wall angles.

The hydraulic jump and downstream distribution of velocity is affected by both the degree of spreading and the "pile-up" effect. Under these circumstances, if the same equation is used, the K value for equivalent end results (after jump) could be expected to vary. In fact, the test results proved conclusively that K does vary, and vary in such a way as to partially com-

pensate for the sharper wall angles. Hence, with a smaller $\frac{Q}{D_o^{5/2}}$ (giving more rapid flare) we obtain a larger K value (less rapid flare). K versus $\frac{Q}{D_o^{5/2}}$ is given on Fig. 2. Note that where F levels off, K also levels off. This is compatible with the principle involved.

The required rate of flare R depends upon the KF produet. In Fig. 2 the relationship between this KF product and $\frac{Q}{D_o^{5/2}}$ is given. It is therefore unnecessary to use the values for K and F separately when determining R.

Although the tests were made with a level pipe, the flow in the transition will be the same even though the pipe be laid on a slope, provided the slope is sub-critical. The sub-critieal slope is required to ensure eritieal flow at the outlet, a eondition upon whieh the design is based. A steep pipe may flow only partly full and discharge the flow at a very high Froude No., in whieh ease the design as formulated would not be applicable.

(4) *Stilling Basin:* The length of the stilling basin L_B is related to the jump height by $L_B = 3d_2$. The width of the stilling basin, W_2, can be made approximately equal to $1.1Q^{1/2}$. The design developed for spreading will be satisfaetory for any width, but sinee greater widths require longer transitions, it would be considerably more expensive to widen the strueture. The model tests indieated that $W_2 = 1.1Q^{1/2}$ would give satisfactory results.

The theoretical hydraulie jump sequent depth d_2 was computed assuming the total energy level was at the same elevation at the start of the basin as it was at the end of the pipe. The measured jump heights were consistently less than this, obviously due to the energy loss in the transition. The jump heights averaged 5 per cent less than the computed no-loss height on the model, and this differenee could even be less on the prototype. For purposes of design it was deeided to negleet this small energy loss, thereby incorporating a safety factor into the stilling basin.

Chute bloeks, basin blocks, and an end sill were made standard equipment on the stilling basin. Bloeks are particularly desirable in this type of design, where flow eonditions at the start of the jump are not completely uniform. The blocks are great equalizers, beeause the

Fig. 6. A new design with a straight wall transition and stilling basin.

Fig. 7. Hydraulic jump in the basin of the new design (660 c.f.s.).

Fig. 8. Bed scour is minor and very local.

most force is exerted where the most force is needed. Testing indicated that with blocks, the jump would remain in the basin even with the tailwater set at 80 per cent of the theoretical no-loss d_2. This could be a valuable safeguard in the event of retrogression of downstream levels.

(5) *Floor Slope Approaching the Stilling Basin:* Early in the testing program it was established that in order to stabilize the hydraulic jump, it was necessary to have a definite slope on the floor of the transition at the entrance to the stilling basin. Excessive tailwater will be the rule rather than the exception, even at design flow. This means that the toe of the jump will be pushed back into the divergence. If the floor is flat, the jump rapidly degenerates into a central jet with side eddies.

The eddies circulate deep into the transition. This condition will persist even with very gradual wall flares of 8 to one. However, the use of a relatively steep slope restricts the area for possible eddy formation and a stabilized jump will readily form, even in the divergence.

A floor slope flatter than 4:1 should not be used. Steeper slopes are entirely satisfactory, although for practical reasons it is unlikely that 2:1 will be exceeded. A slope of 3:1 is a good compromise and should be used when suitable.

The jet should be fully supported throughout the transition, in order to assist spreading and preclude the possibility of separation from the floor. It is therefore necessary to use a curve in the floor at the change in slope. This curve can be a two-thirds gravity curve, or, if preferred, a simple curve which will reasonably fit the two-thirds gravity curve.

(6) *Drop in Floor Elevation:* The stilling basin floor must be set to meet existing tailwater conditions whereas the pipe invert elevation may be an arbitrary choice. It is therefore possible to have various heights of drop. The tested range for this drop h (pipe invert to stilling basin floor) was $0 < h < 3D_o$.

It is desirable in the design to take up this total drop with the floor slope entering the stilling basin (section 5). This is structurally desirable to keep transition wall heights to a minimum; hydraulically desirable to permit initial spreading to develop unhindered by a drop. The question here naturally arises: "How can the designer slope the floor into the basin if $h = 0$?"

As pointed out, the jump must occur on a slope in order to be stable. Further, the height of the slope must be sufficient so that the jump can occur on it for any tailwater stage or discharge. This establishes a definite minimum height of slope irrespective of the available drop. If h is inadequate to give a sufficient height of slope for jump stabilization, then the transition floor must slope upward from the invert to an elevation which will provide an adequate height of slope. With such a design, the transition floor has the shape of a raised hump between the conduit and stilling basin.

The raised hump design will be necessary in cases where the conduit is intentionally set low to get maximum capacity. In the majority of cases this low setting will not be essential, and h can be made large enough for adequate slope height.

The minimum slope height should be set so that, at the top of the slope, the back pressure of the tailwater above this elevation is less than 50 per cent of the forward momentum of the jet. This is not a difficult condition to satisfy and will insure against an unstable jump.

Trial and Error

The elevation setting of the stilling basin floor depends upon the jump height and existing tailwater conditions. Since the jump height computation depends upon h, which is not immediately known, the process is one of trial and error. However, one trial is usually sufficient to determine the correct elevation setting.

(7) *Compound Wall Flares:* As the higher drops were tested, it was noted that central jetting with side eddying commenced at a higher proportion of the design flow. This is a natural consequence of the fact that a plane surface is used for the floor slope to the basin with the steepest line parallel to the centre line. The smaller flows are greatly influenced by this slope and tend to follow the steepest line, irrespective of the wall alignment. With h approximately $3D_o$ jetting occurred in some cases for flows up to 40 per cent of design flow, whereas with $h = 1D_o$ jetting was usually confined to flows less than 20 per cent of design.

Several tests were run with a compound flare — actually two straight flares, with the reduced or more gradual flare at the entrance to the basin. This change in flare tends to build up the depth at the walls and for low flows compensates for the drop in elevation. It was possible to keep eddying below 20 per cent with this method. However, conditions at design flow were undesirable, as there was too much build up and considerable excess flow along the stilling basin walls.

Indications were that eddying even at 40 per cent was quite tolerable and far more preferable than the adverse condition resulting at design flow. It is reasonable that as the discharges decrease to substantially less than the stilling basin capacity, flow conditions less than ideal can be accepted without any increase in erosion potential. This was also borne out with an erodible bed model.

At the design flow, conditions with the single straight flare were practically identical, irrespective of the height of drop. Consequently the same design procedure can be used to determine R independent of h, provided the drop is within the tested limits $0 < h < 3D_o$.

The straight wall flare would appear to have a distinct advantage over the curved wall flare, particularly for the case of considerable drop. The drop accentuates jetting in the latter, since the walls of the transition continually recede from the direction of flow. This has the effect of concentrating even more of the flow in the centre of the diverging transition.

In the case of the straight wall flare, the inertia of the flow in the direction of the transition walls gives adequate spreading in spite of the drop (at least up to $3D_o$). It is desirable, however, to permit the basic spreading pattern to develop before the flow is dropped below the invert elevation. This is the principal reason for concentrating the entire drop at the slope into the basin at the end of the transition.

(8) *Gated Operation:* Gated operation will be a frequent condition. Design capacity is assumed to be the discharge occurring with the gate wide open and the reservoir at FSL. However, if it is desired to pass a reduced flow with the reservoir still at FSL, the gate must be partially closed. This may result in the conduit flowing partly full (as the jet sluices under the gate), so that the discharge at the end of the pipe is not critical, but supercritical.

The Froude No. at the end of the parallel section is much greater with the gated operation. For a typical case with $\frac{Q}{D_o^{5/2}} = 9$, at design flow $F = 2.5$; at half capacity (gate open wide) $F = 1.7$; at half capacity (reservoir gated to FSL) $F = 4.2$. Happily, this increase in Froude No. for gated reduced flows does not result in central jetting.

As previously discussed, depths in the transition with the higher F will be even deeper at the walls than in the centre. This opposes the natural tendency of the smaller flows to concentrate in the centre. Consequently a good hydraulic jump will form at half capacity, with or without gated operation, although the downstream velocity distribution will obviously be different for the two cases. Gated operation, which will be frequent, actually results in the formation of a hydraulic jump for flows which, without gating, would often result in jetting.

(9) *Overload Flow:* All designs were tested up to 125 per cent of design capacity. Although bed scour was naturally more pronounced, the condition was highly acceptable for what must be considered an emergency flow. The safety of the structure is assured.

(10) *Miscellaneous:* It should be emphasized that the designer should not shorten the transition (smaller R) in the hope of making an additional saving. The flows most affected by this shortening would be the design and overload flows. These large flows deserve the most attention and require the most efficient energy dissipation. The downstream velocity distribution is quite sensitive to change in the rate of flare. A smaller R means an increase in the angle at both the beginning and end of the transition, which, as previously discussed, results in excess flow down the walls of the transition and stilling basin.

If it is known that a particular structure will be operated infrequently, and rarely, if ever, at design flow, then there may be some justification for making the whole design for, say, 80 per cent of the design flow.

Design Procedure

The design procedure is a straightforward application of the information given in Fig. 2, supplemented by basic hydraulic computations. The quantities which must be known in advance are Q and D_o, and the rating curve for the discharge channel. The drop h may be quickly estimated by assuming a reasonable value for d_2 and placing the basin floor at this depth below the tailwater elevation (at the corresponding flow).

The design procedure will then be as follows:

(1) Check limitations

$$3 < \frac{Q}{D_o^{5/2}} < 12$$

$$3 \text{ ft.} < D_o < 12 \text{ ft.}$$

$$0 < h < 3D_o$$

Slope of pipe < critical slope at 40 per cent of design discharge.

(2) Width at start of transition

$$W_1 = D_o$$

(3) Width of basin

$$W_2 = 1.1 Q^{1/2}$$

This may be rounded off to the nearest foot.

(4) Length of parallel section

L_p from Fig. 2

(5) Length of transition

Obtain R from Fig. 2. Then,

$$L_T = R\left(\frac{W_2 - W_1}{2}\right)$$

(6) Length of stilling basin

Obtain E_o from Fig. 2, thence

$$E_1 = E_o + h = \frac{v_1^2}{2g} + d_1$$

$$q_1 = \frac{Q}{W_2} = v_1 d_1$$

These two equations must be solved for v_1 and d_1, thence, height of jump

$$d_2 = \frac{-d_1}{2} + \left(\frac{2d_1 v_1^2}{g}\right)^{1/2}$$

This value of d_2 must be checked against the assumed value, and if necessary step (6) must be repeated using a corrected h. Thence,

$$L_B = 3d_2$$

(7) Basin details

Chute blocks—height d_1 or $\frac{d_2}{9}$, whichever is larger;
width and spacing are equal
maximum = height
minimum = ¾ of height

Basin blocks—height $\frac{d_2}{8}$
width and spacing same as chute blocks. A basin block should not be located at the wall. Basin blocks must be staggered with the chute blocks.

End sill—height $\frac{d_2}{8}$

(8) Slope details.

The slope to the basin must be within the limits $1 < S < 4$, with $S = 3$ preferred.

The connecting floor curve to the slope should roughly fit a ⅔ gravity curve, i.e. $x = v\left(\frac{3y}{g}\right)^{1/2}$

The height of slope should be checked for adequacy. The jet momentum $q\rho v$ at the top of the slope must equal or exceed twice the back pressure $\frac{\gamma d^2}{2}$ (d measured from the top of the slope to the tailwater surface, ρ and γ are the density and specific weight of water).

Colour Television

by R. G. Anthes

Continued from page 1053

$E_B - E_Y$ into the G-Y amplifier accomplishes this. The $E_B - E_Y$ input to the G-Y amplifier is adjustable. The G-Y amplifier acts as a phase inverter.

Once $E_R - E_Y$, $E_B - E_Y$, and $E_G - E_Y$ have been obtained it is a simple matter to get E_R, and E_B and E_G by adding E_Y to each of these in turn. E_Y is obtained from the contrast control to the line driver video amplifier. Since the chroma amplifier is narrower band than the luminance circuits it takes longer for the chroma signals to get through these circuits than it does for the luminance signals to get through their circuits to the picture tube. The delay line is used to slow down the luminance signals to arrive at the picture tube coincident with the chrominance.

At the input to the green, red and the blue video amplifiers are located simple matrix circuits, which add the correct amounts of the Y signal to $E_G - E_Y$, $E_R - E_Y$ and $E_B - E_Y$ respectively, in order to extract E_G, E_R and E_B at the input to the respective video amplifiers.

In Figure 7, E_I and E_Q are shown. Experiments with the eye have shown that it is more sensitive to detail for colours lying along the so called I axis, through E_I, than along an axis roughly 90° from this called the Q axis, through E_Q. Consequently the colour standards have been set up to partially transmit chrominance information up to about 1.5 Mc. per second along the I axis and up to 500 kc. per second along the Q.

In order to obtain the ultimate in colour TV reproduction, the receiver may use I and Q demodulators rather than R-Y and B-Y demodulators with the I bandwidth increased accordingly. When I and Q demodulators are used, the matrixing at the receiver must be different from that used for the equal band R-Y, B-Y operation. The trend in industry appears to be to use equal bandwidth R-Y, and B-Y, as it is generally felt that the increased cost for I-Q operation does not justify the slight improvement in colour rendition.

Below 500 kc. s., I-Q and R-Y, B-Y operation are equivalent.

Can Present Mechanical Engineering Curricula Be Improved?

by

E. A. Allcut, M.E.I.C.

Professor and Head of the Department of Mechanical Engineering, University of Toronto.

"Can mechanical engineering curricula be improved?" Of course they can — nothing is perfect, not even mechanical engineering curricula! The real question is, "Can mechanical engineering curricula be improved within the limitations of time, space, staff and money that exist in all educational institutions?" These limitations vary considerably in different places and, therefore, the answers will vary correspondingly. Consider, for example, the sizes of classes. We all know that it is advisable to reduce, as far as possible, the number of students in any one class, but the possibility of doing this depends on the number of staff members available for teaching certain aspects of engineering and on their individual loads. The invariable tendency is to overload the best teachers and this, in turn, tends to increase the sizes of their classes.

Elements of Leadership

For these reasons, I shall discuss the question only in its broadest aspects, as details will depend on local circumstances. I propose to start with the premise that our main objective is to train leaders in industry, business and the community. This involves the development of the following personal characteristics:—

1. The ability to discover the proper bases for action and to select the best of them where more than one or two are available.
2. The ability to determine, by logical reasoning, the best course of action, once the basis has been selected.
3. Analytical skill to resolve the project into suitable component parts, which can be developed separately by individuals or teams.
4. Synthetic skill to put those components together in such a way that the resulting scheme will be useful and economical.

These requirements imply the use of three different types of mental process, namely:—

(a) Imagination and/or artistic sense, because any project must originate as a mental image or rough sketch.

(b) Logic which, in the engineering profession, usually takes the form of mathematical processes.

(c) Common sense, based on experience because, however logical the reasoning may be, the result has to be made or devised at a profit or, at least, without loss.

The Role of Mathematics

It will be noted that mathematics is involved in only one of the mental processes listed here and that it is not invariably the most important of them. The question then arises "Is mathematical ability overstressed as a prerequisite for engineering training and as a course requirement, and does insistence on this cause an undesirable and unnecessary wastage of potentially good human material?" For some years past, there has been a shortage of trained engineers, particularly on the American continent, as is indicated by the following extract from "Newsletter", dated August 3, 1954.

> Realization of the rapid advances in Soviet science and technology, and of the phenomenal growth of Russia's manpower pool of engineers, scientists, and technicians, in contrast with the shrinkage of our professional output, was an important factor in prompting Presidential action. The committee will learn—if it does not already know—that the tide of diminishing student enrollments has turned in certain fields, although the number of graduates has continued to decline, reaching its low of 19,000 in engineering this year. . . . And in no field is the improvement enough to take care of cumulative deficiencies.

This is typical of many recent articles on the subject and is quoted only because it is the most recent of them. It is well known that we refuse admission to many candidates and that, in general, about 50 per cent of those who do enter engineering courses do not graduate. How far is mathematics or mathematical ability responsible for this situation? Here is the

This talk, of immediate interest to all engineers and technical educationalists, was delivered by Prof. Allcut as part of a panel discussion, at the A.S.M.E.-E.I.C. Invitation Convocation held at Clarkson College of Technology in Potsdam, N.Y., last October.

The *Journal* did not wish to publish this text before the appearance of the transactions of the convocation. The way has now been cleared in this respect. Readers will be pleased to hear that if present plans proceed, a similar return convocation will be held somewhere in Eastern Canada during next year, 1956.

opinion of Dr. D. S. Anderson, director of the Royal Technical College, Glasgow, as given in a paper read before the Institution of Mechanical Engineers, on December 2, 1949:—

> Are there any points in the content of courses needing revision? For example, is too high a standard of mathematics attempted in our engineering courses? Nearly every university and technical college seems to find that the chief subject of failure in applied-science courses is mathematics. Would it be better to have a lower compulsory standard, with a higher stage available as an optional subject? There is always the possibility, too, of additional mathematics being taken in a post-graduate course. There are many posts in engineering industry for which a general course of first-degree content is needed, but for which the mathematical requirements are not particularly high.

I admit freely that mathematics is very useful as a mental discipline, but many of our graduates, after leaving university, never use their mathematics beyond that of the freshman year. I am well aware that this statement will be criticized severely, but it embodies my own experience and that opinion is shared by many others. I have a strong suspicion that insistence on the paramount importance of mathematics and the "basic fundamentals" (whatever they may be!) has its origin in the large organizations which employ a minority of our graduates, but have their own training courses and can employ to the best advantage men trained along these lines. This situation has led to a widespread belief that the highly mathematical courses are somehow superior to the others and to a rather pharisaical attitude on the part of both staff and students. I hold that the mathematical mind is not better—it is just different. Stephen Leacock's "Too much college" contains some pertinent remarks in this connection, of which the following is a sample:—

> Or pass from arithmetic to algebra: you can't shoulder your way past quadratic equations or ripple through the binomial theorem. Indeed, the other way: your feet are impeded in the tangled growth, your pace slackens, you sink and fall somewhere near the binomial theorem with the calculus in sight on the horizon. So died, for each of us, still bravely fighting, our mathematical training; except only for a set of people called "mathematicians" — born so, like crooks. Yet would we leave mathematics out? No, we hold our cross. . . . . .
>
> I only refer to these mysteries in order to explain why I still have to speak of mathematics in a reverential whisper, like a Christian entering a Mohammedan mosque, in wicker slippers. He knows it's a reverend place though he doesn't understand it.

This is, of course, a caricature, but it contains a good deal of truth.

Finding The Creative Mind

The proponents of the highly mathematical courses generally fail to realize that engineering is an art as well as a science and that the two are blended together in different proportions in different circumstances. It has been held that the art should not receive much attention, because it is changing. This argument would eliminate from education such changing things as history, sociology, economics, and even many aspects of science itself — for science changes, too! Also, it has been stated that a training in mathematics helps to produce that creative type of mind that is so necessary in engineering. But there are different kinds of creative minds. Were Beethoven, Mozart, Rembrandt, Benvenuto de Cellini or the great writers not creative, and were they trained or even skilled in mathematics?

Sir David Pye, of Cambridge and London Universities, made the following remarks on this matter in his presidential address to the Institution of Mechanical Engineers, in October, 1952.

> Can it be said that the creative mind is typical of the university graduate in engineering today? If it is not, can this deficiency be laid to the charge of the courses provided, and are there any practicable modifications by which the position can be improved? To my mind questions should first be asked about the methods whereby selection is made of those young men who are to be allowed to embark upon honours degree courses. I would suggest that this selection is in danger of being left too much in the hands of the mathematicians. Some chemistry and physics may form part of the qualifying examination; but it is a candidate's ability in tackling the mathematics that is often crucial. Mathematical tests are ideal from the examiner's point of view: easy to set and easy to mark; producing a definite order of merit, easily translated into first-, second-, and third-class honours. But indicative of what? Not, certainly, of the seeds of a creative or instinctive engineer.
>
> The mathematical test contains no element whatever of the positive approach to engineering education that would from first to last place some emphasis upon the ultimate aim of the engineer; which is to devise and construct. Do not imagine I am belittling the importance of mathematics as the basis of an engineering education or, at its higher levels, as equipment that may be essential for some research engineers. All I am suggesting at present is that to rely upon competence in mathematics for the selection of young men to be admitted to an honours course in engineering is to risk the exclusion of quite a number who might have developed into the finest engineers. There are those who do not take kindly to the mathematical approach, and they should not be thrown out at the first hurdle. Under present-day arrangements, and with the mathematical standards now expected, it is largely true to say that the mathematicians decide who shall be our future university-trained engineers. And this is the more dangerous if it is true, as several men have assured me they believe, that a moderately clever and hard-working boy in the hands of an able teacher can be coached in mathematics to show a form in an examination that is quite unreal as an indication of his general intelligence. . . . . .

If the mathematicians are allowed to get the bit in their teeth and go galloping off with half of their unfortunate students trailing behind, unable to keep up, then the only benefit those students will ever get from their higher mathematics will be a few odd marks at their final examination, at the price of many wasted and painful hours that might have been much better spent.

Two Engineering Courses

I suggest that the situation may reasonably call for two different kinds of course, each of which should be of equal importance to the other. The first would be highly mathematical and would be suitable for perhaps 25 to 30 per cent of the students in the engineering course. This would meet the requirements of the large industries and organizations. The second would be of a broader and more imaginative type, containing more of the liberal arts and humanities than it is possible to accommodate in the present engineering courses. In this second course mathematics would be a minor instead of a major tool and would thus be transformed from a bad master into a good servant.

Some people have claimed that the engineering course is too short and should be extended from four to five years. My remarks on this subject relate only to the situation in Ontario, where the student has already had five years in high school and eight in public school. I will again quote Stephen Leacock in this connection:—

> In the above paragraphs I have formulated the plain man's accusations against the continued lengthening of education; or, rather, I must not say his accusation. The poor fellow hasn't the spirit to accuse. It is not an accusation that he formulates or a grievance that he voices. It is just a burden that he carries.

It is my firm opinion, based on over thirty years' experience, that the present four year course is quite long enough for most of the students who are going into industry and that no useful purpose would be served by adding another year. There are, however, a number of students (say about 20 per cent of the whole) who could benefit by a fifth year and should have it. For them, an extension of the scholarship or bursary system and a year or two of post-graduate work is clearly indicated.

I shall only refer to English in passing, as I do not regard it as an integral part of the engineering educational scheme. We all realize the paramount importance of facility in using the written and spoken language, but we include it in our curricula only because the schools are failing us in this regard. It is, in my opinion, a sort of "patching up" process.

I am well aware that in expressing these views I am "sticking my neck out" but, as the turtle said to his mate, "if you don't stick your neck out, you don't get anywhere!" I believe that the sacrifice of good potential engineering material on the altar of mathematics is unnecessary and almost criminal and is caused by a wrong conception of many aspects of industrial work in which engineers are employed.

Of course, if we really wanted to go to the limit in improving our curricula, we could invoke the sacred cow "democracy", which is always a good rabble-rouser. Essentially, this consists of solving our problems by counting heads—no matter what is inside them! As applied to our educational system it might work out something like this:—

Applied Democracy

Our institute is run on strictly
democratic lines,
No longer need we rack our brains
with integrals and sines,
And geometric problems are no
longer learned by rote,
For we sit in solemn session and
we put 'em to the vote.

The differential calculus don't
bother us, because
A statute that we passed abolished
mathematic laws;
We've found a way to circumvent
our algebraic woes,
As we settle all the doubtful points
by counting "ayes" and "noes".

There's not a trace of discontent
in this our model school,
For all the academic looks are
picked by this new tool;
And work is now the only thing of
which there is a dearth,
While our parliament of learning
solves the problems of the earth.

Appendix

The following excerpts from the life of Sir Charles Parsons may be of interest in this connection.

Excerpt from "Some Personal Reminiscences of Sir Charles Parsons" by Lord Rayleigh.[1]

"It was, in fact, very curious how little use he ever seemed to make of the formal mathematical training he had had at Cambridge. He had been 11th Wrangler in the Mathematical Tripos, and must be credited with having had at one time a thorough mathematical knowledge and facility in using it. At the time I knew him, however, he never allowed this to appear. I do not think that I ever saw him use any mathematical method more complex than the rule of three. If he was invited to listen to anything a little less simple, he always turned it off by saying that his mathematics were rusty. "That is analytical," he would say, "I like something geometrical. I never was very good at analysis and now I have forgotten what I once knew." It was difficult to feel sure how far this could be taken literally, but it is certain that he had no liking for symbolical methods of expression, and seldom, if ever, used them in his published papers. . . . . .

Later on in his life, he would simply hand a numerical problem to his staff to be dealt with. He took no interest in the mathematical reasoning used by them; he only wanted the result. . . . . ."

Excerpt from "Sir Charles Parsons 1854-1931."[2]

"At seventeen Parsons was sent to read mathematics at Trinity College, Dublin, where his father had been Chancellor, and a year later went to St. John's College, Cambridge. In 1877 he passed out as Eleventh Wrangler. It is interesting to note, however, that in his engineering career formal calculation interested him little, and he generally reached his results almost instinctively, by some obscure mental processes which even he himself did not properly understand."

[1] Memoir in "Scientific Papers and Addresses of The Hon. Sir Charles A. Parsons", London, Cambridge University Press, 1934.

[2] *ENDEAVOUR*, October 1954, published by Imperial Chemical Industries Limited.

DISCUSSION of Technical Papers

Fatigue Life of Steel I-Beams at Normal and Sub-Zero Temperatures

by

J. Dubuc, Jr. E.I.C., Associate Professor, Dr. T. A. Monti, M.E.I.C., Consultant, Dr. George Welter, Professor of Applied Mechanics, Ecole Polytechnique, Montreal.

The Engineering Journal, May 1955, page 607.

Gordon Cape, M.E.I.C.[1]

The testing of full size beam sections by fatigue while under the influenee of sub-zero temperatures is a program whieh demonstrates the perseverance and ingenuity of the authors in the exeellent equipment which they devised for tests whieh have not been previously made. They are to be individually and jointly eongratulated for furthering knowledge along lines in whieh very little previous data was available.

It is known that the fatigue strength of steel and any of its other meehanical properties eannot be preeisely correlated, although yield strength, tensile strength and some type of duetility, all have some effect on fatigue strength. Also, it is known that size of specimens being tested shows little differenee in fatigue strength of material over ¾ in., but not exeeeding 2 in. thiek. Again, tests made on rolled, welded and riveted beams at the Research Institute of Dortmund, Germany, show that changes from beams 8 in. deep by 5 feet long to 16 in. deep by 36 feet long produced "a fatigue strength of large girders slightly lower than small girders".

Sueh tests, however, have been room temperature tests. The authors of this paper have earried their research into the sub-zero temperature ranges.

Prior work at low temperatures has been eondueted on small specimens only. These have shown that the fatigue strength inereases as temperature decreases. It eould only be presumed that larger speeimens would behave similarly. The authors' paper shows that this is the case. It provides assurance to designers that fatigue at low temperatures earries a higher faetor of safety than at room temperature.

The paper contains a statement that the riveted beams were 13 per cent stronger under static loading than the welded or rolled beams. A caleulation of inertia of the three beams is shown in Table I.

From this table, the three beams are approximately similar in net section inertia. In this ease, it is assumed that slots exist for the full length of the riveted beam, instead of holes at intervals. It can be presumed that the 13 per cent inerease in static strength is due to the 17 per cent in gross inertia. This is in agreement with current design codes which permit 15 per eent reduction of tensile flange area in riveted beams without decrease in statie load carrying ability. It is of course expeeted that flexural tests would show a reduced strength of riveted beams compared to welded or rolled beams.

One result shown in the fatigue tests of fabricated beams vs. rolled beams is that the "welded beams of both killed and rimmed steel are seen to have at +70°F. a mueh greater life than rolled beams".

This finding is at variance with room temperature fatigue tests of rolled and welded beams at Dortmund, Germany, and at the University of Illinois. In Dortmund, the endurance limit from zero to maximum bending stress, was as follows:-

Rolled beams 29 kg. mm.²
Welded beams 17 " "
Riveted beams 16 " "

At the University of Illinois, for complete reversal of bending stresses, the following values of fatigue strength at 2,000,000 cycles were found:-

Rolled 26.6 to 32.7 kips in².
Welded 16.6 to 17.2 " "
Riveted 15.8 " "

Possibly the authors may have some explanation for the variance in results. Electrodes used in welding the beams in the above tests were possibly inferior to the low-hydrogen E-7016 electrodes used in making the authors' test beams.

Flexural tests, however, are only one side of the story in determining the ability of beams to withstand fatigue at low temperatures. The other tests made by the authors, the Charpy keyhole impact tests, are of very great significance. There are, however, so many variables in impact testing that the results of the tests made in the paper must be reviewed with some caution.

Since the material from which the tests were made was ⅜ in. and ¼ in. thick, and since a standard Charpy specimen is 0.394 in. in cross section, it is obvious that the impact specimens made in the paper were sub-standard size, presumably one-half of the standard width or 0.197 in. The width of an impact specimen has a decided influence on biaxiality of stress at the root of the notch. For instance, a steel notched impact test may display notch toughness in a standard width specimen and brittle fracture at double standard width—and actually fracture at a lower energy value. Conversely, specimens of half width, may readily produce transition tempera-

[1]Welding and Research Engineer, Dominion Bridge Company Limited, Lachine, Quebec.

Table I

One welded	= 104.8 in 4	= 100	pereent
One rolled	= 106.3 in 4	= 101	percent
One riveted	= 122.3 in 4	= 117	percent with no rivet holes deducted
	= 109.7 in 4	= 105	per cent with no rivet holes deducted

tures which are lower than standard width. Quarter-width specimens will produce still lower values. Consequently, the impact tests which were made, do not necessarily show a proper transition temperature. The transition temperatures found, seem to be too low for a typical rimmed steel.

The standard for judgment of notched specimens varies greatly with the type of specimen and the transition temperature being sought. In the United States, the Charpy vee notch specimen is finding greatest application and use. By correlation with material taken from ships which failed in service at known temperatures, it has been possible to determine the energy value at which failure starts (maximum value, 11.4 ft. lb.) and the value at which crack propagation ceases (maximum value about 20 ft. lb.).

Similar values could have been obtained for other methods of testing, such as Charpy keyhole or Schnadt test. In the former case, it is possible to determine the temperature at which fractures start, but not the temperatures at which fractures stop due to the flatness of the curve at the energy values where propagation ceases. In the Schnadt test, the reverse is true.

Since the vee notch specimen will predict both transition temperatures, i.e., crack starting and crack propagation ceasing, it is important to realize that these predictions are based on standard size specimens. Specimens of substandard width, will not accurately predict transition temperatures, except in a relative manner.

The curves of energy values obtained in the tests, indicated transition temperatures sufficiently low that failure of beams would not necessarily start by reason of notch sensitivity in the steel.

Failures which did occur were undoubtedly due to fatigue. If steel of greater thickness, i.e. heavier beams, was tested in a similar manner, failure by fatigue may not occur. If it is presumed that material of similar yield point, ultimate strength and ductility were obtained, the fatigue value should be similar. In heavier beams, however, other factors become evident. Greater carbon content to maintain the ultimate strength and coarser grain structure due to mill finishing at higher rolling temperatures would cause an increase in notch sensitivity at low temperatures. Failure then in heavier material might be by reason of loss of notch toughness. Research in welded ship failure indicate that "although ships are subjected to alternating stresses, there has been no evidence that the brittle failures were caused by typical fatigue fractures".

It is therefore, reasonable to assume that the authors have accomplished what they first attempted to do. Previous research on small specimens at low temperatures could only lead to the assumption of working values on larger sections. The authors have proven that such previous assumptions are valid and indeed, have higher factors of safety than fatigue values at room temperature.

Henry A. Spencer, M.E.I.C.[2]

It is encouraging to note that some basic research is being done at Ecole Polytechnique. Engineers usually are confined in industry to doing applied research, and for competitive reasons, even this seldom comes to light. The paper is written in a comprehensive manner, well garnished with good photographs.

One or two points in the paper did seem to require further explanation. I would like to ask several questions.

In the selection of welded, rolled and riveted sections, why were wide flange sections used? Would it not be advisable to use simpler sections, so that basic applied mechanics relations might be established? How were the relative sizes of beams calculated to be roughly equivalent? What precautions were taken to assure specimens of constant cross-section, smooth-surfaced and homogenous in density? If steel was not straight before testing, how was it straightened?

With regard to the testing machine, the general design seems to have been well thought out. The electronic stopping mechanism is very ingenious, as are all the controls. On this design there are a few more questions. On the static flexural test were indicator readings taken before and after to prove that no permanent "set" had been given? In the testing machine, were any readings of deflection taken of the 6 riveted I-beams? How efficient was the refrigerating mechanism in giving a uniform temperature to the beam? In low temperature readings, were the thermometers checked and were the strain gauges calibrated for low temperature? "SR-4" gauges are quite sensitive to temperature.

The central loading system is cleverly designed to make room for strain gauge mounting, and also prevents side action of the eccentric from complicating the stresses. It was noticed from pictures that failures always seemed to occur in the top flange. It is difficult to say just what effect rigidity of the mountings might have on the relative stresses between top and bottom but one might assume that due to the weight of the beam and mechanism that failure in tension might occur in the lower flange first.

The Author

Gordon Cape's remarks have brought out several important points about this type of research; the authors are in complete agreement and would like to make the following additional comments.

Concerning our finding about the greater fatigue life at +70° F. of killed and rimmed steel beams compared to rolled beams, the comparison with results in other Research Institutes seem somewhat difficult to make because their results of fatigue life are given for a much greater number of cycles than in our tests and it is known that, for two different steels, fatigue behaviour at high stresses (low number of cycles) can be very different than that at low stresses (high number of cycles); that is, the S-N curves of the two steels may cross each other so that one of the two steels which has a better fatigue resistance at, say, high stresses, has a lower fatigue resistance at low stresses.

Regarding the Charpy tests, the test specimens were taken only from the thicker of the two plates of killed and rimmed steel supplied with the beams; the killed steel plate had a thickness of 0.395 inch while the rimmed had a thickness of 0.375 inch. Consequently the Charpy specimens of killed steel were standard-size while those of rimmed steel were slightly sub-standard size and Mr. Cape's comments apply to these last.

However, the transition temperatures found were very low and this was foreseen from the begin-

[2] Industrial Engineer, University of Alberta, Research Council of Alberta, Edmonton, Alberta.

ning of this project when our refrigerating equipment was so designed that it is possible to add an extra stage of compression to bring the temperature down to −70° F.; this part of the project has not yet been carried out.

The authors would like to give the following answers to H. A. Spencer's questions.

Wide flange sections were chosen in preference to standard I-beams because the former have parallel face flanges just like the welded beams in which the flanges are made of steel plate. The wide flange sections are also more logical and more economical so that they now tend to replace the standard sections.

The equivalence of the three types of beams was obtained by having all beams of the same depth and making all other dimensions such that the moments of inertia of the three cross-sections would be about equal.

The tested beams were selected to obtain the greatest uniformity of properties possible.

The permanent "set" was detected by the very sensitive and precise SR-4 strain gages and not with indicators.

The refrigerating mechanism gave a uniform temperature within about +1° F.

The SR-4 strain gage readings were not affected by the low temperature because, first, the dummy was also at low temperature and, second, this low temperature was maintained constant; the zero readings were, of course, made only when the low temperature had been reached and maintained for some time.

The fatigue failures did not always occur in the top flange: this impression is given because all beams were placed so as to facilitate photography. In fact, stresses in both flanges of a beam were maintained practically equal and failures were about equally divided between both flanges.

Large Capacity Hydraulic Turbines

by

R. S. Sproule, M.E.I.C., Manager, Hydraulic Division, Dominion Engineering Works, Ltd., Montreal.

The Engineering Journal, April 1955, page 387.

S. Logan Kerr, M.E.I.C.[3]

The paper is of considerable interest in bringing out the many remarkable developments in current practices for design and manufacture of hydraulic turbines in Canada. Much of this information has been known to those closely connected with the industry, but relatively unknown to many who have not had the good fortune to acquire first-hand knowledge of the amazing progress that has been made.

Within a space of some 34 years the hydraulic turbine industry in Canada has grown from practically nothing to be one of the major producing areas of the world. A glance at the table listing the larger units manufactured in Canada since World War II gives a graphic picture of what has been accomplished in ten years.

Along with the construction of 7½ million horsepower there has been a far-sighted program of development and improvement, reflected, for example, by the cavitation laboratory at Dominion Engineering Works, Ltd., in Montreal. This laboratory is probably the largest and most complete research installation to be found anywhere in the world for the testing of both cavitation and performance characteristics of hydraulic turbine models.

There has also been a most gratifying trend toward simplicity in mechanical design, making for more ease in manufacture and reducing maintenance to a minimum. The elaborate details found in many hydraulic turbine units designed abroad have been omitted in Canadian design without sacrificing performance.

Beyond all this research and development work has been a new philosophy, implied in the paper, but not mentioned in detail, namely, "get all the troubles possible licked before the turbine is built". The transition from the use of full scale installations as proving grounds for design to the use of other means such as research laboratories, cavitation laboratories, and intensive design studies has brought about a most satisfactory record in the field. This commendable situation should be noted as it represents an outstanding contribution to the art of design and manufacture of hydraulic turbines.

[3] Fellow, A.S.M.E., Flourtown, Pa., U.S.A.

F. L. Lawton, M.E.I.C.[4]

The author is to be congratulated on his excellent presentation dealing with advances in the design and manufacture, in Canada, of large capacity hydraulic turbines, particularly since the end of World War II. Not previously backward, in any respect, the post-war period has seen advances in the art, which makes Canadian practice second to none.

Figure 1 of the paper is particularly interesting as showing the marked increase in specific speeds, with resultant manufacturing and installation economy, as compared with pre-war practice. Has this been accompanied by any noticeable increase in distribution or extent of pitting damage arising from cavitation?

The author referred to the specific speed of the Paulo Afonso turbines as being 53.5 with a net head of 266 ft. and a unit capacity of 83,000 horsepower. He also noted the centre line of the distributor is set 15 ft. below minimum tailwater level, due to the rock structure. Would the author care to explain this somewhat more fully, since these turbines obviously operate under a rather high back pressure during flood periods, and hence are rather unusual.

The author has stated "It must be admitted, however, that there have been cases where serious cavitation damage has occurred to turbines, even though they were set at a sigma value well above the break in the power curve established by cavitation tests of a homologous model runner. Such occurrences raise doubts as to the value of cavitation testing and also raise various queries regarding the margin of safety which should be used in applying cavitation test data". He has noted cavitation phenomena are significantly affected by the cavitation parameter sigma, by the ratio of the peripheral velocity at a point on the runner to the spouting velocity at the operating head, the position of the wicket gates, and finally the design of the runner and of the adjacent water passages. Has any philosophy been developed as to the relative significance of these factors? How far back from the runner does the de-

[4] Chief Engineer, Power Department, Aluminum Laboratories Limited, Montreal, Que.

sign of the adjacent water passages play a significant part?

The author has referred briefly to the Nilo Pecanha plant of the Rio de Janeiro Tramway Light and Power Company Limited, with the turbine designed for both 50 and 60 cycle service. Could he state the actual best-gate efficiency under the two conditions?

The Author

The author wishes to thank both the discussors for the interest they have shown in this paper.

Mr. Lawton has asked whether the increase in specific speeds has resulted in a noticeable increase in pitting damage arising from cavitation. Although there has been some pitting damage on these postwar designs the author believes that it is restricted to much smaller areas than were damaged on older designs of runners. On some runners the pitting is so localized that comparatively small modifications to the runner design may eliminate pitting or small areas of stainless steel prewelding may be used to give protection against the pitting.

At the Paulo Afonso Plant it was desirable to submerge the centreline of the turbines fifteen feet below minimum tailwater level in order to bring the ceiling of the power cavern down to a point where there would be adequate rock thickness to form a sound roof. Furthermore, by setting well below tailwater level the value of sigma was maintained at a value suitable for a higher specific speed runner than would normally be used at this head, with resulting economies in the cost of turbines and generators. This economy in machinery cost was not offset by any increase in excavation costs because, although the penstock tunnels are somewhat longer than they would be with a higher setting, the size of the power cavern is smaller. A low setting may be economical in an underground power house where added excavation costs for such a setting would be prohibitive in a surface installation.

It is difficult to answer Mr. Lawton's question about the relative significance of the various factors affecting cavitation. The author's company has not been able to carry out a systematic series of tests to show the economic limit for each factor mentioned.

Regarding the Nilo Pecanha turbines which are being operated at either 50 or 60 cycle speeds, we have estimated, from tests of the model equipment, that the maximum efficiency under the rated head of 995 feet at 50 cycle speed will be 91.8% and at 60 cycle speed will be 92.5%. The optimum efficiency for the runner is between these two speeds.

Niagara Remedial Works

by

Dr. Otto Holden, M.E.I.C., Chief Engineer, Hydro-Electric Power Commission of Ontario, Toronto.

The Engineering Journal, April 1955, page 401.

F. L. Lawton, M.E.I.C.[5]

The author is to be congratulated on a most invaluable contribution to Canadian engineering literature, one which reflects outstanding credit to the author and to his associates. It indicates that Canadian engineers are abreast of our professional cousins to the south, even in hydraulic works as complicated and intriguing as any tackled anywhere in the world to date.

The author has discussed the use of echo sounding in the swift, dangerous and turbulent waters in the lower reach of the Chippawa-Grass Island Pool. Would he care to express an opinion, based on this work, as to the relative accuracy of such sounding methods compared with more conventional methods; also, does the turbulent flow result in discrepancies of significance?

The author has indicated an accuracy of one-half foot was achieved expeditiously with the helicopter technique. Was a corresponding accuracy secured with the kytoon technique? Would the author consider, on the basis of experience at Niagara Falls, that the same techniques could be applied effectively in equally turbulent waters two or three times as deep as those encountered at Niagara?

It is to be hoped that the author will present, at a future meeting, a full paper on the cofferdam worked out for the control structure, as it represents a considerable advance over alternative methods.

The Author

Mr. Lawton in his discussion raised several interesting questions in connection with the surveying techniques used in sounding the bed of the Niagara river and cascades. Based on our experience with these methods, the questions are answered below in the order in which they are raised:

(1) The relative accuracy of echo sounding and conventional methods. It is our opinion that echo soundings and weight soundings are equally accurate as the echo sounder is carefully calibrated by weight sounding and checked periodically during the progress of the work.

(2) The effect of turbulence in producing discrepancies in echo soundings. Fast water itself produces no discrepancies as successful soundings have been made in the high velocity Queenston Canal. However, if air is entrained in the water, then the air bubbles will also produce a trace on the chart. If the air is not too dense the bottom will also be traced on the chart, but if large quantities of air are entrained no bottom trace will appear. It is usually obvious to the surveyor when this occurs. In general, where the water includes entrained air, it is not considered advisable to use the echo sounding method

(3) Relative accuracy of helicopter and kytoon technique. At Niagara the same accuracy was obtained by both methods.

(4) Effectiveness of same techniques in equally turbulent waters, two or three times as deep. Under deeper water conditions such as were encountered on the St. Lawrence river, it was found that the heavy rigging required rendered ineffective the kytoons and light helicopters such as were used at Niagara. It was found necessary to employ a heavy Sikorsky type helicopter to achieve successful results.

It is hoped that the answers given above have adequately answered the questions raised in the discussion.

In connection with the cofferdam used for the control structure dewatering, it is agreed that it would provide an interesting paper for a future meeting.

[5] Chief Engineer, Power Department, Aluminium Laboratories Limited, Montreal, Que.

Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

NEW USES EXPAND LIE DETECTOR MARKET

Electronics, v. 27, n. 11, November 1954, p. 8.

Electronic techniques for getting right answers without leaving a mark on the body have been used in police labs for many years. Although most courts don't accept such evidence, information obtained has helped narrow lists of suspects and lead police to acceptable forms of evidence.

Leading instrument for detecting deception is the Keeler Polygraph. This uses five tubes and has three separate channels for recording breathing, pulse rate and skin resistance during carefully planned questioning. About 500 of these are in use by state and city police, sheriffs' offices and district attorney offices.

Simpler one-channel instruments, essentially high-range ohmeters for measuring skin resistance, are also on the market but are rarely used in police work because it is easy to suppress one's emotional response.

Accuracy of Tests

Interpretation of results is the most important factor in accuracy of lie detector tests. The three-channel machines themselves are essentially infallible, but human operators are not. They must phrase special relevant and neutral questions for each particular situation and interpret resulting chart deviations even when a recalcitrant suspect deliberately lies to every question. The limiting factor in expanding the police market is the availability of trained operators.

Industrial Uses

Defense plants used lie detectors routinely during the last war as part of a program for screening out subversives and many have continued this practice. Another use was to reduce thefts of small but costly tools.

Although some plants have their own machines, most utilize the services of some 50 private lie-detecting practitioners who bring in their own machines. A typical test takes 5 to 10 minutes and costs $10 and up per person, depending on thoroughness and the number of persons examined. From 20 to 30 questions are usually asked, of which only a few are relevant to the goal of the test.

Another widely expanding industrial use for lie detectors is in combatting petty theft by employees in retail stores. Some firms now require job applicants to take the test, which may involve such leading questions as "Have you ever taken anything from an employer?" To minimize embarrassment and employee rebellion, the examinations are usually called polygraph tests. Where petty theft piles up into major losses or where inside cooperation on a robbery is suspected, the test is given to all employees. Over a hundred of the machines are in industrial use.

RURAL AUTOMATIZATION IN THE SWEDISH TELEPHONE SYSTEM

B. Bjurel, *Electrical Engineering*, v. 73, n. 12, December, 1954, pp. 1063, 1091.

Automatization of the telephone plants in the rural areas of Sweden has been going on since the beginning of the 1930's. For this automatization the requirements concerning operational reliability are particularly high since the exchanges are small and unattended and located at great distances from each other.

Crossbar Selector

A crossbar selector was developed in Sweden in 1919. As very satisfactory experience had been obtained with this selector, it was decided to use the crossbar selector for the automatization of rural areas. Standardized types of exchanges of unit construction of sizes 10, 20, 50, and 100 subscribers lines then were designed in 1935, the crossbar being utilized in these unit exchanges as a step-by-step switch. Of these types of unit exchanges about 1,200 were manufactured. In the beginning of the 1940's a series of new and modernized standardized types of unit exchanges were developed, the series being restricted to only 40, 60, and 100 number sizes. Further, as special complemental equipment was developed allowing the combining of a 100 number unit with another 40, 60, or 100 number unit to give a combined unit exchange of 140, 160, and 200 number capacity respectively.

The unit exchanges are of satellite type without registers and they are over junctions connected to parent exchanges which, if automatic, are provided with registers. In later years the automatic parent exchanges are crossbar exchanges designed according to a marker system developed in Sweden. Today, not fewer than 2,100 rural exchanges are automatized with unit automatic exchanges.

To enable subscriber-dialed long-distance traffic, the country has been each allotted a 3- or 4-digit area code divided into some 300 number areas, number. Each subscriber is given a 5- or 6-digit directory number.

Subscription Costs

On signing a contract for telephone subscription including an individual subscriber's line, the subscribers in Sweden have to pay an installation charge of 200 Swedish crowns, independent of the costs to the administration for connecting the individual subscriber, although in sparsely inhabited regions these costs may amount to considerable sums. The subscribers as a rule have their own individual line to the telephone exchange.

In the automatized networks the subscriber pays a fixed charge, usually amounting to 86 crowns per annum, and an additional amount the magnitude of which depends on his outgoing traffic. All subscriber-dialed traffic is charged by means of registrations on individual subscriber's meters, each registration step rating 6 ore. For calls between subscribers connected to the same exchange only one registration is made on the meter. Other calls within the same number area cause a new registration on the meter every sixth minute. Calls between different number areas cause a more frequent repetition of the registrations, for instance, every twenty-fourth second for distances between 45-90 km, and every twelfth second for distances between 180-270 km.

In the unit automatic exchanges the subscribers' lines are connected to finder switches and final selectors. Between these switching stages, discriminating selectors are provided over which outgoing calls may be connected either to an idle junction for outgoing traffic or to a final selector in the caller's own exchange. A preselecting stage is provided for routing incoming calls to the final selectors.

For reasons of standardization, each type of unit exchange is provided with fixed numbers of switches. The different control relay sets are made easily removable from the unit racks and are provided with plugs for insertion in jacks in the racks.

The rural exchanges are housed in standardized huts, which are prefabricated and delivered ready for assembly at the site of the exchange. At present the working times for construction of unit automatic exchanges are as follows: the 40 number unit requires 1 or 2 working days, the 60 number unit requires 2 or 3 working days, and the

100 number unit requires 3 or 4 working days.

Conclusions

The cross bar selector has rendered possible great operating reliability which is an indispensable requirement in connection with the automatization of unattended exchanges.

By far-reaching standardization of the type of exchange, huts, and assembling methods, the cost of the plant could be kept down.

For the subscribers in rural Sweden the telephone automatization has resulted in decreased telephone rates for subscriber-dialed long-distance traffic and generally improved telephone service.

STOP COINING WORDS

J. J. Brown, Aluminium Fiduciaries Ltd.

Control Engineering, v. 2, n. 3, March 1955, pp. 48-49, 69.

We stand today at the beginning of a new development in technology. This is automatism—control of machinery to bring about fully automatic production of goods and services. For military and economic reasons we should advance in this field as rapidly as possible. Rapid advance in any science is helped by good definitions, clearly understood. These definitions should be existing dictionary definitions, in order that today's writing on the subject may tie in closely with the writings of the past.

Whenever a new subject appears, there is a tendency to coin words. This urge should be suppressed. The automatic production of goods and services is a complex subject, and ill-considered coinages like "automation" only add to the confusion.

Mechanization

The word for the first step toward automatic production is "mechanization." This word is defined in the New English Dictionary as "the process of making mechanical." The modern transfer machine that performs a series of operations on a rough casting is a highly-mechanized device.

At a round table on the subject of automatism sponsored by Fortune Magazine a year ago last June, I tried to make the point that the dictionary already contains a series of words adequate to describe all known forms of automatic control of processes and machines. Since most of the men writing about the new mechanized plants are from industry, the word "automation" is catching on. This is bad. It is already causing unnecessary confusion which will get worse with the passage of time. Occasionally there is a need for new scientific words, but this isn't one of them.

Automatism

Automatism is the self-control of machines or operations by any means. The key word here is "control." It includes also the supervision of processes. In the dictionary "automatism" is defined as the state or quality of being automatic, and "automatic" means self-acting or self-regulating. A machine is an automaton when it supplies entirely by itself the information needed to keep it running satisfactorily. The basic criterion for judging whether or not a machine is an automaton is to ask what would happen if the man nearest it suddenly has a heart attack and dies. If the machine will go on performing its function exactly the same way and indefinitely, it is an automaton. If, on the other hand, its functioning is in any way connected with the actions of a human operator, it is not.

Automatism in its most general meaning is what we have when there is a coordination of self-operating machines. In a truly automatic factory there are no men in series with the production or transport machines. If in a factory there are any men doing meaningful operations on the production floor, it is not an automatic factory, but a highly-mechanized one.

It is important to insist on the essential difference between mechanization and automatism because the economic, social and design consequences of the two are quite different.

It is true that mechanization, if carried to the point where the last workman is removed from the machines, will turn into automatism. But this is not going to happen. The essential difference between machines and automata is in the question of communication. "How easy is it to tell the device what to do?" If it turns out to be easy, you are dealing with automatism.

Cybernetics

The two key words in this field then are "mechanization" which eliminates some men from the factory floor, and "automatism" which tends to eliminate them all.

Mechanization is by far the older of the two processes, and has gone through many more stages of development. Today automatism is taking great forward strides. Devices that show higher and higher capabilities and self-control are beginning to appear. For this reason we are beginning to need a new word to cover those automata in which the control function predominates. The word for this is "cybernetics." For about 25 years French engineers have used the term "l'industrie cybernetique" to describe the branch of automatism that is concerned exclusively with control mechanism. Norbert Wiener of MIT has popularized the term on this continent, and it seems to fill a legitimate need.

The objection can be raised that automatism, having been in use long before we knew any methods by which high levels of automatic action might be achieved, carries with it the burden of older meanings. One way to answer this objection is to use "cybernetics" to describe areas of automatism where the emphasis is on the control function rather than on the action itself. Automatism has never been a highly popular word, hence its accretions of meaning are slight. The New English Dictionary gives only three examples of its use, all from the 17th and 18th centuries, and all using the word in its philosophical sense as the antonym of "voluntary".

To sum up, the terminology of automatic production that seems adequate is as follows:

Where there is no program, but repeated action. The control is mostly fixed, as for example in the linked transfer machines:

Generic Noun — **mechanization**
Adjective — **mechanized**
Verb — **to mechanize**

Where there is a program of some kind which causes repeated action. The actions repeated are not the same each time because the sensing devices have brought in information to modify the action:

Generic Noun — **automatism**
Noun — **automaton**
Adjectives — **automatic** or **automatized**
Verb — **to automatize**

Where records or sensors cause repeated action, but the emphasis is on the control rather than on the output. Here the actions are even less likely to be exactly the same each time, because many sensors have brought in control information to modify them.

Generic Noun — **cybernetics**
Adjective — **cybernetic**
Verb — **to cybernetize**

HANDLING

The Mining Magazine — Vol. XCL, n. 5, November, 1954, p. 282-284.

A paper by L. L. Goodman (J.R. Soc. Arts. Aug. 7, 1953) on the history and development of methods of handling materials divides industrial operations into material handling and material processing. The two must be carefully integrated if the standards of efficiency needed in modern engineering are to be reached and maintained. Since a substantial part of technology is concerned with the movement of a steady stream through a series of processes, a glance at the development of handling methods down the ages is not without interest.

Goodman defines materials handling as—

> The technology embracing the movement and storage of everything in or about an industrial establishment: for example, the movement and storage of raw material, of material between processes and of the finished material. It covers the services to the processes. The constituent parts are factory siting . . . layout, product design, motion study, mechanical handling, processing, and the human factors.

Obviously, these are matters calling for skilful planning and integration and are increasingly made the responsibility of specializing engineers. The processing work to be done influences or determines, the method of handling which must be used. Form, composition, and quality change from stage to stage in the course of treatment.

Factories

Factories were in existence in this country as long ago as 1500 for the manufacture of arms, armour, and cloth—and earlier than that if the evidence of

pre-historic flint quarrying is considered. In 1775 Arkwright's mill was receiving raw cotton and mechanically converting it to thread, while by 1785 the first steam mill was working. Eli Whitney's arms factory in U.S.A. was making interchangeable parts for arms at the end of the 18th Century and was closely followed by clock-making and the famous operation at Portsmouth in England, where ten unskilled men, using machinery designed by Bentham and Brunel, turned out 160,000 pulley-blocks a year for the Navy. By 1855 Woolwich had an output of 10,000 shells daily which "never touched the ground" during their manufacture. Developing steam power allowed factories to leave village streams and waterwheels and go to the towns where labour was plentiful. Electricity was first demonstrated in 1873 as a power-mover and rapidly led to further modification of methods. Processing's next big forward step was the Ford assembly line (1915). On the whole, however, ingenuity had been applied to processing and even today handling leaves much room for improvement if full advantage is to be taken of plant capacity.

Cranes and Conveyors

Integration seems to have started with American flour milling in 1785. Beyond sporadic development of cranes, nothing much seems to have happened until conveyors came into use in gasworks in 1890. A pneumatic grain conveyor started in Millwall docks in 1891 and F. W. Taylor was making his studies of handling principles which showed, *inter alia,* that maximum tonnage could be hand-shovelled if the load was 21½ lb. (suiting the size of the shovel to the density of the material). Another pioneer was F. G. Gilbreth, who studied motion in handling.

Lifts

The pulley first appears in the 9th Century B.C. for raising water. The pre-Christian Egyptian builders relied on sledges, ramps, levers, and rollers and above all on well-organized slave labour. The *shadoof* existed in China in 330 B.C. and the device of an endless rope to which pots are attached—a bucket elevator—seems to have come from Persia. The scraper conveyor was anticipated by the Chinese chain-pump—a wooden trough up which fitting pieces of wood were pulled by an endless chain. The screw used by Archimedes for raising water was adapted to moving solids in the 18th Century by Evans. Multiplying systems of wheel, axle, pulley, wedge, lever, and screw were recorded by Hero of Alexandria and Vitruvius. Overhead runways seem to start in the mid-19th Century in American slaughterhouses. A telpher, by Mather and Platt, was installed in 1895 in a Midlands railways station. Overhead travelling cranes worked in Manchester before 1840. Lifts are mentioned by Aristotle, but the first one known in this country was at work in London in 1846. Otis's safety mechanism came in 1852 and Hart's continuous lift in 1883. Steam drive was used in New York in 1862 and hydraulic power in London in 1868. Electric drives came along in 1889 and push-button working in 1892.

Conveyors started with a power-driven roller in 1833 and belt-conveyors in 1780 (this last for carrying water). Evans in 1785 used what he termed a "descender" for gravity transport of solids on a belt. A belt-conveyor was installed in an oven in 1810. Grain was first moved on belts at Liverpool docks in 1866. Robins invented the troughed idler in 1896 and also the stepped ply belt. An underground conveyor was installed in 1906. Despite the tremendous development in this method of handling during the past few years, Goodman envisages considerable development for long distance-transport. The chain-grate stoker was patented in 1841. The modern chain conveyor has recently succeeded in performing a vertical lift. The horizontal overhead conveyor has an endless chain towing carrier-trolleys long H-section track. It keeps the floor free and takes material flexibly between fixed points.

Trucks are shown in an Egyptian painting circa 2500 B.C., about which time they were used in China. Iron rails were used in collieries in 1767. The hand-lift truck appears in 1887, the battery electric truck in 1906, and the fork truck in 1914. The elevating fork trucks follow in 1919.

The paper reviewed here does not consider fluid flow, which has become a most valuable means of transport. The traffic of oil through pipelines is the most striking example.

FOUNDATIONS FOR HIGH BUILDINGS

Alec Westley Skempton, D.Sc. (Eng.), A.M.I.C.E.
The Engineer, December 17th, 1954, pp. 848-49.

Before the development of the passenger lift in the 1870s, domestic and office buildings were necessarily restricted to five or six storeys. By 1879, however, nine-storey luxury flats in Kensington had been completed, and in 1882 the ten-storey Montauk Block office building in Chicago was constructed. Those and other buildings of comparable height at that period still had load-bearing external walls—a form of construction too heavy and cumbersome for structures of more than about twelve storeys. The next essential step was the introduction of the metal frame with light panel walls; this was first achieved by Jenney in the nine-storey Home Insurance Building in Chicago in 1885. Five years later Jenney completed the sixteen-storey Manhattan Building, with carefully designed wind bracing, and Burnham and Root, with Corydon Purdy as engineer, erected the first all-steel frame building also in Chicago. In 1892 the first twenty-storey building, the Masonic Temple, was constructed in the same city by E. C. Shankland. The initiative then moved to New York, where in 1898 the twenty-six storey Park Row Building was completed, with nine electric passenger lifts. The thirty-six storey Singer Building established a new record in 1908, but the thirty-eight-storey Metropolitan Life Building was finished only a few months later, and both were eclipsed by the first giant skyscrapers, the fifty-storey Woolworth Building, completed in 1913.

Thus, in the space of thirty years, from Jenney's designs for the Home Insurance Building to the completion of the Woolworth Building, the skyscraper was born and reached maturity. Most of these early high buildings served the purpose of providing more office accommodation in business centres of restricted area. During the past twenty-five years, however, it has become widely recognized that, without overstepping accepted limits of population density or of floor space ratios, it is possible greatly to increase the open space on a given site by concentrating the majority of the accommodation in one or more high buildings instead of almost covering the whole site with buildings of moderate or low height. The increase in open space improves the daylighting of the rooms, provides more fresh air, relieves the parking and traffic problems, and virtually eliminates the risk of spreading fires. Hence, the demand for high buildings is no longer encountered exclusively in the centres of great commercial cities; they are increasingly required in many parts of the world, with correspondingly varied foundation conditions.

Steel Grillage

For the comparatively small buildings of traditional construction, the equally traditional foundation types were usually, but not always adequate. On soils of low bearing capacity the pyramidal footing had to be very massive in order to obtain a sufficiently wide base; in the Home Insurance Building, for example, of only nine storeys, the footings occupied most of the space in what would otherwise have been the basement. A major improvement was the steel grillage, first used for the foundations of a complete building in 1885 in the eleven-storey Rookery Building, Chicago. From that time the grillage, and the later reinforced concrete footings, completely replaced masonry footings for high buildings.

A good illustration of an early Chicago steel-frame structure with I-beam grillage foundations is provided by the sixteen-storey Marquette Building, completed in 1894. The gross bearing pressure is 3,800 lb. per square foot on a stiff clay layer underlain by soft clay about 40 ft. thick. But the net pressure is reduced to about two-thirds of this value, on account of the 10 ft. basement, and the settlements have not been excessive.

As the column loads increased with increasing height of building and also to avoid danger from future adjacent and deeper excavations, the concrete pier was developed. First used in 1893 for part of the Chicago Stock Exchange and in the same year for the seventeen-storey Manhattan Life Insurance Building in New York, this type of foundation rapidly became standard for heavy buildings in localities where rock or very hard soil could be reached within about 100 ft. below ground water level.

Concrete Piles

Throughout the nineteenth century the only form of piled foundation was that of the driven timber pile. During the past fifty years a great number of improvements and alternative types of piling have become available. Precast reinforced concrete piles were first used by Hennebique in 1898 and various in-situ concrete piles have been devel-

oped more recently, whilst the valuable H-section steel pile was first introduced in 1908.

Use of Buoyancy Principle

The most striking advances in recent years are those associated with the buoyancy principle, which can be applied in the most thoroughgoing way with deep raft foundations. The idea that settlement is chiefly dependent on the net pressure, and that, with a raft, this pressure can be reduced to zero by excavating a basement of such depth that the weight of soil removed equals the weight of the building, seems first to have been realized in 1785 by John Rennie at the Albion Mills in London. This heavy building was founded on a masonry raft constructed, in effect, as an inverted vault at a depth sufficient to reduce materialy the net pressure on the underlying alluvial deposits. The more obvious principle of raft foundations, namely, that of achieving the maximum spread of load to the ground, by means of thick mass concrete mats, of which the earliest dates from 1817 in the Westminister Penitentiary. But these types of raft were not altogether satisfactory; the inverted vault was costly and the mass concrete either failed or required to be so thick as to offset appreciably the gain in bearing area. Consequently, it was not until the introduction of reinforced concrete that the raft began to be widely used, and in the early examples such as the raft for the seventeen-storey Michigan Central Terminal, Detroit, in 1914, the buoyancy effect seems not to have been considered, although the excavation was 27 ft. deep. Whether this effect was consciously used in design before 1928, it is difficult to say, but in that year Daniel E. Moran designed the foundations of the twelve-storey Telephone Building, Albany, New York, incorporating not only the buoyancy principle but also making the beams and columns in the double basement act as a Vierendeel truss, and thus form a rigid frame, to reduce the differential settlements. Moreover, the settlements were calculated in advance from tests on undisturbed samples. The success of this foundation, in overcoming difficult soil conditions, has led to the use of deep-raft and rigid-frame basements (often in the form of box frames) for a number of important high buildings on clay during the past twenty-fiive years, as well as for the proposed twenty-five-storey tower block of the Shell Centre, London, and the thirty-eight storey High Paddington project, where the London clay extends to a depth of 200 ft.

The reduction of net pressure by excavation and one or more basements can, however, also be used with advantage in conjunction with piled foundations, and the first examples were probably the buildings in Shanghai erected in 1932 by the Public Works Department. Here, again, a number of important applications can be quoted, but the most outstanding is the foundation for the recently completed forty-storey Latino Americana Building, in Mexico City, where some of the older structures of low height with conventional foundations have settled differentially by several feet.

In summary, then, modern techniques have provided three classes of foundation: spread footings of reinforced concrete or steel grillage, which are the simplest; rafts of reinforced concrete, which provide the maximum spread of load; and piles of timber, steel or reinforced concrete, either precast or cast-in-situ (and concrete piers), which transfer the loads as deep as possible. Moreover, each class can be used either with or without a basement. If there is a basement the net pressure is reduced and the average settlements will also be reduced whilst, at the same time, the basement can be made sufficiently rigid to minimize differential settlements. All these types of foundation have been developed during the past fifty years, with the exception of the timber pile, and some only during the past twenty-five years; yet perhaps the most important single advance in foundation engineering has been the introduction of scientific methods of design. Many have contributed to that advance, but none more than Professor Karl Terzaghi, and of his papers on the subject few have been so influential as that read before the American Society of Civil Engineers in 1927. This date marks a turning point before which the engineer had to rely almost solely on experience and after which, to an increasing extent, experience could be supplemented by design methods based on a rational knowledge of soil mechanics.

SCIENTISTS AND ENGINEERS

Editorial from *The Engineer*, December 17th, 1954, p. 850.

We doubt whether any pure scientist has ever fully grasped what it is that engineers do. Some of them almost totally misapprehend it. Without sufficiently examining the history of engineering, they appear to think of engineers as in some degree their inferiors; as people merely applying to useful purposes the discoveries that scientists have made. They even appear sometimes to regard them as delinquents who fail satisfactorily to perform their job! Sir Edward Appleton in a lecture before the North-East Coast Institution of Engineers and Shipbuilders did not fall into any such error. For he worked during the war in collaboration with engineers and conceived in doing so a high estimation of their abilities. It is indeed remarkable that a scientist should be able to speak with appreciation and admiration of inventors who have "pleasure in rejecting, at least for a time, accepted laws and theories". He appreciates, also, as some scientists do not, that engineers have never been "content to wait on scientific progress". Where would the world be if they had? There is hardly an engineering production today which could have been made unless engineers had proved willing to make it upon a groundwork of good sense and intuition, to learn by trial and error what can and what cannot be done, and to derive admittedly empirical and inexact but still very practical formulae to guide them in design. Upon what a paucity of scientific information was the first steam engine designed and built! Yet it worked. How very much more we should like to know about creep and fatigue, and a thousand other subjects. Yet the plants, machines and other devices that engineers make still work and prove reliable.

The Engineer Makes the Discovery

Far from the scientist providing all the basic discoveries for engineers to apply, it has been, at least as often, the engineer who has made the discoveries, leaving the scientists to "explain" them later on. The steam engine was in use for over a century before Carnot expounded the theory of heat engines. Civil engineers were building dams, waterways and bridges for centuries before relevant constructional theories were worked out. Moreover, there are qualities in the engineering mind which Sir Edward did not touch upon, but which undoubtedly have relevance to the partnership of which he was speaking. The more obvious difference between a piece of scientific laboratory equipment and the full-scale industrial plant developed from it is that of scale. But there is another difference too. The laboratory equipment is fully instrumented; it is cared for by a fully trained scientist able to make adjustments with a complete understanding of what he is doing. It is a very far cry from that sensitive device to the industrial plant the engineer is asked to produce which will perform reliably under the ministrations of men who are likely to have only a vague perception of what goes on within the plant. A prime purpose of engineers, in fact, is to reduce the control of complex operations and devices to the simplicity of operating a valve, moving a lever, or turning a wheel. How much does the driver of an electric train know about electricity? What punishment a diesel engine to be handled by ignorant African natives has to be designed to withstand! And how many laymen appreciate what technical problems have to be solved before, at the simple turning of a tap, the morning bath can be filled with water; or drained of it just as simply by pulling out the plug? Laboratory equipment is fit only for scientists to play with. But many a complex engineering product must be so sturdy, so reliable and so simple to operate that it can be placed with confidence in the hands of those with no scientific or technical knowledge at all!

We Lose By Not Trying

As a conclusion to his lecture Sir Edward quoted some famous words from Francis Bacon. "For there is no comparison between that which we lose by not trying and by not succeeding; since by not trying, we throw away the chance of an immense good; by not succeeding we only incur the loss of a little human labour." But we do not think Sir Edward really had much need to "pass on the same thought" to his partner the engineer. It is true that, more particularly between the wars, many things were not tried by engineers in this country that ought to have been tried; and that foreign nationals developed a number of scientific discoveries made in this country. But the blame did not, we think, lie at the engineer's door. For the normal reaction of an engineer to any new and apparently sound idea is that of Francis Bacon, to try it and see if it works. But at the

elbow of an engineer there always stands an accountant. It is all very well to claim that some new device will prove to have great advantages in a certain application; certainly the engineer would like to try it. But what if it is unsuccessful? In the technological sense "we only incur the loss of a little human labour." But in the accountant's sense some tens of thousands of pounds may have been lost! Indeed, we salute with profound respect those industrialists (not always engineers or technologists) who are prepared to risk experiments with costly equipment. For after all safety always appears to lie in conservatism. One cannot seem to go very far wrong by choosing to use the old well-tried device or method. All the risk lies with the new experimental one. No one can be cashiered for not risking money! It is this monetary factor that makes so great a difference between science and technology. In science there is no such thing as complete failure, since there will be an accretion of scientific knowledge, even if a series of experiments leads only to negative results. But because it is the object of engineers to apply their knowledge not merely as with scientists to extend it, there are failures in engineering, like the Kitson-Still locomotive and rigid airships and many another forgotten project upon the development of which engineers toiled without avail. The accountant who stands behind the engineer makes little allowance for any increase there may have been in technological knowledge. He always demands a profit!

FIELD CURRENT SOURCES FOR ELECTRIC DEFIBRILLATION

P. L. Betz, *Electrical Engineering,* v. 74, n. 2, February 1955, p. 128.

Under certain conditions, the heart may lose its rhythmic pumping action and cease the circulation of blood. This situation is known as ventricular fibrillation and may occur during surgical procedures or as a consequence of electric shock. Normal heart action may be restored by passing an electric current of suitable characteristics through the heart. In the operating room, defibrillation is accomplished by applying electrodes to the heart directly and passing a 60-cycle alternating-current of from 1.5 to 2 amperes through the heart (120 to 135 volts). When fibrillation results from an electric shock received under field conditions, electrodes cannot be applied to the heart directly but may be applied to the surface of the body to permit sufficient current to flow through the heart to effect defibrillation. In animal experiments with electrodes at the chest, defibrillation has been accomplished reliably by the use of 60-cycle alternating-current, 480 volts, 15 amperes applied for periods up to about 1 second. Such a current first brings the heart to a standstill; upon interruption of the current, the heart will usually resume its pumping action provided the elapsed time between the onset of fibrillation and the application of defibrillation current is not excessive.

Suitable Power Sources

The purpose of this discussion is to outline briefly the results of an investigation of various power sources suitable for use in the field where commercial power may not be available.

Consideration has been given to the use of a turbine-driven generator using a propellent charge. This results in a unit having an estimated weight of about 60 pounds. The development cost would be approximately $20,000 and subsequent unit costs about $1,800.

A battery driven motor-generator set has been considered in which use is made of a relatively new type of storage battery that is capable of extremely high discharge rates. This battery employs zinc and silver as the electrode materials and can provide as much as 1,350 amperes for 30 seconds, or 630 amperes for 5 minutes. The weight of the battery together with a suitable motor-generator set would be about 320 pounds and the cost about $3,500.

A generator driven by a separate gasoline engine has been shown to have particular merit. A relatively lightweight a-c generator may be employed together with a suitable gasoline engine. Such a unit on a wheelbarrow-type mounting would weigh about 450 pounds and cost about $700. Its rated output is 15 amperes, 220 volts, 60 cycles, 3-phase. Defibrillation current could be supplied single-phase using a step-up transformer. This unit could be used for routine field operations in addition to being available for defibrillation use. The routine field operations contemplated include the use of power tools, blowers, heaters, lights, and battery charging for radio communication. These uses would increase the reliability of starting the engine for defibrillation use and without routine use, doubt would be entertained as to the ability of a stand-by unit to start promptly when required. Conceivably, the unit might be in operation when needed for defibrillation.

A multitapped transformer might be used as the energy source on circuits up to 2,400 volts. Such a transformer would provide input voltage taps for 120, 240, 480, and 2,400 volts for connection to the circuit causing the shock. The output voltage would be 480 volts and current capability, 15 amperes. A disadvantage is the possible time delay in making connection to the exposed circuit, especially where an overhead line is involved. An advantage is low weight—approximately 50 pounds—and low cost—less than $100. Use of the transformer is based on the premise that shocks obtained from circuits of voltages in excess of 2,400 volts would not produce fibrillation.

Of the four types of field power supplies discussed, the one that appears to hold the greatest promise is the separate engine-driven generator-set used for routine field operations, as well as being available for defibrillation use.

ECONOMIC FACTORS IN THE PLANNING OF RESEARCH

R. M. Lodge, *The Manager,* v. 23, n. 2, February, 1955, pp. 113-114.

By planning *for* research I mean providing the facilities, the men and the equipment, and the correct *milieu;* and planning the internal economy to equate to the amount of money available for research.

The quality of the staff is of prime importance, not only because the quality of their work and its fertility depend most on the calibre of the individuals doing it, but also because the major item in any research budget is salaries.

In many fields, research equipment can be kept simple; but where a subject has developed a long way, complex equipment has to be provided for the less simple experiments. Another symptom of this is that modern research is very much more a group or team effort than it used to be.

A third facet of the process of planning for research is that a conscious effort is needed to preserve the freedom of atmosphere in which alone science seems to flourish. Freedom to think, to argue, and to differ, and freedom to change one's mind are all important. In an industrial setting in particular, these freedoms can easily be lost or obscured.

A fourth item about which a decision must be made is the amount of money to be spent by any particular organization on research. I suppose the minimum amount of money which a company should spend on research is that which allows it to stay in profitable business in competition with other people. It is common experience that research and development work not only costs money itself, but also puts demands on fresh capital; and the rate at which this fresh capital can be supplied most surely sets an upper limit to economic research effort.

I believe that it is true of industry that more money is spent on research than on applying it. It may be that not only are there sufficient research results already waiting in pigeon holes to be applied, but that there is also a shortage of men able to or in a position to apply research results to their industry. The inability of these men to apply the fruits of research may in itself be caused by our deficiency in planning so that research results can be applied.

One of the points worth studying, then, is the description of that *milieu,* on the production side, which will be the most receptive to research ideas. If you concede that development of production is as important as production itself then you must see to it that men are available not only to keep production going, but also that other men are available to keep production developing.

While planning for research is important, it is perhaps second in importance to, and is a less continuous process than, planning what shall be the subjects for research. So much success in research is said to be due to chance that an easy way out would be to say that there is no planned way out; but, on taking a closer look, one discovers that chance only plays a significant part in fundamental, background or pioneering research.

We can safely conclude that the more fundamental and pioneering any research is, the less amenable it will be

to planning and selection of detailed objectives on the grounds of cost or likely value or economic return. It also follows that the more applied any research is, the more clear its objective, and the more amenable it is to planning.

Obviously one has to assess economic factors in choosing subjects for investigation, the more so the more applied the project becomes. This means that the research side must not only be provided with the production cost figures; it should have access to an intelligible and continuous assessment of the non-quantitative aspects of the probable advantages to be gained.

When one has finally determined the likely return, the probability of success must come into the calculation, and also the estimated research expenditure. Attempts have been made to formalize the evaluation of a project as worth while, and set up a quantity called the project value ratio, which is the estimated return multiplied by the probability of success and divided by the estimated research expenditure. This ratio has to be greater than 3 for a project to be undertaken at all, and the actual values of the ratio for different problems enable an assessment of the priority of those problems to be made. It seems to me, however, that this does not go nearly far enough, since there is no term included for the acceptability of the solution to the problem, a solution which is, in the early stages, unknown. By 'acceptability' I mean what extra capital and revenue expenditure will be needed to achieve the object in the way the research suggests.

There is a case for reviewing each project at intervals with a frequency which should become greater as the work progresses through to the applied stage. Always the question 'is the work developing along the lines indicated by the definite objective set?' should be asked.

There is nothing mysterious about the calculation of the economic effects of achieving a given object provided that all the appropriate cost figures are available. Research men are generally reluctant about asking for these figures, and are not qualified to deduce the resultant saving. It is essential, therefore, that the research department has a cost accountant available.

RUSSIAN VISIT

GLIMPSES OF SOME ELECTRICAL DEVELOPMENTS

F. J. Erroll, A.M.I.E.E., M.P. *Electrical Review*, v. 156, n. 1, January 7, 1955, pp. 3-5.

The Parliamentary Delegation which visited Russia this autumn was the first for almost ten years to be invited by the rulers of the Soviet Union. We were able to spend only seventeen days in the country but during this time we had an opportunity of staying in several of Russia's major cities, including Moscow, Stalingrad, Leningrad, Sverdlovsk and Gorki. Our Russian hosts had drafted out a program for us but they made it plain that they would welcome suggestions and do their best to include them in the itinerary. By the end of my visit I had been given facilities for seeing an example of every item on the list.

It is fair to say that in electrical matters Russia has made progress comparable with other aspects of her industrial development. The Russians are making full use of what can be learnt from the industrialized countries of the West. In certain directions Russian engineers, doubtless aided by German designers from Eastern Germany, are able to develop their own engineering techniques and advanced industrial design.

While in Leningrad I was taken round the Electrosilia-Kirov Works. The works director said that the output of turbine-driven generators was running at the rate of 1.5 million kw. a year, and of hydro-electric generators at the rate of 1 million kw. a year. There was in addition an annual output of about a thousand medium sized generators, totalling approximately 1 million kw., as well as a substantial production of small and medium sized motors. The generators (both turbo and hydro) are manufactured up to 150,000 kw. in size, and in addition to rolling mill equipment motors and generators are made from 150 kw. upwards.

Wages

This output is achieved by 10,000 employees of whom about 55 per cent are women. The average wage is of the order of 1,000 roubles a month, maximum earnings, however, reaching 2,000 roubles a month. The works director was frank about his own salary; he said that he received a basic payment of 5,000 roubles monthly and could earn an output bonus up to an additional 5,000 roubles a month.

As regards the rate of exchange, the official figure is 11.2 roubles to the pound, so that a wage of 1,000 roubles a month is approximately equal to £89, while the works director's salary and maximum bonus together would amount to nearly £900 a month. In terms of purchasing power, however, a conservative figure is 40 roubles to the pound, which would make the effective wage £25 a month, or about £6 per week, and the salary £250 a month, or £3,000 a year. Income tax rises to 19 per cent.

Heavy Generating Equipment

During a short tour of the works I was given an opportunity of seeing the main fabricating shop and the principal assembly shop for heavy generating equipment. Amongst the equipment awaiting dispatch was the stator of a 150,000 kw. hydro-electric set. There was also a 120,000 kw. stator for a turbo-generator set, mounted on a railway truck for dispatch.

At one end of the main assembly shop I was shown lathes for rough turning the rotor forgings for turbo sets. Two of the lathes had been made in Great Britain, but the third had been manufactured in Russia since the war. The strategic ban on the export of certain machine tools may have slowed down the pace of Russia's industrial development, but on the other hand it has compelled Russian engineers to make for themselves what they had previously thought was beyond them.

During my visit to a modern gold mine near Sverdlovsk on the eastern side of the Urals I was able to see the extent to which electricity is employed underground by the Russians. Underground haulage is by electric locomotives getting their power from overhead lines or batteries. The substation at the working level was commodious and well equipped. A woman was in charge of this substation; she had obtained her technical degree at the neighbouring university. I saw many other women working underground but none actually at the working face.

Teplow Power Station

In Moscow I was taken to see the Teplow power station. This station was built before the war and further developments, delayed by the war, have since taken place. Our hosts had selected this station for a visit as it was neither one of Moscow's oldest stations nor one of the newest—it represented in their view a good average, and was not intended to be a show place. The installed capacity is 125,000 kw., consisting of five 25,000 kw., 11 kv. 3,000 r.p.m. turbo-generator sets. According to the superintendent the station generates 900 million kwh. a year.

The turbo sets had the following dates on their base-plates: 1933, 1935, 1937, 1946 and 1951. The latest machine had been made by the Ural Turbine Works, near Sverdlovsk, and all the other sets had been made in Russia, too. In fact it was pointed out to me with evident pride that all the equipment had been made in Russia.

The boilers are fired with pulverized fuel and each has a capacity of 230 tons of steam per hour. The pre-war boilers operate at 30 kg./sq. cm. (427 lb./sq. in.) pressure, and at a temperature of 400 deg. C. The latest post-war boiler operates at 100 kg./sq. cm. (1,422 lb./sq. in.) and 510 deg. C.

I was told that the calorific value of the fuel used was 6,300 calories/kg. and its ash content 17 per cent. The superintendent said that the fuel consumed worked out at 480 grammes/kwh. in summer, and 360 grammes in winter. Incorporated in the station is a district heating scheme which, of course, operates only during the winter.

A short tour of the station showed that the Russian engineers had worked to an excellent layout and the station generally compared favourably with stations of similar age to be found in other countries. The control room was luxurious compared with British standards. The whole of one wall was taken up with a vast portrait of Stalin in colour. Amongst the control room staff were two women.

The visit to the station over, the superintendent hurried me back to his office. "To answer your further questions, if any," as he rather stiffly said. But in fact the object was to remove the corks from some bottles of excellent Soviet champagne and to drink toasts to "Peace" and "Friendship between the engineers of the world".

The Right Honourable C. D. Howe, Hon.M.E.I.C., Minister of Trade and Commerce of Canada, was the guest speaker at the annual dinner meeting of the Association of Consulting Engineers of Canada, Toronto, May 12, 1955.

The Engineer in Business and in Government

It is always a pleasure for me to speak to members of my own profession. This is not only a group of engineers, but a group of consulting engineers, and I spent some twenty years in practice as a consulting engineer. However, since then, I have spent another twenty years in public life, so that I may well be out of touch with the problems that the consulting engineer is facing in present circumstances. From my observations as a member of the Government, I would guess that the consulting engineer is doing more business and making more money now than in my day. I sincerely hope that this is so.

I have always believed, and still believe, that the life of a consulting engineer is the best that the engineering profession offers. While the consulting engineer must do without the monthly salary cheque and the social security that most of our fellow engineers can count on, ours is by far the more interesting life. We can at least choose our clients and can choose not to be associated with prospective clients unless we think that the association will be a happy one. However, we must always be alive to the fact that our association with a client is apt to be what we make it, and that failure to give satisfaction can very well damage our ability to attract new clients.

Being detached from the company payroll is, I believe, an advantage. Usually we are retained because the owner has a high opinion of our reputation in the particular field that is his interest at the moment. This puts us in a preferred position in that our opinion is apt to carry more weight than an opinion from a man on the company payroll.

I suggest that the consulting engineer is fortunate if he can build a satisfactory practice in a rather narrow field of engineering. By concentrating his effort in a narrow field, he is better able to develop the engineering techniques that apply in that field. Then too he obtains a mastery of the business side and can offer a service that extends beyond a purely engineering service. Often the client knows his objective but is not too sure of the best path toward achieving that objective, and there, the advice of an experienced consulting engineer can be invaluable from a business, as well as from an engineering viewpoint.

There can be no doubt that engineering has made great strides since I graduated into the profession some 48 years ago. At that time, the question was being debated as to whether engineering was a profession or a trade. It was rare to find even a construction organization headed by an engineer. The thought that an engineering training would qualify a man to be president of a railway or the head of an industrial firm was unheard of. Engineering was then the lowest paid of all the professions.

The engineers of that day were able, competent and enterprising, but for the most part their interest lay in designing, constructing and operating. The decisions as to whether, why and when works were to be undertaken and how they were to be operated were usually taken by others. The fields of management and policy direction in industry were being entered by only a few enterprising engineers possessed of a strong pioneering urge.

The pendulum has swung full over and it is the rule today rather than the exception that engineering-trained executives are to be found in the highest managerial posts of major industries. The demand for engineering-trained executives has contributed to the very sharp rise in the scale of remuneration for our profession.

For some years past the supply of engineers has been far short of meeting the demand. In a country that is developing its natural resources and endeavouring to maintain a rapidly expanding economy, this is a serious handicap to national progress. In the face of the strong demand for engineering graduates, it is discouraging to find that enrolment in engineering courses is on the decline. Why this is so is hard for me to understand. I would expect young men to be attracted in great numbers by the prospects of an engineering career in the world of today.

I suggest that this Association of Consulting Engineers, representing as it does a broad outlook on the profession, might well organize a special effort to publicize the attractions of an engineering career and the opportunities that await those who may become proficient in some branch of engineering.

There is one field in which engineers are well equipped to make a contribution which is being generally overlooked by the profession, and that is the field of government. I hope you will not think it immodest if I suggest that we engineers who take an active part in the legislative and administrative branches of government are making a worth while contribution to the work of government. Just as

Part of the head table at annual dinner meeting of the Association of Consulting Engineers of Canada. Left to right: Mrs. R. E. Heartz, A. T. Hurter, M.E.I.C., retiring president of the Association, C. D. Howe, Hon.M.E.I.C., guest speaker, E. A. Cross, M.E.I.C., president of the Association, Mrs. A. T. Hurter, R. E. Heartz, president of E.I.C.

our predecessors brought to scientific and industrial policy the benefits of their training and talent, so we are bringing to bear on the terribly involved problems of present-day government the outlook and philosophy which is the hallmark of our profession.

The day is past when rule by a group of citizens trained in any one field can give satisfactory service to a nation in a complex world. The engineer's voice should be heard and his presence felt in the deliberations of national councils, for he has something unique to contribute to the understanding of present day problems. I would like to testify from my own experience that an engineer can get elected to office and is welcomed by his fellow legislators and administrators. I find that there is a special kind of satisfaction in public service which makes all the inevitable sacrifices seem unimportant.

Before entering public life, I was aware that modern governments deal with a wide range of problems of an engineering and industrial character. It did not seem unreasonable to believe that an engineering background might be helpful in dealing with some of these problems. I still believe this is true; but I have also found there is a profession of government which also has to be learned, and in which it is at least equally difficult to become expert.

Democratic government, like engineering, is concerned with the balancing of forces, not, of course, physical forces but political forces. Solutions must be found which maintain the stability and well-being of the political structure. It is not sufficient to know what should be done. It is also necessary to persuade the various national groups and interests to support the right policies. This means leadership, but it also involves compromise.

In these days when science and technology impinge directly upon our daily lives and activities, governments cannot avoid assuming responsibilities that formerly were considered outside their rightful duties. I am a firm believer in private enterprise, as the most effective method of developing the industrial strength, and exploiting the incentive, enterprise and inventive genius of a country, but today there are some highly technical activities that only governments can do. Private industry, for instance, could never carry on a war, although without the resources of a strong private industry this country would be weak indeed. Private industry on its own would not have developed the atomic bomb, although I am equally convinced that until private industry is in a position to exploit the enormous possibilities of fissile material, there will be no great developments in the industrial potential of atomic energy.

One hundred and seventy-eight years ago, a great British statesman, pleading with his government for conciliation with the American colonies, put the idea in another well-known form when he said: "All government — indeed every human benefit and enjoyment, every virtue and every prudent act — is founded on compromise and barter." This truth, so eloquently put by Edmund Burke, is, to my mind, one of the eternal verities. It was ignored in 1775 by the British Government, to their incalculable loss.

The word "compromise" has acquired a somewhat sinister connotation. Compromise as a means of conciliation still remains the foundation of good government and good human relations. Engineers in their most daring endeavours always have to compromise between the desirable and the attainable. In our human relations, conciliation is our most effective agency, and expediency is our constant companion. It is not strange, therefore, that engineering experience not only brings to government service a knowledge of things scientific, but also a training in one of the basic practices on which government is founded.

My thesis is, of course, that just as compromise should have been the foundation of government activities in Burke's time, so today, when modern society has to deal with innumerable technical problems, compromise is still the foundation on which sound government rests. I suggest that the challenge is to work out the most acceptable and beneficial way in which government and private industry can co-operate in fields where neither party can expect to exercise exclusive rights.

My somewhat random remarks will lead you to the thought that the consulting engineer tends to become a specialist and loves to talk about his own specialty. Twenty years ago I could not have made this address without referring to grain elevators; now, you find me referring to the work of government. Had I listened to the discussions today, I am sure that I would have found some of you discussing your own specialty. It is good that we all prefer to talk about the work of the moment which occupies the greater part of our thought and energy.

There is no doubt in my mind that consulting engineering is the king of the professions for those who succeed in the field. I am sure that this Association is making a contribution to Canada by bring-

Continued on page 1105

Month To Month

JAN. FEB. MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

"P. D."

What is "P.D."? "P.D." stands for "professional development". And what is that? It is any program of an educational nature, but non-technical, designed to round out the young engineer, say up to the age of 35, into the full man that it is agreed that he should be if he is to occupy the niche in society where he belongs.

The topics covered in such a program may cover a wide range, from abstract philosophy and a look at the fine arts on the one hand, to the detailed techniques of business administration on the other, but as a matter of policy no subjects are included in such a program if instruction in them is available elsewhere in the neighbourhood. Any method of instruction is appropriate—lectures, seminars, debates, visits, case studies, question and answer periods; all these have been successfully used.

The inspiration for this little article stems from the recent release by our field secretary, Col. L. F. Grant, HON.M.E.I.C., of material giving some account of P.D. courses conducted by several branches during the past winter. This material has gone or will go to every branch secretary right across the country, but, of course, there will still be a good many of our members who will not see it.

Seven branches conducted P.D courses last season, with a total registration of about 300 young engineers, nearly all *Juniors*. Attendance was generally good, but, as might be expected with a group in this age bracket, changes of employment and transfers often took some of the "students" away.

The most popular subjects were those connected with business administration, naturally enough. Judging from the schedules at hand and the names of the lecturers, some of these must have been excellently and thoroughly treated.

Some branches found it relatively easy to enlist competent help from local industry, others found it less easy and at least two got a neighbouring university to put on appropriate courses for them. In one of these latter cases a "certificate of attendance" was awarded those who deserved it. No examinations were held in any P.D. courses.

Fees varied all the way from five or six dollars to sixty, the latter for one of the comprehensive and thoroughly organized university extension courses. All the branches but one came out with small credit balances, which were set aside for next year's operations. The one branch that found itself headed for the red assessed its "students" seventy-five cents each to make ends meet, an insignificant sum.

In May last a P.D. conference was held in Toronto with six of the seven branches represented and with our field secretary taking a leading part. No formal written conclusions were arrived at, but from reading the minutes one gathers that a P.D. course to be a success must:

> Be general in its first year, if it is to run for more than one, to attract all possible members.
>
> Change from year to year to hold the same group.
>
> Keep away from any suggestion of continuance of university courses.
>
> Get away from the engineering theme into the realm of more general knowledge.

It seems also that P.D. courses are as good — or as bad — as the committees running them and that any such committee should be made up of the young engineers for whom the courses are designed, and that it should be as independent as possible of the regular branch executive.

A quotation from Col. Grant's closing remarks at the Toronto conference will state the aims of P.D.'s better than any words of this writer:

> "The interpretation of professional development differ(s) between the United States and Canada. In the United States(it) has become a five-year program . . . leading to a master's degree in engineering. The result . . . is that there is only one course running . . . Meanwhile, in Canada there have been as many as twenty courses running at one time . . . (I) would

Cover Picture

Since the days of Linde, the separation of air into its components has advanced into a major industry. Production of oxygen starts with compressors such as the one shown, where the air is "squeezed" to almost unbelievable pressures.

Photo courtesy of Union Carbide Canada Limited

like to think of every young engineer as being a help and an ornament to his profession (and) as being able to (take) his part in general discussion, knowing something of art and international affairs, of history and government. Although perhaps general knowledge does not make money, (I) believe . . . it makes for happiness and an interest in the world about you."

Our P.D. program is run by the young engineers themselves and pretty much according to their own ideas, with only so much help from their seniors as they may ask. So far it seems to have been reasonably successful and we hope that it will spread.

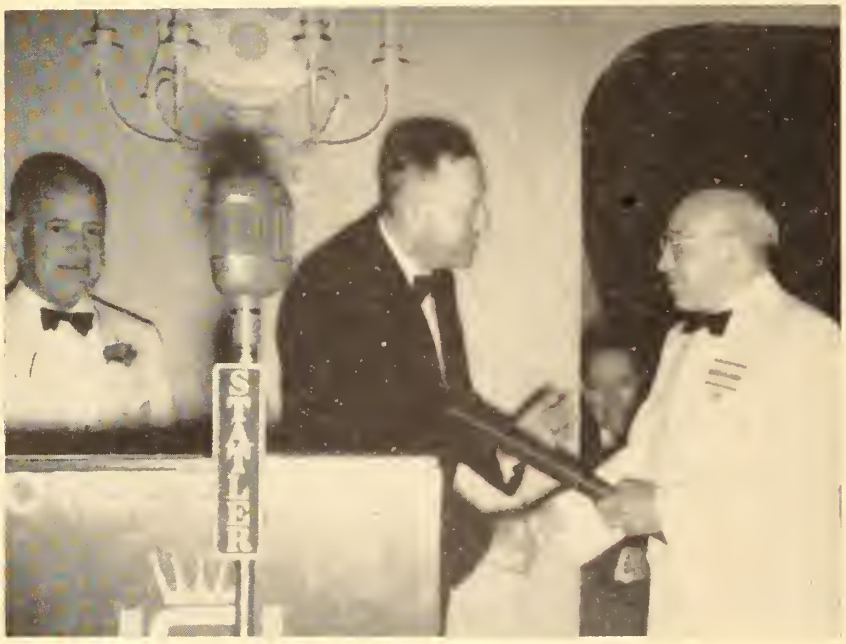
Richard E. Heartz is Made Honorary Member of ASME

The president of the Engineering Institute, Richard E. Heartz, president of The Shawinigan Engineering Company Limited has been elected an honorary member of the American Society of Mechanical Engineers. He becomes the fifth Canadian in history to receive this honour.

Honorary membership, the highest honour in the power of the 50,000-member Society is given for "acknowledged eminence in the engineering field" and for "effective and faithful service rendered to the Society, to the engineering profession or to the public".

Since 1880 it has been awarded previously to 160 persons, of whom more than one-third have been non-Americans. The Canadians who have received it previously are: R. W. Angus, M.E.I.C., professor emeritus of mechanical engineering at the University of Toronto. N. R. Crump, M.E.I.C., president of the Canadian Pacific Railway Company; Rt. Hon. C. D. Howe, HON. M.E.I.C., minister of Trade and Commerce and Defence Production; and General the Hon. A. G. L. McNaughton, M.E.I.C., Canadian chairman, International Joint Commission.

With Mr. Heartz, five other distinguished men received the honorary membership at the semi-annual dinner of the Society's diamond jubilee year on June 21. They were Jakob Ackeret, professor of aerodynamics in Switzerland's Federal Institute of Tech-



Dr. David W. R. Morgan (above right), president of the American Society of Mechanical Engineers, presents Dr. R. E. Heartz, president of the Engineering Institute of Canada, with his certificate of honorary membership. Frederick S. Blackall, Jr., a past president of ASME, at the left, presides.

Panel discussion at ASME diamond jubilee semi-annual meeting. The panel members, left to right: W. L. Batt, Hon.M.E.I.C., past president ASME, chairman, H. V. Tornebohm, Hon. M. ASME., president, International Organization for Standardization, R. E. Heartz, Hon.M.ASME., president EIC, and Sir Vincent de Ferranti, president, Ferranti Electric Limited.

nology; Detlev W. Bronk, president of the Rockefeller Institute for Medical Research, New York; Sir Vincent De Ferranti, chairman and managing director of Ferranti Limited, in England; Ernest Frederic Mercier, of Paris, outstanding international engineer and business man; and Dr. Hilding V. Tornebohm, member of the board of the Swedish Standardization Association.

IAESTE Report—1955

It will be of interest to many readers to know that for the third year Canada is participating in The International Association for the Exchange of Students for Technical Experience. The Institute is again acting as the Canadian agency for arranging these exchange visits. The organizational work for this year is now virtually completed and it is possible, therefore, to present a brief report of the IAESTE activity for 1955.

Although it has been covered in the *Journal* before, for the benefit of those who may not be familiar with IAESTE, it is an international association of nations for the purpose of arranging employment abroad for engineering students during the summer preceding their final year. During 1954, 19 nations participated and jobs were found in other countries for a total of 4,267 students.

Describing the year in general terms, it is unfortunate that we have to report that the response in terms of actual numbers has been slightly less than last year. Although considerably more inquiries were sent out to Canadian industry compared to 1953-54, it happened that our approach to prospective employers was made, unavoidably, during the fall and winter months when there was a definite feeling of uneasiness about the immediate future of the Canadian economy. This had quite a marked effect on the attitude of many industrial firms toward their employment prospects for the 1955 season. At least this was so stated by many who rejected the invitation to accept students this year. If it could have been possible to delay the despatch of our letters until the spring, we have the feeling that the response would have been much more enthusiastic because by that time business had taken an optimistic up-turn again, which is continuing.

In numbers, we have 46 European students coming to Canada this year from 9 countries, and representing all branches of engineering. This compares with 52 last year. These positions in Canada were made possible through the cooperation of 32 Canadian firms who are participating this year. Moving in the other direction, we have 10 Canadian students, from 6 universities, who have decided to take advantage of summer employment offers in Great Britain, Germany, Belgium, Denmark and France. This in turn compares with a figure of 12 for 1954. We can hardly expect the proportion of our students to be much higher as long as the earning differential between our own and European countries remains as adverse as it is for the Canadian working abroad.

There is another phase of this year's activity to report which is also on a disappointing note. Following a decision taken in October 1954 at a meeting of the Canadian IAESTE Committee, an invitation was sent, with a copy of the 1954 report, to the deans of engineering in all Canadian universities where there are students eligible for the exchange plan, asking for the nomination of a member of their staff who could act as liaison officer for the IAESTE plan. His responsibilities would be to answer student inquiries within his capability and to maintain contact with this Headquarters as necessary. Only six names were received in all, and it is regrettable to have to report that in some cases no reply was made whatever. Consideration will have to be given to the question of renewing these contacts for the 1956 year, or adopting some other policy.

The results this year, while nothing to be proud of, are nevertheless not too discouraging and we feel that with reasonable luck (which it is safe to say we did not have this year), if we keep the shoulder to the wheel, we can look forward to an IAESTE exchange program a year from now in 1956 which will be larger than ever.

The Maritime Miners

The Mining Society of Nova Scotia held its annual meeting on July 7, 8 and 9, 1955, at Keltic Lodge, Ingonish, Nova Scotia.

The accompanying photograph shows the new officers. From left to right: Angus MacDonald, district superintendent, Dominion Coal Company Limited, Glace Bay, first vice-president; Edward D. Brown, M.E.I.C., vice-president, and general manager, National Gypsum (Canada) Limited, Halifax, president; Sydney C. Mifflen, secretary-treasurer; D. Owen Hartigan, president, Indian Cove Coal Company Limited, Sydney Mines, second vice-president. Mr. Hartigan is also Mayor of Sydney Mines and a member of the Dominion Coal Board. The Engineering Institute of Canada was represented at the meeting by its president, Dr. R. E. Heartz.

Channel and dyke construction opposite Montreal on south shore between Harbour and Victoria bridges—June 28.

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

Progress By Ontario Hydro

Ontario Hydro on June 21 announced the contract award for construction of the Ontario section of the international powerhouse to Iroquois Constructors, Limited, for the sum of $21,940,253. This is a company composed of experienced and well-known Canadian companies. Their participation in the contract is as follows: Angus Robertson Ltd.—20%; Foundation Co. of Canada Ltd.—40%; Pentagon Construction Co. Ltd.—17%; Rayner-Armstrong Ltd. — 13%; Canadian Comstock Ltd.—10%.

The three lowest bids were submitted by: C. A. Pitts General Contractors Limited, Canadian Division of Merritt, Chapman and Scott Corp., New York, at a price of $18,885,769; A. Perini-Walsh Construction—Utah-Kiewit-Morrison Knudsen Joint Venture Group, at a price of $22,552,295; Iroquois Constructors Limited at a price of $23,337,454, which had been negotiated to $21,940,253 with the concurrence of the Power Authority of the State of New York. This amount was in close agreement with the tender accepted by NYSPA for their section of the powerhouse, after making adjustments for materials and quantities.

In considering the tenders received, special attention was paid to existing work loads of the bidders, breadth of their respective experience in this construction field and the vital importance of strict adherence to time schedules.

In awarding a contract of this size, considerations to be taken into account included:

1. The lowest price compatible with completion in accordance with the high standards required by the Commission and the necessity of meeting a scheduled date.
2. The desirability of strengthening the Canadian fabric by doing the work with Canadian workmen, materials and equipment.
3. The Commission is in business and has an obligation to stimulate Canadian business and industry.

The Commission felt that Iroquois Constructors Ltd., as a Canadian company, met the requirements above set out, and accordingly it negotiated a contract with this firm well within its own estimates for the work, and in close agreement with the contract price accepted by the NYSPA for their half of the power house. It was pointed out that the Perini group above referred to had already been awarded $61 million in contracts by the New York Power Authority, and this had been considered in awarding the contract.

A contract has been awarded to Macamic (Ontario) Limited, of Timmins, for the improvement of Nine Mile Road and construction of a roadbed for a railway siding to provide access to the powerhouse area. This tender, the lowest of three, was for $227,713. The work is to be completed on or before September 15, 1955.

Tenders have been called for major channel improvements at and adjacent to Galop Island and Chimney Island in the St. Lawrence River. Closing dates are July 19 and July 12 respectively.

The Galop Island project calls for the excavation of some 14,500,000 cubic yards of earth and 1,000,000 cubic yards of rock. The work, comprising wet and dry excavation, cofferdams and rock embankments, is to be completed by July 1, 1958.

The work in the Chimney Island area calls for excavation of some 3,700,000 cubic yards of earth and construction of a timber crib and rock fill pier. It is to be completed by July 1, 1958.

Hydro Work Well Advanced

A detailed inspection trip of the project area was made on June 23 by Hydro Chairman Dr. Richard L. Hearn, accompanied by Chief Engineer Dr. Otto Holden, members of the staff for The St. Lawrence Power Project, and officials of Iroquois Constructors Limited, Rayner Construction Limited, Rayner-Armstrong Limited, and Pentagon Construction Company Limited. Following a review of the various stages of work in the immediate area of the powerhouse site, Dr. Hearn announced that work was well advanced on all stages and that the project was now at a major turning point.

An immediate start would be made on the removal of 2 million cubic yards of earth at the powerhouse site, he stated. By early October of this year, drilling and blasting would be started for the removal of 125,000 cubic yards of rock. This excavation work would clear the way for the pouring of the first concrete for the powerhouse itself—scheduled to begin early in the new year. While the dewatering operations were not completed as early as anticipated, he now felt that the original completion date for the entire project would be met.

In addition, Dr. Hearn outlined the contracts awarded to date by Ontario Hydro. A total of more than $61 million in contracts had already been awarded for the various parts of the project.

Two giant steel power-line towers, the tallest ever erected by Ontario Hydro, stand side by side on the north bank of the St. Lawrence ready to carry power lines across the river and present ship channel. The towers are each 335 feet in height and were erected in the record time of about two weeks.

Similar towers were erected on the south bank of the St. Lawrence by the contractors for NYSPA. These towers, weighing 98 tons each, will make it possible for 115,000-volt power lines from Cedar Rapids, Quebec, and the 230,000-volt power lines from the Ontario Hydro system, including the St. Lawrence Project, to span the river. The lines will replace those presently routed adjacent to Ontario Hydro's Cornwall transformer station.

Behind the two huge towers, adjacent to Ontario Hydro's power development administration area, are two other tall steel power-line towers, each 200 feet high and weighing 43½ tons, which will be used to span the existing and proposed Seaway canal, a distance of 1,709 feet. Stringing of the power lines across the river from these crossing towers commenced in June.

Preparatory work for channel excavation on south shore opposite Nun's Island —June 28.

The stringing will be done under tension, a complex operation requiring the use of special stringing equipment. A boat or helicopter will be used to pull a cable into position which, in turn, will be used to pull the conductors into position. The entire stringing operation must be done under tension, in order to maintain clearance for ships passing along the Cornwall Canal and the river.

Flooded Areas

An immediate start is being made on moving about 1,100 people in the village of Iroquois to a new, approved site north of the present community. The present village will be re-established on a selected adjacent site and still within its existing corporate limits. In all, the large-scale move will involve some 280 homes, in addition to commercial properties, schools, churches and municipal offices.

As this is the first St. Lawrence community to be relocated, every effort has been made to establish a workable pattern acceptable to Iroquois families. For purposes of negotiation, residential properties have been classified into two main groups:

(a) Homes which, because of their size and construction, can within economic limits be moved to a new position; and

(b) Homes of such dimensions or types of construction that would prohibit their being moved on an economic basis.

The value of every residence in Iroquois has already been appraised, and to date a number of satisfactory purchases have been made. Hydro's offer to purchase includes 15 per cent allowance for inconvenience, disturbance, et cetera. So that owners may have an opportunity of remaining in the area if they so desire, one building lot in the new Iroquois will be made available to each such owner.

In such instances, the owner will be charged not more than the same price per foot agreed on in the sale of his existing property. The purchaser must, within a limited time, either build on the property or resell it to Ontario Hydro at the same rate, plus simple interest at 5 per cent per annum. As far as possible "moveable" homes, after purchase on the above basis, will be moved to a location in the new Iroquois for the tenant group or for those whose homes cannot or should not be moved.

Where the owner wishes to sell, Ontario Hydro will pay a negotiated amount including the 15 per cent allowance, and will grant to the owner the right to purchase a lot in the new community on terms described. Where the owner wishes to locate in New Iroquois, homes owned and moved by Ontario Hydro will be available. It is expected that in most cases the

compensation paid for these large, heavy buildings will be generally adequate to finance a new and satisfactory home.

Progress By Canada's Seaway Authority

A contract for three and three quarters miles of seaway channel and dyking between Montreal Harbor and Laprairie Basin, has been awarded to Walsh-Canadian Construction Company Ltd., at a price of $4,213,800, the lowest of seven tenders ranging up to $8,435,000. Another contract for three miles of Seaway channel and dyking, upstream from Laprairie to the town of Baudette, has been awarded to Northern Construction Company and J. W. Stewart Limited in joint venture, at a price of $3,279,050, the lowest of five bids ranging up to $5,780,000. Tender calls for these contracts were reported in the July issue of the *Journal*. They bring to twenty the number of contracts awarded to date, for a total value of some $33,544,000.

The National Harbours Board has accepted a tender from the E. G. M. Cape Co. of Montreal for adding some 1,600 ft. of wharf space at the east end of Montreal harbour at a price of $1,800,000. Sheds will be added later.

Progress By NYSPA

A contract has been awarded to the Morrison Knudsen Construction Co. for channel improvement on Galops Island at a price of $5,900,000. Award of a contract for 2 transformers was made to the English Electric Export and Trading Co., at a price of $367,316, the lowest of six tenders. Lowest bid from a U.S. manufacturer was $423,462. A contract for 2 miles of bituminous concrete pavement five miles east of Massena was awarded to D. W. Winkelman of Syracuse at $299,474.

The contract for 32 spillway gates and emergency stoplogs for the Iroquois Dam was awarded to Canadian Vickers Ltd. at $1,964,850, while contract for 31 spillway gates for the Long Sault Dam went to Baldwin Lima at approximately $2,300,000. Tender calls for repairs to the Massena Taylorville transmission line were withdrawn from bidding. Closing time for tenders on the Massena intake and appurtenant works has been extended from July 26 to August 2.

Progress By SLSDC

The Ogdensburg Bridge Authority has set November 1 as the date for opening tenders for a new bridge between Ogdensburg and Prescott. The United States and Canada are expected to announce agreement shortly on the exact location of the channel approach to the Seaway, which will determine the design of the bridge.

Agreement Nearing On Lake Levels

How the Seaway will affect Lake Ontario water levels has led to many a bitter argument between Canadian government officials and New York State lakefront property owners, particularly around Rochester. Three years ago, as a good will gesture Canada removed the Gut Dam which controlled the flow out of Lake Ontario, at a time when the lake level had risen to its maximum.

The International Joint Commission has now drawn up recommendations for controlling the level between a "high" at elevation 248 and a "low" at elevation 244. Some property owners had advocated establishing the range between elevation 247 and 243. While adopting the IJC recommendation will mean some minor adjustments in Seaway construction plans, the property owners' plan would have meant a major deepening of the channel and locks, and thus added cost and almost certain delay in opening the Seaway to navigation.

The Iroquois Dam, when built, will regulate the river flow in such a way that best use may be made of the water at the international powerhouse 25 miles further downstream. A flow into Lake Ontario great enough to raise its level one foot in a month would raise the level of the much smaller Lake St. Louis, which lies between the power plant and Montreal, by one foot in half a day. Because regulation includes discharge of extra water into Lake St. Louis, Quebec Province is also an interested party to the current Lake Ontario level negotiations.

The IJC proposals will represent an improvement over natural conditions, under which water level fluctuations in Lake Ontario now range over 6½ feet. Levels higher than those obtaining naturally will be regulated so as to occur only 10 per cent of the time. Most of the damage to Ontario lakefront property occurs in March, April, November and December.

Lake St. Louis presents a more delicate problem because of the added flow into it from the Ottawa River at the time the ice breaks up. The proposals, now under consideration by New York State, and Ontario and Quebec provincial authorities, hold promise of controlling future lake levels to minimize lakeshore property damages.

Downstream cofferdam for International Powerhouse after dewatering—June 28. Note Hydro traffic tunnel under canal in foreground.

Commission On Coastal Shipping

The commission to inquire into the advisability of changing Canada's shipping laws opened hearings at Ottawa in mid July. Commissioners the Hon. Justice W. F. Spence, W. N. Wickwire and Mr. Belanger received some ten written briefs presented by shipping

and labour organizations. Hearings were then held in St. John's, Newfoundland, Charlottetown and Saint John, New Brunswick, early in August, to be followed by hearings on the west coast and in central Canada.

Spokesmen for the shipbuilders group expressed the view at Ottawa hearings that coastal trade should be reserved to Canadian-built and Canadian registered vessels to give work to Canada's shipyards and as an essential to national defence. This view was supported by speakers for the Canadian Congress of Labour. The Trades and Labour Congress and the Canadian and Catholic Confederation of Labour, who also advocated varying types of subsidies for shipbuilding and shipping to expand these twin marine industries.

Representatives of the Shipowners Association and of the Canadian Industrial Traffic League, however, maintained that the full potential of the Seaway would be blocked if protectionist measures to limit competition were adopted. Both these groups were cool to the idea of federal subsidies for the marine industries.

The Dominion Marine Association, chief voice for the $200 million Great Lakes shipping fleet, withdrew support from proposed restrictions against British shipping on Canada's eastern seaboard, but continued to ask for restricting to Canadian ships the traffic between Canadian ports in the Great Lakes St. Lawrence area. They advoeated a treaty between Canada and United States to bar vessels of other nations from trade between the two countries in the lake-river region.

Toll Charges Being Studied

Canadian and United States toll committees have already met to discuss tolls in a preliminary way, and research is steadily being carried on for this long and vital study which will affect hundreds of thousands of businesses in Canada and the U.S. Since the ultimate cost of building the Seaway will have a direct bearing on the toll rates to be charged, a final schedule of tolls will probably not be set until navigation through the Seaway opens in 1959. Meantime, there will be many more meetings and probably some major disagreements.

Canada is represented by Charles Gavsie, vice-president of Canada's Seaway Authority, assisted by J. C. Lessard, former deputy minister of transport and G. A. Scott of the Department of Transport. The United States committee is chaired by E. Reece Harrill, comptroller, USSDC, assisted by Dr. Charles Taff, a transportation economist, and H. M. Hochfield, government expert on marine transport.

Some questions to be answered: Should tolls be collected by one authority and then divided on some formula yet to be determined, or collected by officials of each authority in their respective areas? Will toll revenue be divided according to use, or according to the money spent on construction by each nation, or a combination of the two? Will tolls be assessed on a commodity or a tonnage basis, or some combination of these? Should tolls be charged on the Welland Canal, and how should they compare with charges on the new locks on the St. Lawrence?

Free Port For Newfoundland?

Newfoundland businessmen who are helping to shape the Island's future see it as the gateway to North America for overseas products. They visualize an ice-free year round port on the Island's south coast, where big cargo vessels can trans-ship and where grains and raw materials can be stockpiled during the open season on the Seaway. They want Canada to declare this a "Freeport". Possible sites are Mortier Bay and Baie d'Espoir, both on the island's south coast, where ocean ice does not drift in far enough to block ocean passage.

The further eastward the "lakers" can operate without trans-shipping inland goods like grain, the shorter the ocean voyage. With stockpiling and trans-shipment on the south shore of Newfoundland, Canadian lake boats would benefit from higher revenues due to the longer haul, it is argued.

Proponents of the idea of a south coast free port claim that if lakers are to be strong enough to carry iron ore up-lake from Sept Isles, they will also be sturdy enough to navigate the gulf between Father Point and Mortier Bay or Baie d'Espoir. Grain earriers now often make return trips to the Lakehead in ballast. If they could off-load grain at Baie d'Espoir their chances of picking up a return load of ore at Sept Isles is bettered; since they would only have to travel in ballast from the Newfoundland port to Sept Isles, or half the distance from Newfoundland to Montreal.

Agreement On Montreal-South Shore Traffic

The Federal Government and a Montreal delegation reached agreement in principle at a meeting in Ottawa on July 20, respecting vehicular traffic improvements as proposed by City authorities. While no final decisions were announced, an agreeable and complete discussion was held. The overall cost of between $40 and $50 millions will be financed by tolls, though whether federal, provincial or municipal authorities would pay for the construction was still to be decided.

The main features proposed are:

1. Access to the centre-harbour Seaway dyke from St. Helen's Island, with connecting bridge link from dyke to Victoria Bridge.

2. A second bridge link from the western end of the dyke to Laprairie on the South Shore.

3. A third bridge crossing Nun's Island from the North Shore to the dyke.

4. A short vehicular tunnel from the south end of Victoria Bridge under the Seaway channel.

5. A four lane highway on the dyke, with small parking lots for vehicles in distress.

Other News Of Seaway Affairs

The House of Representatives Public Works Sub-Committee on June 30 completed hearings on a bill to deepen connecting channels in the upper Great Lakes at a cost of $110 million. Not a single witness appeared to voice opposition.

Chairman John Blatnik will press for quick action by his subcommittee and the full committee. He will also seek action by the House during the current session of Congress. Belief is general that congressional approval is certain, though it may not come before 1956. There has been no voiced opposition to the channel-deepening legislation in the Senate, and none appears to be developing. Senator Wiley has stated he would make every effort to have the bill taken up by the Senate Public Works Committee this year.

"Where Do We Go in the Next Twenty Years"

An outstanding feature of the Aviation Writers Association's recent annual meeting in Toronto was the panel discussion on this subject. With a group of experts on the platform and a group of vitally interested persons in the audience everything was set for a most interesting experience.

The platform party consisted of Ralph Platt of the Cleveland *News* as moderator, and the panel members were Dr. Edward Warner of Montreal, president of the council of International Civil Aviation Organization; Sydney G. Cooper, public information officer, International Civil Aviation Organization; J. T. Dyment, M.E.I.C., director of engineering, Trans Canada Airlines; John Bellringer, Technical Secretariat, International Air Transport Association, and S. Ralph Cohen, public relations officer, International Air Transport Association.

The session opened with the moderator asking Dr. Warner if he would tell something about ICAO. Dr. Warner gave a nicely condensed, fully comprehensive history of the organization and a statement of its objectives. Among other things he stated that the membership of ICAO included representation of sixty-five governments and represented ninety-seven per cent of the international civil flying. The work of the organization was concerned with technical, economical and legal matters relating to international aviation.

In response to a question as to what he thought would happen to airplanes and air travel in the next twenty years he stated that by 1960 he thought the new planes would be turbo jets carrying about one hundred passengers, flying about five hundred and fifty miles per hour, and going from New York or Montreal to London or Paris non stop. In twenty years he thought further developments would be in speed, and that by that time planes of international service would be doing about six hundred miles per hour.

Jack Dyment when asked about helicopters for the future stated that there are serious economic problems which would retard the use of the helicopter for ordinary transportation. He pointed out, too, that at the present state of development the helicopter was very noisy and therefore not suited to ferrying people from the centre of the city to an airport.

He thought that the new type of vehicle which was operated by vertical thrust held a great deal of promise but he did not know when it would be developed to the point that it could be used commercially.

Discussion

The following questions and answers are reported at random without attempting to identify any of the speakers.

With the increase in numbers of planes, their size and their speeds, the auxiliary services at an airport become increasingly important. The complete preplanning of traffic becomes more and more important under the changing conditions.

Jet planes are expensive to bring down and to get up inasmuch as they do not operate efficiently at anything less than maximum speed. Therefore it becomes increasingly important to cut out stops for this type of aircraft.

To eliminate one stop in a jet plane's flight would be equivalent to adding from one hundred to one hundred and fifty miles per hour to its speed. Also time taken at the airport should be kept at the minimum because ten minutes time lost anywhere is equal to eighty miles per hour flight in the air.

The audience kept coming back with questions about the helicopter. The panel experts continued to emphasize the amount of noise made by these machines. It would require a lot of power to overcome this and the present designs of helicopters are such that there is no extra power that can be used for this purpose. As a matter of fact there is not now enough power in the machines to equal the safety factor of the ordinary airplane. It was the opinion of the panel that it may well be 1960 to 1962 before there is any wide use of the helicopter for passenger service, and it is felt that this machine would within a reasonable period of time be succeeded by the vertical rising aircraft, which would do away with rotors, particularly of the large type required by helicopters.

The vertical rising machine has its power applied in such a way that it will rise vertically by the downward thrust of the jets, and when the proper height has been reached the direction of the jets can be changed so that the machine can be driven in any direction. There are other variations.

Today's aircraft has been developed to a point where it develops an 1,800 pound thrust for 200 pounds of weight. It was suggested by one panel member that it might be 20 or 25 years before the "bedstead" or vertical riser would be in commercial use.

For jet flying at higher speeds, air traffic control will become more difficult, and more lateral separation will be required. The vertical separation will not be so important. The lateral considerations become especially important above the level of 25,000 feet although below that height it is felt that the present conventional controls will be sufficient. It was suggested that additional aids to navigation would be developed. There is now a device which operates independently of the ground contacts. It is a self-contained mechanism and the information it gives is based on the record which the instrument itself has set up from the time of its departure from the air field.

Tariffs

It was the panel's opinion that tariffs are steadily coming down. For the past ten years, as far as first class transportation is concerned, the line has been held. This means that holding 1945 values in terms of dollar values really represents a cut of about 45% in cost. The tourist services have brought about reductions in fare from about 20 to 30%. There is now a "B" fare which is applicable under certain conditions. This is another 20% below the tourist rate. The present international fare structure is based on last year's experience and foreseeable conditions for next year.

Cargo

The volume of cargo has increased less over the last three years than has the volume of passenger traffic. It was the opinion that cargo costs would never get down to a real competitive level until a new and better type of plane was available to civilian use. The present air cargo ships are

simply converted passenger planes, but it is unlikely that anything better will be available for a long time.

Vertical Take Off

Vertieal take off is definitely a matter of immediate importance.

It was not felt that present runways would be increased in length. It was believed that companies manufacturing aireraft would now limit themselves to designs of machines that permit them to take off from present runways. In spite of talk about vertical take off and other types of planes it was felt that runways similar to our existing runways would be required for the next fifty years anyway.

Helicopters for Short Hauls

The suggestion was made that helicopters might be used to replace trailer trucks on short hauls of cargo. However, it was felt that the cost was too high. It was admitted, however, in computing such costs consideration should be given, where they are applicable, to the cost of making new roads for highway transport. A ease was cited in Australia where it was found cheaper to fly beef at the high cost of air travel than to build a new road that would be necessary for this traffie and whieh would have but little other traffic.

The present cost of large airplanes was in the neighbourhood of two million dollars. It was felt that this would approach the figure of four million dollars and that all must have automatic approach equipment.

Lighter than air machines were discussed but it was indicated that they were slow, having a speed of only about one hundred miles an hour, and that they were hard to handle.

The influenee of directional flow of eargo was diseussed. It was pointed out that as far as T.C.A. was concerned their cargo traffic was very largely in one direction. For instance early in the year there is a volume of traffic in flowers from the west to the east, also in due season the heavy traffic in apples from the west to the east. From the east to the west there was considerable traffic in fish but in those seasons there is no great volume of traffie to occupy space in the opposite directions.

Airport Design

Referenee was made to a recently opened airport which had been designed by an architect. It was pointed out that while this had a lot of interesting features it failed in a great many instances to meet the actual requirements because the architect had had no knowledge of, and apparently but little interest in, the functional operation of the area. It was suggested that before airports be designed, full consideration should be given to their needs from every point of view, present and future.

Nuclear Power

It was not thought that there would be any significant development in this in the near future as far as aviation was concerned. It was pointed out that what is wanted now, and will be wanted in the future, is a more frequent service rather than faster planes or bigger planes. In other words, a better service could be supplied by smaller equipment operating at hourly intervals rather than by carriers double the size leaving at two hour intervals.

Future Growth

The volume of passenger traffic at the present time was increasing at about fifteen per cent per year. It was the opinion that this would continue to increase and that shortly the volume would be two or three times the present volume. In twenty years time it was thought the volume might well be five times what it is now.

Conclusion

One thing about this type of audience was that there was no shortage of questions and no shortage of answers from people who knew of what they were talking. It was a most interesting and profitable experience to be present.

International Air Show

On June 4 the Aviation Writers Association meeting was made to coincide with the International Air Show which was put on by the Toronto Flying Club as a feature of the Canadian International Trade Fair and the A.W.A. meeting. It was held along the lakeshore in front of the Exhibition Park and was opened by the Right Honorable C. D. Howe, HON.M.E.I.C. According to the newspapers 150,000 people were present but according to this observer, and many others who found it almost impossible to get into their reserved seat section, there must have been ten times that many.

It is interesting to contemplate what a drama eritic or a musie eritie would say about an air show. The stage is so gigantic in comparison with the indoor affairs and the action is so fast and so varied that the vocabulary used in a routine way by those erities would never apply.

The show was a great success no matter from what point of view it was regarded. In the first place —and there is nothing more important than this—the weather was ideal. Secondly, the program was a most exciting one. Every pilot in turn was a star and every plane was a perfect medium through which to demonstrate his skills.

It would be useless, doubtless boring, to attempt to describe the work of each plane as it appeared, particularly when it is remembered that there were almost twenty items on the program. These included demonstrations of such machines as the F 86 Sabre Jet, the C.F. 100's, and the T 33 Silver Stars, the de Havilland Chipmunk, the R.C.A.F. Neptune Coastal Reconnaissance Aireraft, helicopters of the following varieties: Piasecki (the flying banana), the Bristols' Sycamore, and Bell's 47 H., the de Havilland Beaver and Otter, jets of the U.S. Navy and the naval reserve, a Martin Marlin flying boat of the U.S. Navy, the F 86 D with after burner, U.S. Navy Reserve Cougars, a two-seat military trainer from Czechoslovakia, and a Grumman C.S. 2 F, built for the Royal Canadian Navy.

Unfair Competition

On at least three occasions the audience was delighted with a flying performance put on by seagulls and wild ducks. While the pilot of a Chipmunk was putting on a breathtaking exhibition of aerobatics high in the sky, a gull flew into the foreground and put on a similar act which made man's efforts seem less magnificent than they had been before.

At another time when the U.S.A.F. were putting on a very brilliant demonstration with three jets, some wild ducks ran a counter show. The three jets had crossed the course and circled far

out over the lake to return again from the east; the audience was waiting breathlessly for their return, suddenly a man at the front of the crowd cried, "here, they come", the audience turned round over their shoulders to look, and there coming diagonally over the crowd and then across the course were three black ducks flying in perfect formation. It was only a few seconds before the jets also crossed the course but nevertheless it was the ducks that stole the show. Their effort was greatly appreciated by the audience and really provided the unofficial highlight of the afternoon which is saying a lot.

The Big Surprise

Reference must be made to the performance of the Motokov two-seater military trainer from Czechoslovakia. Over the P.A. system the audience were informed that this plane had been put together by the pilot and a helper in three hours' time that morning. It was stated that the plane weighed less than two thousand pounds and was powered, if that is the right word for it, by a 105 h.p. engine.

Naturally under these conditions the audience did not expect very much. However, they were all in for a shock. When the pilot got under way he put on a show the like of which it was said had never been seen at any other time. As one R.C.A.F. officer was heard to remark after the performance of a most exciting pattern: "He can't do that—nobody can do that". That seemed to be the opinion of all the experts. The man continued to do all the things which nobody could do.

The little plane with its small engine did the impossible. It is hoped that some of the moving picture cameras which were there in great numbers, caught his performance with a telescopic lens so that other audiences as well can be thrilled with his performance.

To illustrate some of the things that he did here are a few observations. At one point he flew for a considerable distance with the wings vertical, in other words there seemed to be nothing but the body of the fuselage in the plane that would give support to his machine, and yet he did not lose altitude. He started a loop close to the water's surface and then rose up to the top of the loop and levelled off. Instead of completing the loop by coming down he turned in the opposite direction and went on up and performed another loop on top of the one which he had just half finished.

At another time he flew a complete circle with the machine upside down. At another time his stunt was to fly a complete horizontal circle doing rolls continuously. It seemed to make but little difference to this man whether he was upside up, upside down, sideways, or in between.

It seemed like a futile thing to do and yet there was no other way that the audience could express its approval and so as he flew past the last time everyone stood up and applauded him.

It would not do to overlook the performance of the C.F. 100 which came almost at the end of the program. Several jets had flown earlier in the day but when this star appeared on the program all the others were forgotten. Particularly exciting was the ability of the plane to climb vertically. To the eye it seemed to go up, and up, and up, as though it were never going to come down again and then with a short hovering just at the top of the climb it would turn over and dive back across in front of the grandstand. It was a thrilling experience, particularly to a Canadian who took pride in the fact that this machine had been designed and built in Canada.

If this international air show can continue to put on a program such as was put on on this occasion there is no reason why greatly increased numbers of persons should not come from all over North America to see it. However, if such a development does take place they are going to have to build a lot more grandstand seats and standing area. Everyone associated with this show is to be heartily congratulated.

T.C.A. Viscounts

At a business session during the Aviation Writers Association annual meeting, Jack Dyment, M.E.I.C., director of engineering of T.C.A. told why that company had selected the Vickers Viscount. Among other things which he said are the following:

Simplicity of flying the Viscount is a great advantage. In the ordinary conventional machine it takes a pilot and flight engineer to do what can be done on the Viscount by the pilot alone.

The first costs of the aircraft are not so important. It is the long time experience that counts along with the safety and reliability. The Viscount power plant as it gets older is much more economical to operate than would be the piston type engine under the same conditions.

At the present time the Viscount costs between $800,000.00 and $1,000,000.00 each, which was considerably less than other machines of the conventional type in the same field.

One man can fly the aircraft by himself from either seat. The engines use the JP/4 fuel, which is described as "a wide cut fuel" instead of kerosene. The decision to use this fuel is based on safety, reliability and economy. JP/4 is much more readily obtained in different parts of the world and it is figured that as compared to the cost of kerosene the T.C.A. would save about $190,000.00 a year on fuel, and as well will avoid certain low temperature operation problems.

T.C.A. proposed about 250 changes which Vickers Armstrong Limited agreed to and installed in the Canadian machines. Many of these changes came from the experience gained by a prototype which was flown to Canada early in 1953 for test purposes. It is interesting to note also that almost all of the changes requested by T.C.A. will now be included as standard for Viscounts operating in North America. Capitol Airlines of the United States has already ordered forty Viscounts and has an option on twenty more.

A great deal of standard American equipment was installed in order to reduce the servicing problems on this side of the Atlantic.

Operation Experience

Experience in Canada has shown that 86% of 308 flights were conducted on schedule. Only 11 flights were delayed for mechanical reasons. On flights between Montreal and Toronto 86% of the seats were occupied, and on the Toronto-New York route the factor reached 87%. Since these figures

were released the traffic has been even higher.

T.C.A. now has 8 Viscounts delivered and 17 more on order.

Another further interesting piece of information is that out of a great number of occasions upon which something was not quite right it turned out that only in one instance was it due to engine trouble, and this was a minor affair. All the rest of the difficulties were related to the aircraft and its equipment. Such "teething" troubles are of course the normal experience with any new large aircraft design.

Up to the middle of April, 186 Viscounts had been ordered by 21 different customers including 18 airlines and 3 governments, representing 16 countries. Up to the date of these figures 52 of the Viscounts had been delivered.

CSA Annual Meeting

The Canadian Standards Association completed its 36th year of service to Canada in the holding of its 28th annual general meeting at the Chateau Laurier, Ottawa, on June 15, 1955. Dean R. E. Jamieson of McGill University, the retiring CSA president, who has given twenty-five years service to the work of standardization in Canada, was chairman.

Every yearly report emphasizes the growing importance of CSA to the Canadian economy. As the chairmen of 19 sectional committees made their reports, it was evident that the scope of the new standards is becoming wider year by year.

In October, 1954 the new and modern CSA Laboratories with 50,000 square feet of floor space, for the testing of electrical and oil-burning equipment, located at Toronto, were opened by Dean Jamieson. Applications received by the Approvals Division covering all phases of their work numbered 4,008.

The report of the Canadian Welding Bureau made by C. E. Macdonald, chairman of the administrative board, showed increased acceptance of CSA welding standards throughout Canada. During the year the number of fabricators approved by the Bureau to the requirements of CSA Welding Qualification Code W47 increased from 148 to 168. In June, 194 wrote the Bureau's examinations in "Welding Fundamental Principles and Practices", and 120 are currently enrolled in the same course.

F. A. Sweet, general manager, stated that sustaining memberships in the Association were at an all time high of well over one thousand organizations, coming mainly from industrial concerns, provincial government departments, municipalities and public utilities. Seventy-three new and revised standards were published out of 298 standardization projects that were active during the year.

Dean Jamieson declared that the vigorous growth in membership of the Canadian Standards Association shows clearly Canadian industry's sincere desire to streamline its own far-flung operations.

J. S. Cameron, M.E.I.C., CSA President

He reported he had attended the 1954 council meeting of the International Organization for Standardization (ISO) held in Geneva in September, and that, incidentally, CSA was being represented at the general assembly meetings of ISO being held in Stockholm, Sweden, at the present time, by First-Vice-President J. S. Cameron. CSA also participated in an "ABC" conference on Unification of Engineering Standards held in New York in April of this year.

Most of the meetings of the

CSA Sectional Committee Activities and Meetings

For Year Ended March 15, 1955

Committee on	Standards Published	Revisions Published	Standards under Revision	Standards under Int. Revision	New Projects	Projects withdrawn	Held in abeyance	Meetings held
Building materials	8	12	..	1	2	.	..	1
Concrete	..	..	1	2	..	..	..	5
Mechanical work	3	3	8	4	11	1	..	8
Fire prevention	..	..	2	1	4	..	..	3
Electrical work	2	1	7	2	6	..	..	5
Illumination	1	..	..	..	3	..	..	1
Electrical Code Part II	12	56	3	7	13	1	.	3
Outside wiring rules	..	..	4	..	2	..	..	2
Electrical Code Part III	4	..	1	..	4	..	..	3
Electrical Code Part V	..	..	..	..	..	..	..	..
Electrical Code Part VI	..	..	..	..	..	..	..	..
Ferrous metals	6	..	..	..	..	..	3	.
Non Ferrous metallurgy	..	..	2	..	3	..	..	1
Timber	36	..	1	1	6	..	..	5
Steel construction	..	..	1	..	..	..	..	1
Welding	..	..	.	..	1	..	..	.
Marine welding	..	..	..	..	1	.	.	1
Protective packing	..	..	..	..	10	..	..	.
Photographic Equipment	..	..	2	..	3	..	..	1
Abbrev., Defin. Symbols	..	..	1	..	2	..	.	1
Oil burning equipment	..	..	..	..	11	..	.	2
Miscellaneous	1	..	..	..	..	.	.	1

technical committees of ISO are held in Europe, he stated, and it was therefore usually not practicable to have Canadian members attend. However, when such meetings have appeared to be of sufficient importance, it had been possible to arrange for such personal attendance.

Among the new projects currently authorized or under discussion, the president mentioned air pollution control and gas burning appliances. Of these, the former had been authorized as a CSA project and a committee was being formed under the chairmanship of Prof. E. A. Allcut, M.E.I.C., of the University of Toronto. The plan is to prepare a code of standards on measurement of air pollution and methods of control. The request for this project was sponsored by the Engineering Institute of Canada.

The subject of standards for gas burning appliances and their installation had recently been assuming greater importance with the spread in the use of natural gas, he stated. The Board had had lengthy discussions with representatives of the industry and of provincial inspection authorities.

The sixth edition of the Canadian Electrical Code, Part I, was published in August, 1953 and 23,000 copies have been sold. Over 100 revisions to this edition have been formally approved and were published in April, 1955 in a separate publication identified as "Section 70".

Elections of Directors and Officers

As 1955 was an election year for the Association, seven members were elected to the board of directors, as follows: Alan Brown, Gatineau Power Co., Ottawa; J. H. Jenkins, Department of Northern Affairs and National Resources, Ottawa; C. E. Macdonald, International Nickel Co., Toronto; A. A. Moline, M.E.I.C., Canadian Westinghouse Co., Hamilton; Dr. P. L. Pratley, M.E.I.C., Montreal; G. B. Tebo, Hydro-Electric Power Commission of Ontario, Toronto; and M. C. Thurling, Canadian General Electric Company Ltd., Toronto.

A meeting of the board of directors held at the conclusion of the annual meeting elected the following officers: president, J. S. Cameron, M.E.I.C.; first vice-president, Dr. J. M. Thomson, M.E.I.C.; second vice-president, R. S. Eadie, M.E.I.C.

Peaceful Uses of Atomic Energy

Possibly the most important development in the "atomic age" has taken place at Geneva, Switzerland, in the past few weeks when eighty-four nations have turned their attention to international cooperation for the use of atomic energy for the benefit of mankind.

Canadian scientists presented thirteen papers to the International Conference on the Peaceful Uses of Atomic Energy just concluded there.

The main topics on the agenda were atomic power and the use of radioactive isotopes in medicine, biology, agriculture and industry.

W. J. Bennett, president of both Atomic Energy of Canada Limited and Eldorado Mining and Refining Limited, headed the Canadian delegation. Dr. W. B. Lewis, vice-president, research and development, Atomic Energy of Canada Limited, was one of six scientists appointed to act as vice-presidents of the conference.

A Canadian exhibit on display in the Palais des Nations throughout the conference, included such items as models of the NRX and NRU reactors, a collection of radioactive minerals from various regions of the country, radiation detection instruments developed at Chalk River, two Cobalt-60 beam therapy units (an "Eldorado" unit and a "Theratron"), an actual piece of an NRX fuel rod and blueprints not only of a fuel rod but also of the reactor itself, detailed data sheets on the ZEEP, NRX and NRU reactors, preliminary diagrams of Canada's first atomic power station, and a large number of photographs. Atomic Energy of Canada Limited distributed at the conference a 72-page booklet describing the Canadian atomic energy program. This will be the subject of a further review.

The *Journal* will publish more about the conference proceedings, based on information sent directly by a member of the Canadian delegation.

It is further proposed to follow the progress of nuclear energy developments, particularly of power production, by a series of technical articles on engineering aspects involved, and by news items.

Canadian Papers Presented at Geneva Conference

Some Economic Aspects of Nuclear Fuel Cycles
Dr. W. B. Lewis, vice-president, research and development, Atomic Energy of Canada Limited, Chalk River, Ont.

Studies of Special Problems in Agriculture and Silviculture by the Use of Radioisotopes
Dr. J. W. T. Spinks, dean of graduate studies, University of Saskatchewan, Saskatoon.

Further Clinical Studies of Thyroid and Salivary Gland Function with Radioiodine
Dr. C. H. Jaimet and Dr. H. G. Thode, Department of Medical Research, Hamilton College, McMaster University, Hamilton.

Experiments on Some Characteristics of the NRX Reactor: Part I — Methods and Prolonged Fuel Irradiation
Dr. D. G. Hurst, assistant director, Reactor Research and Development Division, Atomic Energy of Canada Limited, Chalk River.

Experiments on Some Characteristics of the NRX Reactor: Part II — Temperature and Transient Poison Effects
A. G. Ward, Reactor Research and Development Division, Atomic Energy of Canada Limited, Chalk River.

An Economic Forecast of the Role of Nuclear Power in Canada
Dr. J. Davis, associate director, Economics Branch, Department of Trade and Commerce, Ottawa, and Dr. W. B. Lewis, vice-president, research and development, Atomic Energy of Canada Limited, Chalk River.

Uranium Prospecting in Canada — Ground and Aerial Surveys
Dr. A. H. Lang, acting chief, Mineral Deposits Division, Geological Survey of Canada, Ottawa.

Electric Power in Canada, Regional Forecasts in Relation to Nuclear Power Possibilities
Dr. J. Davis, associate director, Economics Branch, Department of Trade and Commerce, Ottawa.

Experience with Heavy Water Systems in the NRX Reactor
Dr. R. F. S. Robertson, Development Chemistry Branch, Atomic Energy of Canada Limited, Chalk River.

Canadian Practice in Ore Dressing and Extractive Metallurgy of Uranium
A. Thumaes, director of research, Eldorado Mining and Refining Limited, Ottawa.

Health and Safety Activities in Reactor Operations and Chemical Processing Plants
Dr. A. J. Cipriani, director, Biology and Radiation Hazards Control Division, Atomic Energy of Canada Limited, Chalk River.

Waste Disposal into the Ground
Dr. C. A. Mawson, Biology Research and Radiation Hazards Control Division, Atomic Energy of Canada Limited, Chalk River.

Current Techniques in the Handling and Distribution of Cobalt-60 Radiation Sources
Dr. A. B. Lillie, Commercial Products Division, Atomic Energy of Canada Limited, Ottawa.

British Official Signs Register

Kenneth Platt, assistant secretary of the Institution of Mechanical Engineers, England, is shown here with, from left to right, I. R. Tait and the general secretary. Mr. Platt attended the annual meeting of the Institute in Toronto and also visited Headquarters the following week.

New Aircraft Computer

The new PSC Applied Research R-Theta Computer indicates to the pilot how many miles he is from base or target, and what direction he must steer to arrive there. For inventing the R-Theta, W/C J. G. Wright, DFC, one of Canada's outstanding navigation specialists, has been awarded the McKee Trans-Canada trophy for 1954, presented annually to the person who has contributed the most toward the advancement of Canadian aviation.

With the advent of high-speed jet planes the range of aircraft has become greater and the time factor has decreased. Work on a 1500 mile flight which had previously taken approximately ten hours now has been compressed into less than three. There is neither time nor working space on today's jet planes to keep a "dead reckoning" plot, and nor is it feasible for military planes to fly in the straight directions required to perform accurate navigation.

Work on automatic navigation systems began in various countries as early as 1935. Research went on in two directions, one intent on solving the problem by developing a "dead reckoning" instrument, capable of giving the navigator an approximate position, the other concentrating on radio aids to navigation, of which Loran, Decca, radio range, and search radar are some of the developments. Such systems are reliable and time-tested, but suffer from two distinct disadvantages, of which the main one is the enormous expense of the large ground stations required for radio navigation. The second disadvantage is their dependency on radio transmission for operation, which in wartime could be of great advantage to the enemy.

All of the automatic deduced reckoning systems were basically the same. They all sensed the direction and distance the aircraft had gone, broke this information down into North-South, East-West components, and indicated the aircraft's present position as latitude and longitude. Although the aircraft's present position can be valuable information for the navigator, he usually requires this information to compute the direction to go to reach his destination and the time required to get there. For this reason it is much more valuable to find a means of expressing position as a distance and bearing from a given point.

The R-Theta computes automatically the combined effect of the aircraft's heading and airspeed and adds to this the distance the aircraft will be blown by the wind, expressing the resultant as a distance and bearing, rather than latitude and longitude. In addition, the 37-pound, instrument can be set to compute the distance and bearing of any other position desired, within the range limit of the device. Translated into the terms of a human navigator it is an automatic plotter and computer.

To visualize the operation of the computer, one must imagine an aircraft taking off with two long fishing lines tightly wound on their reels held by a spring and attached to its fuselage. One line is fixed to its takeoff point, while the other is attached to its destination. No matter what manoeuvers the air-

W/C J. G. Wright, RCAF, inventor of the R-Theta Computer, received the McKee Trophy at the Aviation Writer's Association annual dinner, June 3, 1955. W/C Wright is shown at left, with Bill Hachnel (centre) and Jack McKelvie, project engineers on the computer.

craft performs during flight, the pilot need only follow one line back to his starting point or the other to his destination. Distances of course, can be read from the lines, marked off in miles.

Calculations in the R-Theta Computer are performed automatically, entirely independent of radio transmissions. Distance and bearing of an alternate base can be set into the device by turning two knobs and depressing a switch, whereupon distance is indicated on a counter in the face of the instrument, and direction is shown by a double arrow. A single arrow in the display panel indicates the aircraft's track over the ground. When the pilot turns until he brings the single arrow over the double one he is flying toward his destination. Should the pilot wish to return to base, all he need do is lift a small lever marked "vector-add," and the double arrow swings around to the direction of the base from him.

One of the most interesting features of the instrument is what is referred to as its "memory," which remembers the aircraft's heading and speed during the time the navigator is adding or subtracting vectors.

The name "R-Theta" is derived from W C Wright's concept of reporting position by distance and bearing rather than Cartesian co-ordinates. The new concept required plotting position in polar co-ordinates. This can be illustrated by a man standing on a plank and flying a model aircraft on the end of a string. The man represents the Pole. The position of the aircraft at any time during its flight can be expressed by the length of the string, (the radius, "R") and the angle between the string and the plant (direction) as the angle Theta. A computer indicating position and R and Theta co-ordinates was naturally called an R-Theta computer.

W C Wright became interested in developing a computer of this type more than ten years ago, but he first put his ideas down on paper in the spring of 1946. He used these ideas as materials for a thesis on a specialist's navigation course at the RAF's Specialist Navigation School at Shawbury in England.

He has been engaged in navigation research and development work since 1946, and currently heads the instrument development section at Air Force Headquarters in Ottawa.

The ASME Boiler Code

Interpretations

The Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

The following revisions were formulated at the meeting of April 29, 1955.

Proposed Case No. 1204

(Special Ruling)

Inquiry: Is it permissible in welded construction conforming to the requirements of Section VIII of the Code to use quenched and tempered steel plate and forgings conforming to the requirements of the following specification:

1—*Scope* This specification covers alloy-steel plates of firebox quality and alloy-steel forgings intended particularly for use in welded pressure vessels.

2—*General Conditions for Delivery* Material furnished under this specification shall conform to the applicable requirements of the current edition of the Tentative Specification for General Requirements for Delivery of Rolled Steel Plates of Flange and Firebox Qualities (ASTM Designation: A-20), except as herein modified.

3—*Process* The steel shall be made by either or both of the following processes: open-hearth or electric-furnace.

4—*Heat Treatment* The material shall be treated by the material manufacturer to produce the tensile requirements of Table II by heating to not less than 1650F, quenching in water between 50F and 100F, and tempering to not less than 1150F with a holding time of one hour per inch of thickness, but in no case less than one half hour.

5—*Chemical Composition* The steel shall conform to the chemical requirements prescribed in Table I.

Table I—Chemical Requirements

Carbon, per cent	0.10 /0.20
Manganese, per cent	0.60 /1.00
Phosphorus, max., per cent	0.035
Sulphur, max., per cent	0.040
Silicon, per cent	0.15 /0.35
Nickel, per cent	0.70 /1.00
Chromium, per cent	0.40 /0.80
Molybdenum, per cent	0.40 /0.60
Vanadium, per cent	0.03 /0.10
Copper, per cent	0.15 /0.50
Boron, per cent	0.002/0.006

If the material is subjected to check analysis, the AISI standard permissible variations apply.

6—*Tensile Properties* The material as represented by the tension test specimens shall conform to the requirements as to tensile properties prescribed in Table II.

Table II—Tensile Requirements

Tensile strength, psi, min.	105,000
Yield strength, psi, min.	90,000
Elongation in 2 in., min, per cent	17

7—*Bending Properties* The bend test specimen shall stand being bent cold (room temperature) through 180° without cracking on the outside of the bent portion to an inside diameter which shall have the relation to the thickness of the specimen prescribed in Table III. When the test is made on a specimen reduced in thickness, the rolled surface shall be on the outer curve of the bend.

Table III—Bend Diameters

Thickness of material, in.	Ratio of Bend Diameter to Thickness of Specimen
½" to 1", incl.	2
Over 1" to 2", incl.	3

8—*Test Specimens* The test specimens shall be prepared from the material in its heat-treated condition, or from full thickness samples similarly and simultaneously treated.

9—*Number of Tests for Plate* One tension test longitudinal from the bottom, one tension test longitudinal from the top, and one bend test transverse from the top shall be made from each plate as heat treated. One homogeneity test shall be made from each plate as rolled.

Note: The term "plate as rolled" used here refers to the unit plate rolled from a slab or directly from an ingot in its relation to the location and number of specimens, not to its condition.

10—*Number of Tests for Forgings and Formed Parts* One tension and one bend specimen shall be made of each heat of material included in any one heat-treatment lot.

Reply: It is the opinion of the Committee that the material specified in the Inquiry may be used in the construction of welded pressure vessels under the rules of Section VIII of the Code provided the following additional requirements are complied with:

(1) The maximum thickness of shell and head plates shall be 2 in.

(2) The maximum operating temperature shall not exceed 650F.

(3) The requirements of Par. UG-84 shall be met for vessels that are to operate at temperatures below —20F.

(4) The maximum allowable stress value for use in Table UCS-23 shall be 26,250 psi.

(5) Shell plates shall not be heated for forming to a temperature higher than 1100F. Other parts including heads that are heated for forming to temperatures over 1100F shall be heat treated by the manufacturer of the head or part. Forgings shall be heat-treated by the manufacturer of the forging. Test

specimens prepared from full-thickness material in its final heat-treated condition, or from full-thickness samples similarly and simultaneously treated, shall be taken from any pressure parts that have been heat-treated above 1100F after forming.

(6) When the shell or head thickness exceeds 0.50 in., the finished vessel shall be stress-relieved as provided in Par. UCS-56(c). The stress-relieving temperature shall be between 1000F and 1100F (at least 50F below the minimum tempering temperature.)

Cautionary Note: Filler metal deposited by nickel-molybdenum-vanadium type of electrodes can become embrittled at the above stress-relieving temperature.

(7) Double welded butt-joints shall be examined radiographically for their full length as prescribed in Par. UW-51.

(8) Welds not fully radiographed, including welds for attaching non-pressure parts, shall be examined after the hydrostatic test by the magnetic-particle method.

(9) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX, except that the radius of the mandrel used in the guided bend tests may be 1¼ in. instead of ¾ in. A separate welding procedure shall be made for this material.

(10) All main welded joints including welds for nozzle attachment shall be of the double welded butt type.

Proposed Case No. 1205
(Special Ruling)

Inquiry: Under what conditions may the carbon and alloy steel forgings of ASTM Specification A-372-53T be used in the construction of special integrally forged unfired pressure vessels and be stamped with the Code symbol? May working stresses of one-third of the minimum specified tensile strength be used for storage vessels in non-corrosive service?

Reply: It is the opinion of the Committee that forgings complying with ASTM Specification A-372-53T may be used in the construction of seamless unfired pressure vessels under the rules of Section VIII provided the following additional requirements are met, and when so constructed the vessels may be stamped with the Code symbol.

1. The maximum inside diameter of the shell is 24 inches.

2. The design temperature of the vessel is between —20F and 150F.

3. The streamlined design as shown in the sketch below incorporates:

(a) No stress raisers such as openings, welded attachments, or stamping on the shell portion.

(b) Integral heads, hot formed, concave to the pressure, and so shaped and thickened as to provide details of design and construction of the center openings which will be as safe as those provided by the rules of the Code; center openings not exceeding 50% of the diameter of the vessel or 3″ pipe size; other openings in the head not exceeding ¾″ pipe size; openings shall be placed at a point where the calculated stress, without holes, is not more than one-eighth of the specified minimum tensile strength.

(c) No welding.

4. The completed vessel, after all forming operations, is heat treated by one of the applicable methods outlined in A-372. When oil quenched and tempered, forgings shall be subjected to a magnetic particle inspection as outlined in ASTM Designation A-275, to detect the presence of quenching cracks on the outside surface of the shell portion. A crack which is not removed within the minimum thickness limit of the shell is cause for rejection.

5. The tensile properties are determined by the testing method outlined in ASTM Designation A-372-53T using specimens which are representative of each lot and which are selected after the final heat treatment of the lot.

6. Each vessel that is subjected to a heat treatment involving an oil quench and temper shall be hardness tested at 5 foot intervals with a minimum of three different locations representing approximately the center and each end of the heat treated shell. The average of individual hardness readings at each location shall not be less than 225 Brinell nor more than 300 Brinell, and the highest average hardness shall not exceed the lowest average hardness on an individual vessel by more than 40 Brinell number. (Other hardness testing methods may be used and converted to Brinell using the tables in ASTM Designation E-48). Reheat treatment is permitted.

7. Maximum allowable working stresses shall be *one-fourth* the specified minimum tensile strength given in ASTM A-372-53T except that maximum allowable working stresses of *one-third* the specified minimum tensile strength may be used under the following limitations:

(a) The vessel is not subject to corrosion on the interior or exterior.

(b) The vessel is not subject to shock or rapid cyclic operation.

(c) Each vessel, regardless of heat treatment, is subjected to a magnetic particle inspection as outlined in ASTM Designation A-275, to detect the presence of quenching cracks on the outside surface of the shell portion. A crack which is not removed within the minimum thickness limit of the shell is cause for rejection.

(d) The vessel is stamped on the thicknened head portion with both the maximum allowable working pressure based on a stress equal to one-fourth the specified min. tensile strength and also the maximum allowable working pressure based on a stress equal to one-third the specified minimum tensile strength. The marking "Case No. 1205" shall be stamped following the latter pressure marking.

Case No. 1206
(Special Ruling)

Inquiry: Pending further review of practical experience data made available to the Committee, may the provisions of Par. P-268 and Table P-12 included in the 1952 edition of Section I be used for construction of boilers instead of the revision issued as an Addenda in 1954?

Reply: It is the opinion of the Committee that pending further review either the provisions of Par. P-268 and Table P-12 of 1952 edition of Section I or the Addenda of 1954 may be used in the construction of boilers.

Case No. 1207
(Special Ruling)

Inquiry: May seamless steel pipe having 70,000 minimum tensile strength be used in the construction of high pressure boilers and pressure vessels under the rules of the Code?

Reply: It is the opinion of the Committee that carbon steel seamless pipe having 70,000 minimum tensile strength may be used for Code construction. The pipe shall be manufactured in compliance with the requirements of SA-106 with the following modifications:

(a) The carbon content shall not exceed 0.32% by ladle analysis or 0.35% by check analysis. Other chemical elements shall be as listed for SA-106, Grade B.

(b) The physical properties shall meet the following minimum requirements:

Tensile strength	70,000
Yield point	40,000
Elongation in 2″ in the longitudinal direction of a standard round 2″ gage length.	20% min.

(c) The flattening test shall be as required for SA-106, Grade B.

(d) The grade designation for marking shall be "70,000 T.S. A-106 SPCL"

(e) The maximum allowable stresses are:

—20 to 650F	700F	750F	800F
17,500	16,600	14,750	12,000

Annulment of Cases

The following Cases are to be annulled:

Case No.	*Reason for Annulment*
1144	Boilers operated on unit systems, now included in Par. P-23(a).
1149	Permission to use revisions to Section I, now included in Code.
1162	Radiographic porosity standards, now included in Par. P-102(h)(8)(c).
1169	Substance of this Case now included in Case No. 1197.
1178	Pressure-temperature ratings for flanges, now included in Sections I and VIII.
1186	Permission to use revised Par. P-268 now included in 1954 Addenda.
1193	Ring-reinforced furnaces, now included in 1954 Addenda.
1137	The essence of Case is now included in Section IV.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.

TABLE P-2

Maximum allowable working pressures for seamless steel and electric-resistance-welded steel tubes or nipples for water tube boilers, where expanded into drums or headers, for different diameters and gages of tubes conforming to the requirements of specifications SA-83, SA-178 Grade A, and SA-192.

Wall Thickness	Nearest Gage	1/2″	3/4″	1″	1 1/8″	1 1/4″	1 1/2″	1 3/4″	2″	2 1/4″	2 1/2″	2 3/4″	3″	3 1/4″	3 1/2″	3 3/4″	4″	4 1/2″	5″
0.055	+ 7 −	400	160																
0.065	16	910	450	270	210	160													
0.075	15 +	1470	820	520	420	350	230												
0.085	14 +		1150	780	650	550	400	290	210										
0.095	13				1910	1650	560	430	340	260	200	160							
0.105	12 −					1890	1470	1180	950	370	300	240	190						
0.120	11						1770	1430	1150	1000	860	740	650	270	220	190			
0.125	10 +							1680	1400	1180	1020	990	780	690	610	550	490		
0.150	9 +							1950	1620	1370	1180	1030	910	810	720	650	580	480	400
0.165	8								1850	1570	1350	1180	1040	930	830	750	680	560	470
0.180	7									1770	1530	1340	1180	1060	950	860	780	650	550
0.200	6 −										1770	1550	1370	1230	1100	1000	910	760	650
0.220	5											1770	1570	1400	1260	1150	1040	860	750
0.240	4 +												1770	1550	1430	1300	1160	1000	860
0.260	3 +													1770	1600	1450	1320	1120	960
0.280	2 −													1960	1770	1610	1470	1250	1070
0.300															1950	1770	1620	1370	1180
0.320																1930	1770	1500	1300
0.340																	1920	1630	1410
0.360																		1770	1530
0.380																		1910	1650
0.400																			1770
0.420																			1890

1. These values have been calculated by the formula in P-22 (a), using allowable stress values at a temperature of 700 F., from Table P-7. Values above the solid line include an additional thickness of 0.04 in. to compensate for thinning of tube-ends due to the expanding process.
2. Where calculated allowable working pressures exceeded an even unit of 10 by more than 1, the next higher unit of 10 is given in the table.

Unfired Pressure Vessels, 1952

Par. UA-6(b)(4)—add as note:

Note: These formulas are approximate in that they do not take into account continuity between the flange ring and the dished head. A more exact method of analysis which takes this into account may be used if it meets the requirements of Par. U-2. Such a method should parallel the method of analysis and allowable stresses for flange design in Appendix II.

Par. UG-76—delete the last sentence of (b). Add the following as (e):

Exposed inside edges shall be rounded (grinding permitted) to a radius of at least ⅛″ as shown in Fig. UW-16.1 or may be chamfered at 45° to at least 5/32″ flat.

Fig. UA-48

Revise Fig. 6(b) to indicate that the hub slope from the flange intersects the "*h*" dimension line at their intersection with the continuation of the outside surface of the shell (the g_o dimension line). Also a maximum slope of 1:3 to be shown for the distance of $1.5g_o$. Sketch 7 is revised to show a distance of $\frac{g_1}{2}$ to the force line HD and the dimension g_o to be moved to indicate the shell or neck thickness. This will then be comparable to Sketch 5.

Add the following to the note of Fig. UA-48 in Detail (7): This weld may be machined with a corner radius as permitted in Detail (5) in which case $g_1 = g_o$.

Power Boilers, 1952

Table P-7—Add the following sentence to Note No. 11 to read:

When material to this specification is used for boilers, water wall, superheater and economizer tubes that are enclosed within a setting, the stress values above 700F up to and including 850F may be divided by a factor of .085.

Par. P-22(a)—Add the following to the description of "*e*" as used in the formula—

$e = 0.04$ over a length at least equal to the length of the seat plus 1 in. for tubes expanded into tube seats, except

$e = 0$ for tubes expanded into tube seats provided the thickness of the tube-ends over a length at least equal to the length of the seat plus 1 in. is not less than the following:

- 0.095 inches for tubes 1¼ inches O.D. and smaller;
- 0.105 inches for tubes above 1¼ inches O.D. and up to 2 inches O.D. inclusive;
- 0.120 inches for tubes above 2 inches O.D. and up to 3 inches O.D. inclusive;
- 0.135 inches for tubes above 3 inches O.D. and up to 4 inches O.D. inclusive;
- 0.150 inches for tubes above 4 inches O.D. and up to 5 inches O.D. inclusive.

$e = 0$ for tubes strength-welded to headers and drums.

Table P-2, revise as shown in table herewith.

Par. P-186—Add specification SA-178 to the list of specifications in the last paragraph of (e).

Unfired Pressure Vessels, 1952

Par. UHA-11(c)—Add the following sentence:

The maximum allowable stress values for materials with columbium added shall be the same as given in Table UHA-23 for Types 309, 310 and 316 respectively.

Low-pressure Heating Boilers, 1952

Par. H-39—delete the last sentence and revise to read:

The required minimum capacity of the cushion tank may be determined from the following table or from the formula in the next paragraph. Provisions must be made for draining the tank without emptying the system.

Add the following after the present table and footnote:

The following formula may be used when the necessary information is available.

$$V = \frac{(.00041T - .0466)V_s}{\frac{P_a}{P} - \frac{P_a}{P_o}}$$

where

V_t = minimum volume of tanks, gals.

V_s = volume of system—not including tanks, gals.

T = average operating temperature —Deg. F.

P_a = atmospheric pressure—psia

P_f = fill pressure—psia

P_o = maximum operating pressure psia.

Par. H-92—revise as given above in Par. H-39.

Power Boilers, 1952

Par. P-112—add the following to the end of Par. P-112(a)(5) to read:

. . . . the furnace gases (See Par. P-300 for American Standard Socket Welded Flanges).

Par. P-300—revise the last sentence of the fourth paragraph to read:

American Standard Slip-on Flanges, not exceeding 4 in. nominal pipe size, may be attached to piping, etc. Add a sentence to the fourth paragraph reading:

American Standard Socket Welded Flanges may be used in piping provided the dimensions do not exceed 3 in. nominal pipe size for 600 psi and lower Classes, and 2½ in. in the 900 and 1500 psi Classes.

Thirty-five Years Ago

Comment on the *JOURNAL* of August 1920

The war of 1914-18 was not yet two years over, so it was natural that papers dealing with some of its engineering features were still appearing in the *Journal* of August, 1920. There were two in this number, "Naval Gunnery", by Lord Congleton, JR.E.I.C., and "Inundation Work with the British Expeditionary Force in France," by Lieut. G. L. Shanks, A.M.E.I.C. Lord Congleton's name has disappeared from our books, but Mr. Shanks is now professor of agricultural engineering at the University of Manitoba.

Lord Congleton describes the workings of the Admiralty's new fire director, which enormously increased the accuracy of naval gunnery. With it, hits could be registered at 25,000 yards, as against an extreme accurate range with the same guns of 12,000 yards without it. It took about 30 men at a central fire control station to work out the data received from the spotters and so fix range and elevation and the process required an appreciable time. Today these calculations are made electronically, by a smaller staff and in a matter of seconds.

The intricate canal system and the low-lying character of much of the terrain fought over by the Germans and the Allies in France and Belgium in 1914-18 naturally led to the consideration of inundation, both as an offensive and as a defensive weapon. Lieut. Shanks describes, from the British viewpoint, what was done during these years. As early as 1916 the British used a plant mounted on a barge to pump water over a ridge running parallel to their front lines and thus kept flooded a section of country which the Germans were most anxious to keep dry. In his paper Lieut. Shanks made the point that inundation should be shallow. If the water were too deep it became navigable, whereas a marsh was impassable to the vehicles then in use and to foot soldiers and cavalry, conditions which probably do not obtain today with the development of crawlers and of amphibious vehicles.

J. W. LeB. Ross, M.E.I.C., wrote on the "General Design of a Lock and Approaches", mostly from the standpoint of safety and convenience. He analyzed a number of accidents which had occurred in the Soo Canal, in the Welland Canal and in some of the canals of the St. Lawrence system and concluded that in practically every case they could have been avoided by more careful design of the canal. Perhaps we should call this paper to the attention of the St. Lawrence Seaway authorities.

"Engineering" Defined

What is "engineering" and what is an "engineer"? Definitions of these two terms acceptable to everybody have not yet been made. Those used in the various professional acts have been questioned from time to time and the courts have been called upon to rule whether or not a particular act was or was not "engineering" and whether or not the person carrying it out was or was not an "engineer". In this August *Journal* A. D. Flinn, the secretary of Engineering Council, the predecessor of the Engineers' Joint Council, makes a critical study of some 20-odd definitions, but arrived at no definite conclusion, other than that all the definitions he studied were defective in one way or another.

The Institute's own affairs seem to have been progressing smoothly for once. The new Nova Scotia Engineers' Act was published in full, but without comment. A full page organization chart of the Institute appeared, showing that it had 18 branches and 3,657 members of all grades. Tentative programs for the Ontario (Niagara Falls) and Western (Banff) professional meetings were published. To liven things up a bit, the Niagara Peninsula Branch challenged any other branch to an indoor baseball game, to be played on Saturday, September 18, 1920, at the professional meeting.

Alberta Association Formed

A note gave the names of the officers and council of the new Alberta Association of Professional Engineers—F. H. Peters, M.E.I.C., president; L. E. Drummond, vice-president; Professor R. S. L. Wilson, A.M.E.I.C., secretary-treasurer and registrar; S. G. Porter, M.E.I.C., R. J. Gibb, M.E.I.C., O. E. S. Whiteside, N. C. Pitcher, R. B. Baxter, W. S. Gray and F. W. Hobson, councillors.

The final report on the Quebec

bridge was reviewed briefly: "These two . . . volumes will occupy a worthy place in the . . . records of the . . . government and constitute a record of achievement of which all associated may be proud."

The American Society of Chemical Engineers did accept the Institute's invitation to use its facilities for the A.S.Ch.E. meeting held in Montreal in the summer of 1920, to which we referred two or three months ago.

A member wrote in to "express the opinion that the Institute has done more to advance the welfare of the engineering profession than any similar body on the continent. Please accept my . . . congratulations for the . . . results achieved." . . ."

after the brickbats the editor must have become accustomed to receiving.

About 25 jobs were available, with salaries offered notably higher than they had been during 1919. Some of the positions sounded really attractive, e.g., a construction manager at $7,200 a year, equivalent to about twice that today. And income tax was low then, but we venture to guess that there were few or no "fringe benefits". The "Members' Exchange" attracted some patronage; this month a transit, barometer and stadia rod were offered for sale, as well as 40 years of the Transactions of the Institution of Civil Engineers, price $100. A firm of consulting engineers wanted a partner, with capital, of course, and some town engineer inquired where he could buy 60-inch concrete pipe.

This August *Journal* was one of the better ones. The paper on inundation work in France and Belgium is well worth reading today.

Elections and Transfers

At the meeting of Council held at the University Club, Montreal, on Friday, July 29th, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

T. E. Appleton, *Ottawa*
H. W. Argent, *Toronto*
E. Avouris, *Montreal*
S. A. Barnas, *Goose Bay*
J. H. Baudouin, *Montreal*
J. S. Barrick, *Prescott*
A. F. Bauer, *Victoria*
Q. R. Ball, *Montreal*
E. D. Bent, *Montreal*
E. A. Boys, *Montreal*
J. J. Bruno, *Windsor*
W. O. Findlay, *Niagara Falls*
S. W. Fraser-Underhill, *Toronto*
R. M. P. Hamilton, *Toronto*
R. A. Harvie, *Hamilton*
G. N. Hutchinson, *Liverpool, N.S.*
S. A. Janusz, *Montreal*
P. Kawulka, *Flin Flon*
K. W. H. Krause, *Toronto*
H. D. Lyon, *Montreal*
G. H. Macdonald, *Asbestos*
S. K. McWalter, *Montreal*
L. E. Marion, *Peterboro*
S. Martyn, *Montreal*
N. F. Moodie, *Ottawa*
B. H. W. Mulder, *Montreal*
A. O. H. Neilson, *Montreal*
J. C. Nicholls, *Kingston*
R. M. Nicholson, *Toronto*
E. A. Osis, *S. Ste. Marie*
A. G. Perry, *St. John's*
P. R. Pettit, *Toronto*
C. N. Priestley, *Capetown, S.A.*
W. H. Russell, *Toronto*
A. Southgate, *Montreal*
P. L. Strigner, *Hamilton*
W. A. Tangye, *Ottawa*
G. B. Tebo, *Toronto*
F. A. Todds, *Montreal*
E. N. Webb, *Montreal*
J. W. Whytock, *Toronto*
F. J. Willis, *Cornwall*
H. S. Wilson, *Sarnia*
W. G. M. Wilson, *London*
J. G. Wotherspoon, *Edmonton*

Juniors:

R. G. Beattie, *Sarnia*
M. Charleson, *Montreal*
W. M. Clark, *Montreal*
P. F. W. M. de Neeve, *Montreal*
G. A. Ding, *St. John's*
R. D. Emmett, *Toronto*
L. N. Hogarth, *Toronto*
P. M. Jangaard, *Halifax*
A. D. Keene, *Montreal*
W. H. Peacock, *Toronto*
R. Przysiezniak, *Montreal*
D. A. Shaw, *Victoria*
C. D. Slaughter, *Vancouver*

Affiliate:

E. G. Metcalfe, *Ottawa*

Transferred from the class of Junior to that of Member:

S. T. Bieniada, *Toronto*
E. Chow, *Vancouver*
C. G. Cook, *Montreal*
P. T. Cote, *Vancouver*
G. E. Gunn, *Dawson Creek*
E. B. A. LeMaistre, *Toronto*
A. Ouellet, *Quebec*
R. F. Quick, *Kingston*
A. R. M. Reid, *Montreal*
H. A. Templeton, *Pakistan*
A. M. Thomson, *Toronto*
F. E. Trewartha, *Cardinal*
H. J. Whelan, *Edmonton*
G. E. Wilson, *London*
R. G. Wolff, *Montreal*
Z. Zabner, *Montreal*
M. Zinn, *Toronto*

Transferred from the class of Student to that of Member:

H. A. Bradley, *Labrieville*

Transferred from the class of Student to that of Junior:

D. M. Ackford, *Kitchener*
J. B. Erskine, *Ottawa*
J. H. Ferguson, *Peterboro*
E. B. Jakeman, *Calgary*

The following Students were admitted:

W. L. Aggiss, *B.Sc., Queen's, 1955*
A. Barber, *Nova Scotia Tech. College*
W. J. Brown, *B.A.Sc., Toronto, 1954*
R. W. Bratty, *Queen's University*
J. P. A. Cadieux, *Royal Military College*
W. G. Deeks, *B.A.Sc., Toronto, 1955*
J. S. Fisher, *Univ. of Alberta*
H. M. Flint, *B.A.Sc., Toronto, 1955*
J. W. Hanley, *B.A.Sc., Toronto, 1955*
K. Hoeck, *M.Sc., Tech. U. Denmark, 1955*
D. H. Hook, *Royal Military Coll.*
N. A. Jost, *Mt. Allison Univ.*
E. V. Jull, *Queen's University*
L. R. Keddy, *Univ. of New Brunswick*
W. H. Lawford, *B.Sc., Queen's, 1955*
J. D. Mistak, *Univ. of Manitoba*
L. I. Rotgaus, *McGill University*
W. R. Russell, *Univ. of Toronto*
G. S. Saunders, *B.A.Sc., Toronto, 1955*
J. W. Tremain, *B.Eng., McGill, 1955*
J. E. Venart, *Univ. of Toronto*

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members:

P. M. Baxter
H. J. Childs
J. A. Cunliffe
D. B. Furlong
A. B. FitzPatrick
C. R. Hamilton
R. J. Harmer
J. E. S. Harvey
F. H. Hedley
G. D. Hobson
W. C. Laureshen
G. Magnolo
P. Nahaiowski
P. J. Savage
F. L. Thompson
P. Wiggins

Junior:

H. K. Bowers
J. W. Johnson
A. M. Malanchuk
C. A. Noble

Junior to Member:

P. M. Dranchuk

Student to Junior:

R. L. Foster

SASKATCHEWAN

Members:

W. J. Babey
J. S. MacDonald
E. E. N. Smith
W. N. Stowe

Junior:

J. A. Klassen

Students:

W. R. Bauman
O. S. Smith

Junior to Member:

Z. Bakun
O. K. C. Mang
L. A. Rowe
E. H. Stinson

MANITOBA

Members:

K. J. M. Renger
W. K. Roots

NOVA SCOTIA

Members:

F. R. Compton
K. H. Wheatley

Junior to Member:

W. A. Burgess
D. H. Franklin
G. M. Josephson
E. A. MacDonald
G. C. McCausland
D. J. Power

NEW BRUNSWICK

Junior to Member:

V. C. Dohaney
H. S. Grant
C. F. Olive
K.M. Ratcliffe
W. M. Steeves

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Quebec

Leopold Nadeau Resigns Post

Leopold Nadeau has recently resigned his position as general secretary of the Corporation of Professional Engineers of Quebec to become the assistant to the president of D. C. MacCallum and Associates Limited in Montreal.

Mr. Nadeau joined the staff of the Corporation of Professional Engineers of Quebec in 1946 as assistant general secretary, becoming general secretary in 1949. In this capacity he was responsible for the administration of all activities of the Corporation, and at the same time served as joint secretary-treasurer of the Dominion Council of Professional Engineers.

A native of Montreal, Mr. Nadeau graduated in civil engineering from Ecole Polytechnique in 1936. His early engineering experience included that of assistant plant engineer at the Port Alfred mill of Consolidated Paper Corporation and of resident engineer for the Quebec Department of Highways. He then joined the technical staff of the Canadian Underwriters' Association as fire protection engineer. During the war years he was mainly engaged in designing and supervising the fire protection equipment of war industries and other installations. During this period he contributed a number of articles to technical publications on the subject of fire protection and insurance.

Ontario

News of the Members

Howard S. Gibson of Ottawa has been appointed assistant city engineer of St. Thomas, Ont., and assumed his new appointment on August 1.

Mr. Gibson graduated in civil engineering from the University of Toronto in 1950 and in 1952 joined the engineering department of the City of Ottawa. At the time of his appointment he was sewer engineer of Ottawa.

Gordon A. Antenbring, of E. Long Limited, Orillia, Ont., has been appointed sales manager, Western Division, and will be located in the Keystone Building, 569 Howe Street, Vancouver, B.C.

Mr. Antenbring is a graduate in civil engineering of the University of Manitoba and also in mining of Queen's University.

P. A. E. Hess, of Ontario Hydro is divisional engineer of the St. Lawrence Power Project of the Hydro-Electric Power Commission of Ontario and is located at Morrisburg, Ont.

Dennis Temple, has moved to Toronto and is the Toronto representative of the St. Lawrence Cement Co., now erecting a new cement plant at Clarkson in the western suburbs of the city.

Mr. Temple was born in Karachi and began his professional career in England. He was for a time engaged in civil engineering work with National Research Council at Chalk River and latterly has been with Defence Construction Ltd., in connection with the Colombo Plan.

Dr. J. M. F. Vickers of Toronto will join the staff of the University of Nebraska in Lincoln this fall as associate professor of mechanical engineering.

A graduate of the University of Birmingham, he obtained his degree of Doctor of Philosophy at the University of Toronto in November, 1954. During the academic year he was on the staff of the Faculty of Applied Science and Engineering as a lecturer in mechanical engineering.

Prof. P. B. Hughes, assistant professor of mechanical engineering at the University of Toronto, is one of the winners of the President's Medal for best contributions to periodicals in 1954. Announcement of the award was made by R. D. Hilton Smith, chairman of the Governor-General's Awards Board.

Prof. Hughes' winning effort was a short story "Catherine and the Winter Wheat" which was published in Maclean's Magazine. An unique feature was that this was his first printed story.

Prof. Hughes was born in Montreal and graduated in engineering from McGill in 1926. During the last war he served with the Royal Canadian Navy and during his five years of service rose to the rank of lieutenant-commander.

W. A. O'Neil, of the St. Lawrence Seaway Authority, has been transferred from Montreal to St. Catharines, Ont., where he is divisional engineer of the Welland Section.

Canadian Line Materials Ltd., Toronto, has announced the appointment of **Henry G. Mah** as chief engineer. Mr. Mah graduated in electrical engineering from the University of Alberta in 1940 and has been employed by the company for the past 14 years in various engineering capacities, particularly in carrier current control communication equipment and metallic rectifiers.

J. W. Palframan who is a construction engineer with the Trans-Canada Telephone System, has moved from The Pas, Man., to Dawson Creek, B.C.

K. R. Simmons has moved from Georgetown, Ont., to Maple, Ont. and he is engaged as engineer for the Township of Markham.

Geoffrey W. Ince has moved to British Columbia where he is associated with B.C. Transformer Co. Ltd., 4204 Lougheed Highway, North Burnaby, Vancouver. Mr. Ince was formerly with English Electric Co. of Canada, Ltd., in St. Catharines, Ont.

W. E. Mulholland has left Imperial Oil Ltd., where he was employed as industrial sales representative, and is now sales manager with Magnus Products Corporation of Detroit, Mich.

Col. A. P. Miller is engaged in the New Brunswick Electric Power project at Chatham, N.B., as resident engineer.

Peter Isaac has severed his connections with the Brantford Coach & Body Co., of Brantford, Ont., where he was employed as a design engineer, and is now with Avro Aircraft at Malton, Ont., as a systems engineer.

Donald R. Evans of Toronto is employed in the capacity of project engineer by the consulting firm of Marshall Macklin and Monaghan, 154 Merton Street, Toronto. Before joining he was district sanitary engineer for the Ontario Department of Health.

The appointment has just been announced of **S. Douglas Turner** as manager of the Alberta Division of the Calgary Petroleum Association.

Born in Toronto and a graduate in engineering from the University of Toronto in 1940, Mr. Turner served as an engineer officer and pilot with the R.C.A.F. during the Second World War. After retiring from the R.C.A.F. he attended Osgoode Hall, Toronto, and graduated, and was called to the Ontario Bar in 1949.

On being admitted to the Alberta Bar, Mr. Turner engaged in private law practice in Calgary. In 1952 he joined the legal department of Imperial Oil Ltd., in Calgary and but recently resigned from that company to re-enter private practice.

In addition to engineering and law, Mr. Turner has found time for some football in both Ontario and Alberta. In 1949 he was a member of the Calgary Stampeders.

Manitoba

Returns to Manitoba

D. G. McClellan, a former graduate of the University of Manitoba who served with the Royal Canadian Engineers in Korea and at Chilliwack, B.C., has returned to the Province of Manitoba and will practice here.

Council Appointment

A vacancy in the Council of the Association was filled by the appointment of **R. N. Sharpe**, to serve in the place of **G. B. Williams** who has been transferred to Ottawa. Mr. Sharpe is presently with Manitoba Good Roads in the capacity of divisional engineer.

Alberta

New Act Passes Legislature

Bill No. 70, entitled "An Act to Regulate the Professions of Engineering and Geology" received it's third and final reading in April and was assented to by the Lt. Governor on April 6th, 1955. The new Act sets out an entirely new definition of Professional Engineering and the practice of Profession Engineering. The new definition is much broader in scope and makes the administion of the Act much easier. It also provides for the appointment of a Discipline Committee composed of members of Council and this new Committee has much broader powers to investigate and carry out discipline of the membership.

The new Act provides for the increase of the number of Councillors from eight to twelve, providing for the election of four Councillors each year for a three-year term. It also provides for the Council being empowered to fill vacancies by appointment. Copies of the Act will be circulated to the members in the centre of the new Register in June.

New Council Meets

The first full meeting of the new Council was held on April 22 at which time new councillors were appointed to fill the vacancies created by the new Act. The Council appointed the following members to serve on Council until the next election: Past Councillors D. R. Livingstone of Lethbridge, and J. A. Harle of Edmonton and Dr. J. C. Sproule, consulting geologist, of Calgary, and K. F. Huff, geologist and exploration manager of Imperial Oil Ltd., Edmonton, Council also regretfully accepted the resignation of Councillor Dr. H. H. Beach who has been transferred to Texas. Dr. W. C. Gussow, consulting geologist of Calgary, was appointed to fill this vacancy until the next election.

At the meeting the various committees for the coming year were set up and organized. The chairmen of these committees are as follows: Discipline Committee, Prof. J. A. Harle, chairman; L. H. McManus, vice-chairman; Membership and Enforcement Committees, R. D. Livingstone, Lethbridge Chairman; L. A. Thorssen, Calgary chairman; and J. F. McDougall, Edmonton chairman; Finance and Budget Committee; T. D. Stanley, president; Joint Finance Committee, J. F. McDougall and R. C. McPherson, the Association's representatives. Chairman to be chosen. Admission's Committee, J. G. Dale, chairman; Student Loan Committee, J. G. Dale, chairman; Watching Legislation Committee, L. H. McManus, chairman; Public Relations and Editorial Committee, E. W. Christian, chairman; J. N. Ford, vice-chairman; Meetings Committee, L. Schofield, chairman; R. C. McPherson, vice-chairman, Calgary section; and R. D. Livingstone, vice-chairman, Lethbridge section.

Board of Examiners Adopts New Uniform Examination Syllabus

The Alberta Board of Examiners in Engineering have now adopted the uniform examination syllabus which has previously been adopted by Ontario, Quebec, British Columbia, Saskatchewan and Manitoba. This is the Syllabus of Examinations which persons desiring to enter the profession who do not have a degree from an accredited institution or who wish to enter the profession without attending the university must write. The new syllabus contains about 13 examinations instead of five. The effective date for the new syllabus is July 1, 1955, and all applicants to write the examinations after that date will automatically go on the new syllabus. Persons who have applied to write the examinations prior to July 1st, will have two years to complete under the old syllabus.

The new Act also has an effect on applicants to write the examinations. Under the new Act all persons who make application to write the examinations must have an Alberta High School diploma or in the opinion of the Department of Education its equivalent. Persons who have taken their schooling outside of Alberta should submit transcript of their High School Record to the Registrar, Department of Education, Administration Building, Edmonton, and obtain an evaluation of their High School credits before applying.

British Columbia

Consulting Engineers' Division

A Consulting Engineers' Division of the Association of Professional Engineers of B.C. has been formed to deal with matters relating particularly to the consultants in their relationships with contractors, building trades and other professional bodies. Forms of application for membership in the new division are being forwarded shortly to all those who might be interested by D. W. Russell, assistant registrar of the Association, who is acting as secretary-treasurer for the group. Chairman of the pro tem steering committee is John H. Read. Committee members are V. M. W. Gwyther, D. M. Drake and F. W. Urry.

Consulting engineers constitute only a fraction of the 2,800 members of the Association of Professional Engineers of B.C. Their function and problems in some essential respects differ from those of the majority of professional engineers and engineers-in-training directly employed in industry. The need for a special group to deal with these phases of their professional activities has been felt for some time, and a meeting of interested members was called through the Association last spring.

In the past year there have been several meetings of the steering committee, and two general meetings, at which by-laws for the division were established. Eligible for membership are registered members of the Association of Professional Engineers of B.C., who are permanent residents of the province. They must own all or part of a consulting engineering practice, and have no financial affiliations with manufacturers, agents or contractors, other than fees for services rendered.

The by-laws and qualifications for membership have been approved by the Council of the Association, and the Consulting Engineers' Division is now an established entity, operating within the Association in much the same manner as the Municipal Engineers' Division. A nominal entrance fee of $5.00 has been established in the by-laws, with provision for annual dues and assessments to be decided by the membership. An insignia of membership will be issued as a visible indication that the members subscribe to the standards of professional practice embodied in the by-laws.

Municipal Engineers' Convention

A three-day program of technical papers and panel discussions is planned for the Thirteenth Annual Convention of the Municipal Engineers' Division of the Association of Professional Engineers of B.C., which will be held in Nanaimo from September 22 to 24.

Delegates will include city and municipal engineers, and members of public works departments from all parts of B.C. as well as representatives of equipment and supply firms. More than three hundred are expected to attend. Chairman of this year's convention, which will have its headquarters in the Malaspina Hotel, will be A. P. Leynard, city engineer of Nanaimo.

Directory Number Completed

The big job of double checking more than 2800 listings for the annual June Directory Number of The B.C. Professional Engineer has been completed. The directory includes names, addresses and business affiliations of all registered professional engineers, engineers-in-training, and temporary license holders in the province.

Other special features in the issue will be the new recommended minimum salary schedule for employed engineers, as promulgated across Canada, and the recommended schedule of fees for B.C. consulting engineers. There is also a list of all architects practising in the province, and the complete details of the new provincial Engineering Profession Act. A special photographic section provides a pictorial record of recent and current engineering projects.

Editor J. A. Merchant announces it will be off the press on schedule.

Engineers in the News

P. R. Purcell has accepted a position with the Department of Northern Affairs and National Resources, engineering and water resources branch, at Ottawa. His duties will entail co-operation on all structural matters with hydraulic engineers of the water resources division. Mr. Purcell left his former post as assistant chief engineer for the Public Utilities Commission in Victoria on July 8.

Dr. U. J. Okulitch, a member of the University of British Columbia faculty, has been awarded a $650 research grant by the Geological Society of America.

Dr. L. W. Shemilt, associate professor of chemistry at the University of British Columbia, has been elected chairman of the Canadian division of the National Association of Corrosion Engineers.

H. A. Dare, of H. C. Acres and Co., has left Montreal for Pakistan where he will be engaged in work on the Warsak hydro-electric project.

J. S. Wilson, of Tyee Machinery Co. Ltd., recently retired as president of the company and was appointed chairman of the board of directors. The position of president has been filled by the general manager, J. R. Wilson.

F. C. Tomlinson, has taken the position of general manager of the International Mining and Development Corporation with head office in Nassau, Bahamas.

W. A. Ker, of the water rights branch, Department of Lands and Forests, who has been district engineer at Kelowna, has been moved to Victoria as deputy comptroller and chief, operations division, water rights branch.

J. M. Bezer has left the employ of Gordon Russell Ltd. and taken a position with Eric Ackland and Associates Ltd. of Vancouver.

L. F. Morrison, of Canadian Wood Pipe and Tanks Ltd., has been appointed chief engineer effective July 1.

J. M. Oldham recently accepted a position on the engineering staff of the Municipality of Burnaby.

H. L. Taylor has joined the staff of Simpson and McGregor where he will carry out electrical inspection work. Prior to his retirement, Mr. Taylor was chief electrical inspector for the B.C. government.

D. W. Jebbink, who recently returned from the Dominican Republic where he had been factory superintendent for the B.C. Sugar Refinery, has accepted a temporary position with M. A. Thomas.

F. R. Moore has taken a position with C. D. Schultz and Co. Ltd. in Vancouver. He used to be with Alaska Pine and Celulose Co. Ltd. at Holberg.

K. N. Nordlund, formerly of Chemainus, B.C., is now with the B.C. Forest Service at Prince George.

H. M. Yerex has left the Powell River Co. to take up a new position with C. F. Braun, consulting engineer, of Alhambra (Los Angeles), California.

F. J. N. Spook has left the firm of H. A. Simons Ltd. to take up a new position with the B.C. Electric Co.

H. P. Pfeiffer recently returned from Norway to take a position with the Bechtel Corporation, Los Angeles, as project engineer for the Snake River hydro-electric project.

H. D. Forman was recently appointed managing director of the Canam Copper Co.

News of Other Societies

The **Canadian Management Council** (1549 Burnside Place, Montreal) will hold its first one-day conference in Montreal, September 22, 1955, at the Ritz Carlton Hotel.

The program on the theme Education for Management — Whose Responsibility?, will include morning and afternoon panel discussions with speakers representing management, professional societies, universities, and management consultants. The meeting will conclude with a reception and dinner at which Stuart M. Finlayson, president of Canadian Marconi Company will be guest speaker.

Total charge for the day, including dinner and cocktails will be $15.00.

The annual meeting of the **American Society of Civil Engineers** (33 West 39th Street, New York 18) will be held at the Hotel Statler, New York, October 24-28, 1955.

The twenty-third annual meeting of the **Engineers' Council for Professional Development** (29 West 39th Street, New York 18, N.Y.) will be held in Toronto, Ontario, October 13-14, 1955, with headquarters at the King Edward Hotel.

The first meeting of a new **Canadian Technical Asphalt Association** will be held in Victoria in late October. This association for asphalt producers and consumers is being organized by a steering committee. D. T. Willis, provincial surfacing engineer, British Columbia Government, has undertaken to advise interested bodies.

The Chemical Institute of Canada (18 Rideau St., Ottawa 2, Ont.) has three conferences planned: September 8-9, a conference of the Physical Chemistry Division, at Montreal, on the subject of nuclear chemistry; September 15-16, a corrosion symposium in Montreal; October 12-13, a symposium on phospholipids at the University of Western Ontario, London, Ont.

The fourth briquetting conference will be held at the Stanley Hotel, Estes Park, Colorado, September 1, 2, 3, 1955.

The meeting is sponsored by the International Briquetting Association, whose secretary-treasurer is Neal Rice, University of Wyoming, Laramie, Wyoming.

THE ENGINEER IN BUSINESS AND IN GOVERNMENT

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ing together men who are experts in diverse fields. Having brought them together it should be the purpose of your Association to direct their thoughts to a common purpose. The opportunities for the engineer have never been better in the history of the profession, and I trust that the activities of this Association will add lustre both to the reputation of the engineer and to the engineering profession.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Dr. John Andrew Allan, HON. M.E.I.C., former head of the department of geology at the University of Alberta, died on May 23, 1955, at his home in Edmonton, Alta.

Dr. Allan was born at Aubrey, Que., in 1885. He received his B.A. degree

Dr. J. A. Allan, Hon. M.E.I.C.

from McGill University in geology in 1907. The following year he obtained his M.Sc. degree and was awarded a fellowship at the Massachusetts Institute of Technology, where he continued his geological studies and received his Ph.D. degree in 1912.

In the fall of 1912, Dr. Allan was appointed lecturer in the department of geology and minerology at the University of Alberta, and became professor of geology the following year. Dr. Allan retired as head of the department in 1949 after nearly forty years at the university.

In 1919 Dr. Allan began a systematic investigation of the mineral resources of Alberta for the provincial government and he was one of those responsible for the organization of the Scientific & Industrial Research Council of Alberta, now known as the Research Council of Alberta. From the outset he directed the geological survey division of the organization, whose publications contain numerous reports and maps which he prepared dealing with the geology and mineral resources of various sections of the province. Another outstanding contribution made by Dr. Allan was the building up of a large collection of minerals and fossils to form a geological museum at the University of Alberta which is now considered to be the finest in Western Canada. Dr. Allan's work took him into practically every part of the Province of Alberta as well as into Northern British Columbia. He was largely responsible for the mapping of the coal fields, together with general studies in geology throughout the province and in the Rocky Mountains. His work in pioneering the development of Alberta's oil and gas resources has been equally important. He was the first to establish the structure of the Skiff field southeast of Lethbridge and subsequently pioneered the discovery of the Kinsella structure in east central Alberta.

Dr. Allan was a past president of the Association of Professional Engineers of Alberta, as well as the Canadian Institute of Mining & Metallurgy. He was for many years a fellow of the Royal Society of Canada as well as an active member of many other societies and organizations in both Canada and the United States.

Dr. Allan became a Member of the Engineering Institute of Canada in 1941 and was awarded Honorary Membership in the Institute in 1952.

John William Hunter, M.E.I.C., of Kingston, Ont., died on November 15, 1954. He had been retired from the practice of engineering for some years and was residing in Kingston, having worked previously in Newark, N.J.

Mr. Hunter was born in Kingston on April 20, 1868. He graduated from McGill University with a B.Sc. degree in mechanical engineering in 1896. His early experience was chiefly in shipbuilding and marine engineering on vessels for the Great Lakes, when he worked for the American Shipbuilding Company in Cleveland and for the Canadian Shipbuilding Company in Toronto.

He had also been associated with the Hunter Engineering Works in Toronto, Ont.

Mr. Hunter became an Associate Member of the Engineering Institute in 1907, transferring to Member in 1940. He had attained life membership in the Institute in 1947.

Joseph Bertram DeHart, mining engineer with the department of natural resources of the Canadian Pacific Railways, died on June 9, 1955, in Calgary, Alta.

Mr. DeHart was born in Newcastle, England, on August 9, 1890. He came to Canada at the age of 17 and enrolled at McGill University. He received his B.Sc. degree in civil engineering in 1910, his B.Sc. degree in mining engineering in 1911 and his master's degree in mining engineering in 1912.

In 1914 he was manager of the Twin City Coal Company, and from 1915 to 1918 he held the same position with North American Collieries Ltd. at Coalhurst. He was appointed general superintendent the following year. From 1922 to 1923 he was engineer and manager for Cadomin Coal Company. Mr. DeHart was appointed district inspector of mines for the Alberta government at Lethbridge, Alta., and in 1937 he accepted a position with the Provincial Institute of Technology and Art in Calgary, taking charge of the coal mining courses. Two years later he became associated with Canadian Pacific Railway's department of natural resources at Calgary, Alta.

Mr. DeHart was a past-president of the Professional Engineers of Alberta, and a member of the Canadian Institute of Mining and Metallurgy. He was a Member of the Engineering Institute from 1925 to 1953 and was a recipient of the Past-President's Prize in 1936.

John Charles Heath, JR.E.I.C., diesel engineer with the Winnipeg office of Canadian Aviation Electronics Ltd., died in an automobile accident on April 18, 1955.

Mr. Heath was born in Winnipeg on June 19, 1924, and received his public and high school education there. He graduated from the University of Manitoba with a degree in mechanical engineering in 1950, working in the summer months of his course as a machinist apprentice with Canadian Pacific Railway.

During World War II he served for three years with the R.C.A.F.

Following his graduation from university, Mr. Heath took a diesel course at Le Grange, Ill., and worked in the service department of General Motors as a diesel instructor. In 1951 he went to Sault Ste. Marie, Ont., and joined

J. C. Heath, Jr.E.I.C.

the staff of Algoma Central and Hudson Bay Railway Company as a diesel supervisor, later becoming assistant to the vice-president. He returned to Winnipeg in 1953 to accept a position as diesel engineer for Canadian Aviation Electronics Ltd., working with diesel operations on radar sites across Canada.

Mr. Heath became a Student Member of the Engineering Institute in 1949, transferring to Junior in 1952.

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Personals

News of the Personal Activities of Members of the Institute

Robert J. Anderson, M.E.I.C., has been named chief engineer of Linde Air Products Company, a division of Union Carbide Canada Ltd. in Toronto. The announcement was made by **David S. Lloyd,** M.E.I.C., president of the company.

Mr. Anderson graduated from the University of Toronto in 1931 with a B.A.Sc. degree in electrical engineering and has been on the staff of the company since that time.

He has held a number of positions in the field and in a supervisory capacity with the company. For some years he has been manager of engineering service, the position he held until his new appointment.

Mr. Anderson is a member of the American Society for Metals, the American Welding Society, and the Association of Professional Engineers of Ontario. He is also a member of committees for the Canadian Standards Association, Compressed Gas Association, and the International Acetylene Association.

John W. Ross, M.E.I.C., has been appointed manager of engineering service for the Linde Air Products Company in Toronto, succeeding **R. J. Anderson,** M.E.I.C.

Mr. Ross, who graduated from the University of Toronto in 1941 with a B.A.Sc. degree in mechanical engineering, has been with the company for the past ten years. In 1946 he was development engineer and early this year was named assistant manager of the engineering service for the company.

He is a member of the American Society for Metals, and of the Association of Professional Engineers of Ontario.

R. J. Anderson, M.E.I.C.

John B. Carswell, M.E.I.C., has been appointed general manager of Canada House (New York) Ltd. Mr. Carswell will divide his time between New York and Toronto, where he is engaged in private practice as a consulting engineer.

A native of Paisley, Scotland, he received his technical training at Paisley Technical School and Glasgow College. His first engineering work in Canada was in 1911 when he was on maintenance work in connection with the Grand Trunk Railway. During the first World War Mr. Carswell pioneered the design and construction of Canada's first airfields and maintenance shops. Subsequently he became president of Carswell Construction Company in Toronto and managing director and then president of Burlington Steel Company Ltd. in Hamilton, Ont. When the second World War began Mr. Carswell was appointed director-general of the offices of Canada's Department of Munitions and Supply at Washington, D.C. Later he became the first president of the Canadian War Assets Corporation.

John W. Ross, M.E.I.C.

In 1948 he was chairman of the Fraser Valley Dyking Board and of the Greater Winnipeg Dyking Board in 1950. He was chairman of Kitimat Constructors and supervised all construction work at the Aluminum Company of Canada's plant at Kitimat, B.C. He opened his private practice in Toronto in 1954.

Mr. Carswell attained life membership in the Engineering Institute in 1950.

Dr. Ingo Ingenohl, M.E.I.C., formerly industrial engineering supervisor with the Dupont Company of Canada, has been appointed assistant professor of industrial management at the Massachusetts Institute of Technology.

Dr. Ingenohl, a native of Denmark, graduated with a M.Sc. degree in civil engineering from the Technical University of Berlin. After some years experience in building and construction he became interested in the works of Taylor and Gilbreth and returned to the University for formal training in scientific management techniques, concluding with a Ph.D. degree in industrial psychotechnique. Activities as a consulting engineer brought him over most of Europe. He came to Canada in 1948 and joined the staff of the Dupont Company in 1950.

Dr. I. Ingenohl, M.E.I.C.

He has appeared as lecturer and speaker before various management groups in Canada and the United States.

E. J. Robertson, M.E.I.C., is now with the Federal Civil Service in the department of transport air service's construction division at Montreal Airport, Dorval, Que. The position is an electrical power engineering appointment involving design, estimating and supervision of construction of electric power and lighting services at various airports. Mr. Robertson was formerly with Canadian Aviation Electronics Ltd. in Montreal.

Mr. Robertson graduated from Manchester University with a degree in electrical engineering, and has had considerable experience in Britain, both with manufacturing and operating companies. He was a mechanical and electrical engineer in the Air Ministry Works Directorate during the war and was chief electrical engineer in the Manchester Corporation Transport Department before coming to Canada in 1949. He became associated with the Toronto Transit Commission specializing in the signal system for the Rapid Transit projects. He was also with Bepco Canada Limited as traction department engineer in Toronto.

He is an associate member of the Institution of Electrical Engineers, and a member of the American Institute of Electrical Engineers.

A. Brewer Hunt, M.E.I.C., has resigned as director of the electronics branch of the Department of Defence Produc-

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tion, and is returning to the Northern Electric Company.

Mr. Hunt graduated from the University of Toronto with a B.A.Sc. degree in 1928 and was awarded a medal from the British Association for the Advancement of Science, which is the highest engineering award of the university. Upon graduation he joined Northern Electric as manufacturing methods engineer in connection with theatre sound systems and vacuum tube production. In 1933 he was appointed special products manufacturing superintendent, and in 1935 took over the added duties of radio receiver engineer. Two years later he was made special products superintendent in charge of manufacturing, engineering and installation.

In 1948 he moved to Belleville, Ont., with the electronics division where he stayed until 1950 at which time he returned to Montreal as assistant manager of Northern's telephone division. Three months later Mr. Hunt became general manager of the communications equipment division. He has been on loan to the Canadian government for the past year.

Mr. Hunt is a past-president of the Radio-Television Manufacturers Association, a member of the Institute of Radio Engineers, of the Canadian Manufacturers Association, and a member of the Corporation of Professional Engineers of Quebec. He also holds the rank of lieutenant-colonel in the reserve army having served as commanding officer of the 2nd Corps H.Q. Signals Regiment.

Dr. G. G. Meyerhof, M.E.I.C.

Aime Cousineau, M.E.I.C., head of the City Planning Department of Montreal, has retired after 41 years of service with the City. His assistant, **C. E. Campeau,** M.E.I.C., was appointed as his successor.

Mr. Cousineau, who graduated from Ecole Polytechnique, Massachusetts Institute of Technology, and Harvard University, joined the Montreal Health Department as sanitary engineer in 1914. He was later named superintendent of sanitation and in 1943 Mr. Cousineau was appointed head of the City Planning Department, the position he held upon his retirement on July 1.

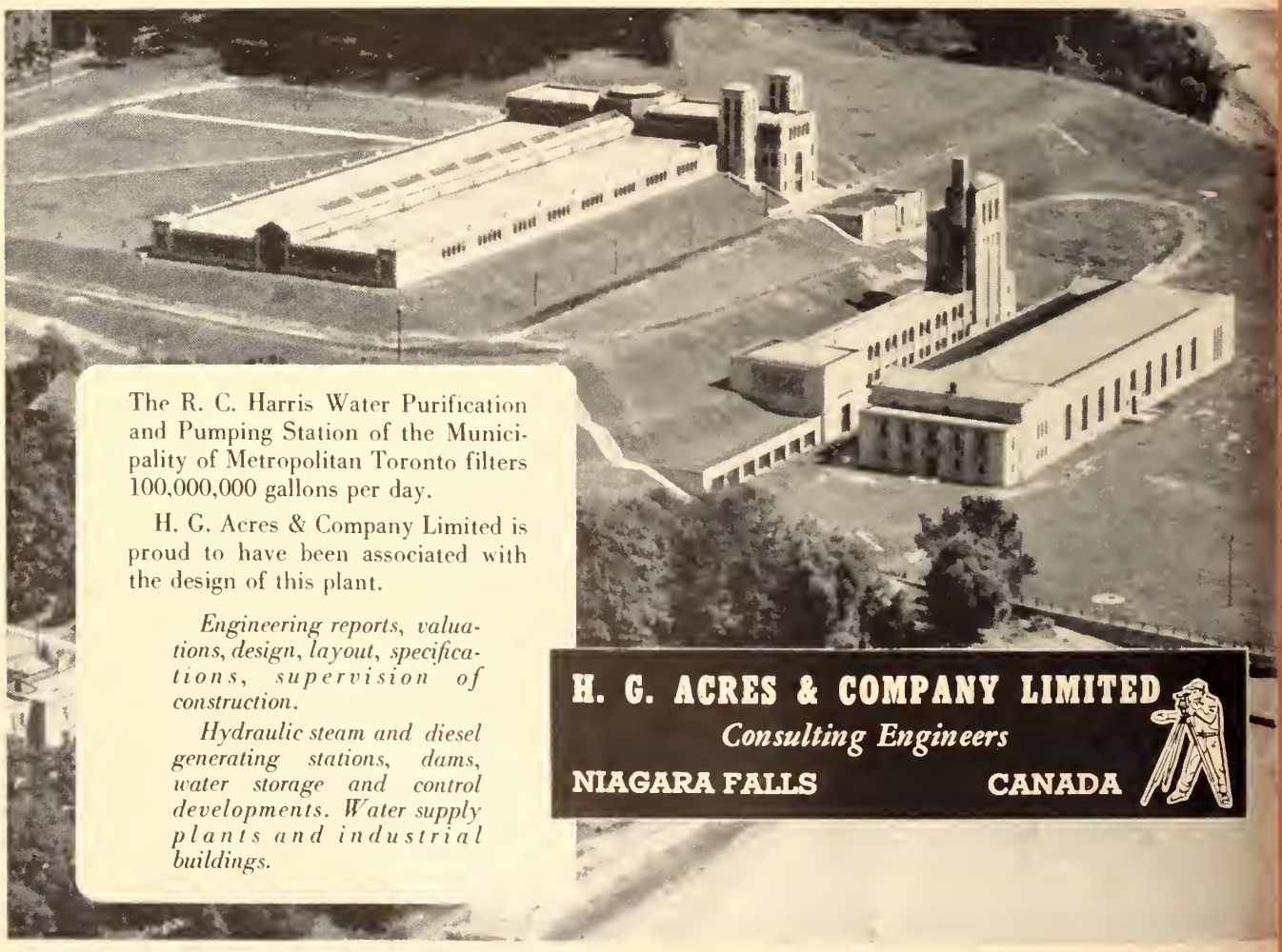
In 1940-1941 he served as chairman for the Conference of Municipal Public Health Engineers.

Mr. Cousineau was awarded an honorary degree of doctor of applied science by the University of Montreal in 1947.

He attained life membership in the Engineering Institute in 1951.

Dr. G. G. Meyerhof, M.E.I.C., has been appointed professor of civil engineering and head of the Department of Civil Engineering at the Nova Scotia Technical College, Halifax, N.S.

Dr. Meyerhof graduated from University College, London University, England, in 1938 with a first class honours B.Sc. degree in civil engineering and received the Vernon-Harcourt Civil Engineering Prize of the College. After practical training with civil engineers and contractors in London he joined the Expanded Metal Company (reinforced concrete engineers), rising to the position of principal designer. In 1944 Dr. Meyerhof received the M.Sc. degree of



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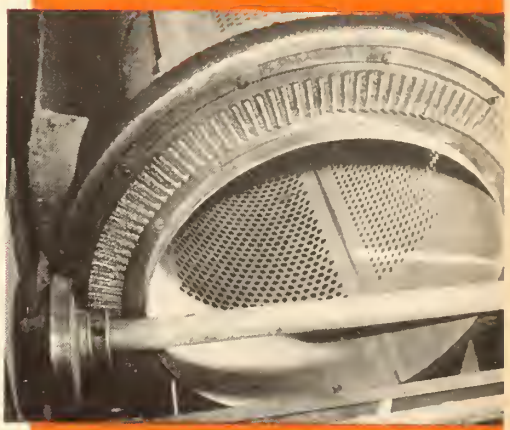

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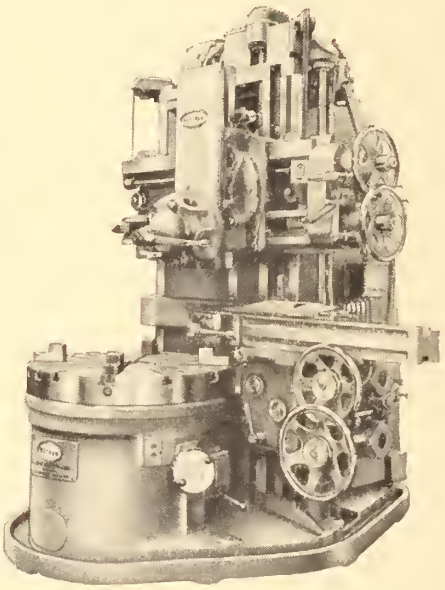

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London University for research in soil mechanics, and he took charge of the soils department of Messrs. R. H. Stanger (testing and inspection engineers) in London.

From 1946 to 1953 Dr. Meyerhof was on the staff of the Government Building Research Station in England, latterly as principal scientific officer in the soil mechanics division. He was head of the foundation section and in charge of investigations for large public buildings, bridges and industrial structures. He also carried out extensive research on foundation problems for which he was awarded the Ph.D. degree in the Faculty of Engineering of London University in 1950 and the Research Medal of the Institution of Structural Engineers in 1953. In the following year the University of London awarded him the degree of doctor of science (engineering) for his distinct contributions to the study of foundations and structures.

Dr. Meyerhof paid his first visit to this country in 1947 during a government mission to U.S.A. and Canada where he also took part in the first Canadian conference on soil mechanics in Ottawa. He returned to Canada in 1953 to join the staff of the Foundation Company of Canada in Montreal. In 1954 he was appointed to the position of supervising engineer in the Montreal office of the Foundation of Canada Engineering Corporation and was in charge of the designs of various civil engineering works.

Dr. Meyerhof is the author of numerous papers on structural and soil mechanics subjects, which have been published by scientific and technical societies in England, Canada and elsewhere. He is a member of the American Society of Civil Engineers, the Institution of Civil Engineers, the Institution of Structural Engineers, the Corporation of Professional Engineers of Quebec, the Association of Professional Engineers of Ontario, the International Association for Bridge and Structural Engineering and the International Society of Soil Mechanics and Foundation Engineering.

Lawrence M. Howe, M.E.I.C., has become associated with C. A. Energia Electrica de Venezuela at Maracaibo, Venezuela.

Mr. Howe has been with the Bolivian Power Company at La Paz, Bolivia, since 1948 as general manager. Before going to South America he was operating superintendent of the Newfoundland Light and Power Company at St. John's. He has also been with the Saskatchewan Power Commission at Regina as district superintendent of the rural transmission system.

Mr. Howe graduated from the University of Manitoba in 1933 with a degree in electrical engineering and received his M.Eng. degree from McGill University in 1935.

H. J. Williamson, M.E.I.C., has been transferred by the Department of Transport to Edmonton, Alta. He will be district controller of air services, the same position he held with the department in Moncton, N.B.

Mr. Williamson, who graduated from the University of New Brunswick with a degree in electrical engineering, joined the government service 24 years ago. He served first with the Department of National Defence and then in 1937 with the Department of Transport in western Canada where he took part in the early development of a trans-continental airway.

He was transferred in 1941 to Edmonton and was in charge of developing radio communications for the northwest staging route and the Alaska Highway. He left Edmonton in 1949 to begin a National Defence College course at Kingston, Ont., and a year later went to Moncton, N.B., as district controller of air services.

Leon Wigdor, M.E.I.C.

Leon M. Wigdor, M.E.I.C., has been named technical manager of Asbestos Corporation Limited in Montreal. He

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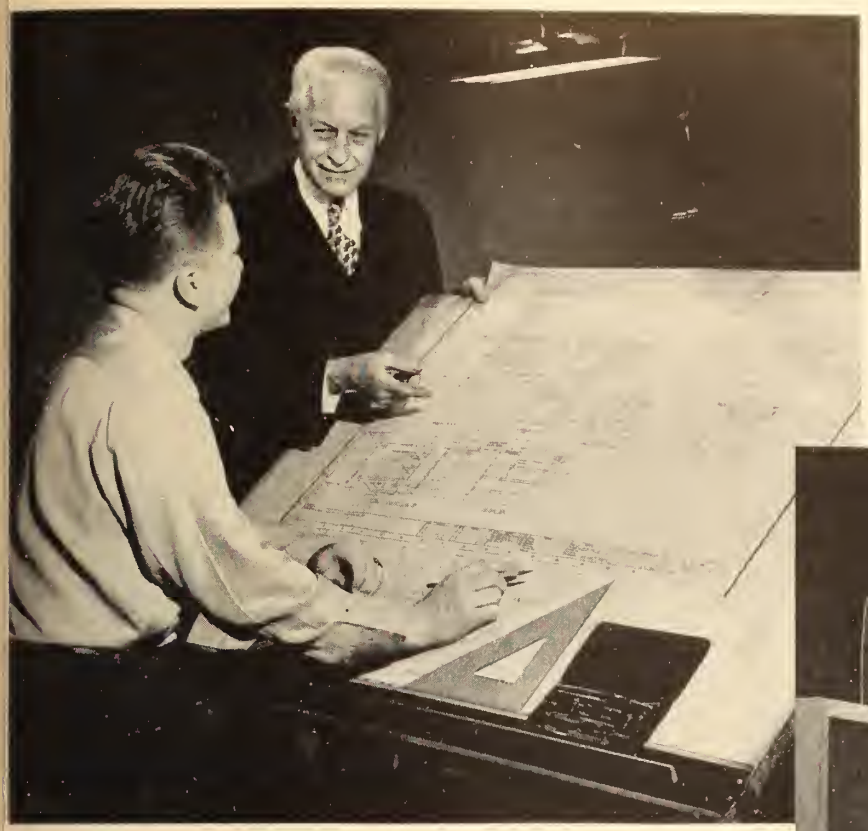

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was formerly manager of the technical department of Atlas Asbestos Company Ltd., also in Montreal.

Mr. Wigdor graduated from McGill University in 1941 with a B.Eng. degree in chemical engineering. In 1935 he received the University's certificate in business administration.

He joined Atlas Asbestos in 1948 as a development engineer. Previously he had been on the research staff of the Ault and Wiborg Company in Toronto. He has also been connected with the engineering department of Distillers Corporation Limited in Ville Lasalle, Que., and with Defence Industries Limited in Valleyfield, Que.

St. Lawrence Seaway Authority Appointments

The Honorable Lionel Chevrier has announced the appointment of three division engineers for the Authority. **Fred M. Corneil,** M.E.I.C., of Morrisburg, Ont., assumes the post of division engineer at Iroquois, Ont., in the international rapids section of the Seaway; **G. V. Bourbonnais,** M.E.I.C., of Quebec City and Montreal has been appointed division engineer at Cote Ste. Catherine, Lachine section of the seaway; and **W. A. O'Neil,** JR.E.I.C., has been named division engineer of the Welland section with headquarters at St. Catharines, Ont.

Mr. Corneil graduated from Queen's University in 1923 with a degree in civil engineering and joined E. G. M. Cape and Company in 1928 working for the company both in Toronto and Montreal. In 1934 he became associated with H. D. Sutherland in Montreal and they formed the Sutherland Construction Company. Ten years later Mr. Corneil formed his own construction company under the name of Iddon and Corneil, Inc., Montreal. He gave up his interest in the firm in 1954 and has since been living at Morrisburg, Ont.

Mr. Bourbonnais, a graduate of McGill University in civil engineering, class of 1940, was project engineer with Komo Construction Company at Labrieville, Que., before joining the St. Lawrence Seaway Authority. He has also been associated with Canadian Arsenals as plant engineer at Valcartier, Que., and on the reconstruction of the C.N.R. freight facilities at Riviere du Loup, Que. He saw service during World War II with the Royal Canadian Engineers.

F. M. Corneil, M.E.I.C.

Mr. O'Neil received his degree in civil engineering from the University of Toronto in 1949 and joined the Department of Transport upon graduation. He was junior engineer at St. Catharines, Ont. ,and assistant resident engineer in Montreal. In 1954 he was appointed engineer with the special projects branch of the department at Montreal becoming resident engineer with the Seaway Authority when the branch was taken over by the St. Lawrence Seaway Authority.

S/L. Ian Gillean, M.E.I.C., has been promoted to the rank of wing commander and is now serving at Air Force Headquarters in Ottawa, Ont.

He graduated from McGill University in 1940 with a degree in engineering and joined the R.C.A.F. in 1941. He was discharged at the end of the war with the rank of flight lieutenant and was associated with the Marconi Company in Montreal, before joining the permanent force in 1949 as signals officer in Ottawa with the R.C.A.F. Maintenance Command.

G. V. Bourbonnais, M.E.I.C.

Gerald G. Fisch, M.E.I.C., has joined the firm of Bruce Payne and Associates, management consultants in Westport, Conn., as senior associate. He was formerly vice-president and general manager of J. B. Fraser & Associates Ltd., in Toronto.

A chemical engineering graduate of McGill University and a 1950 graduate of the Massachusetts Institute of Technology in business and engineering administration, Mr. Fisch had also been associated with Canada Packers Ltd. before joining J. B. Fraser and Associates in Montreal in 1950.

Arthur M. Toye, M.E.I.C., has been named head of the bridge engineering branch of the Department of Highways of Ontario. He was previously assistant chief engineer with the department.

Mr. Toye graduated from the University of Toronto in 1925 with the degree of B.A.Sc. in engineering. He joined the Department of Highways in 1931 taking a leave of absence from 1942 to 1946 to serve at Ottawa as inspection officer for the Inspection Board of the United Kingdom and Canada. Returning to the highways department he was named assistant chief bridge engineer in 1954.

W. A. O'Neil, Jr.E.I.C.

Mr. Toye is a member of the Canadian Welding Society and of the Association of Professional Engineers of Ontario.

Robert C. March, M.E.I.C., is project manager for the New Brunswick Power Commission's hydro-electric power development at Beechwood, N.B.

Mr. March, a civil engineering graduate of Kansas State University in 1911, was for a number of years works engineer with the Aluminum Company of Canada at Arvida, Que. He has also been connected with the Deer Lake Development in Newfoundland; the Island Falls Power Project in Saskatchewan; and the Lac Cassé Development for the Quebec Hydro, until his new appointment with the New Brunswick Power Commission.

C. E. Campeau, M.E.I.C., assistant director of the Montreal City Planning Department since 1953, has been named director of the department upon the retirement of **A. Cousineau,** M.E.I.C.

Mr. Campeau graduated from Ecole Polytechnique in 1941 with a B.A.Sc. degree and immediately after graduation became associated with the Public Works Department of Montreal. He joined the city planning department in 1943 as chief engineer.

He is a past-president of the Quebec Provincial Division of the Community Planning Association of Canada.

Narcisse J. A. Vermette, M.E.I.C., of the Quebec Department of Roads, has been elected a member of the Catholic School Commission of the City of Verdun for a period of three years. He will serve as president of the board for 1955-56.

Mr. Vermette, a graduate of Laval University in 1915, is a professional engineer and land surveyor. He has been with the Department of Roads since 1940 and is chief of surveys for districts 3, 4 and 5 of the province.

He attained life membership in the Institute in 1955 having joined as a Student in 1913 while at Laval University.

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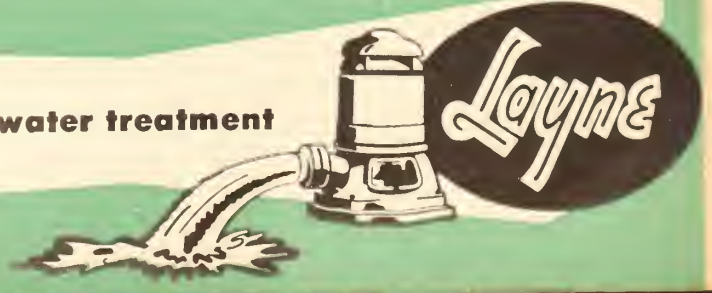

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• Personals

L. W. Grover, M.E.I.C., has been transferred by Underwood, McLellan & Associates Ltd. to Calgary, Alta. He has been named regional engineer in charge of the recently opened branch office there. Mr. Grover was previously in Saskatoon at the head office of the company as resident engineer.

He graduated from the University of Alberta in 1950 with a B.Sc. degree in civil engineering.

Robert N. Denluck, M.E.I.C., is on loan from Harold J. Doran, consultant, in Montreal, Que., to Defence Construction (1951) Limited. He is at the Camp Gagetown project in New Brunswick.

Mr. Denluck graduated from the University of British Columbia in 1948 with a B.A.Sc. degree in civil engineering.

F. W. Iveson, M.E.I.C., has accepted a position with Giffels & Vallet of Canada Ltd. in Windsor, Ont. His new position is that of assistant chief mechanical engineer.

Mr. Iveson is a mechanical engineering graduate of McGill University, class of 1940. He was formerly sewer and mechanical engineer for the City of Ottawa, having become associated with the city in 1951 as assistant sewer engineer in the engineering department. He has also been town engineer for Perth, Ont.

J. B. Gordon, M.E.I.C., is now employed by Atomic Energy of Canada Ltd. as a trainee supervisor of reactor operations at Deep River, Ont.

He had been with Hudson Bay Mining and Smelting Company Ltd. at Flin Flon, Man., where he was in charge of electrolytic research and development in connection with the company's zinc plant. He had joined the company in 1950 as research engineer.

Mr. Gordon graduated from the University of Saskatchewan in 1950 with a B.Sc. degree in chemical engineering.

R. T. Bogle, M.E.I.C., has been transferred by the Canadian General Electric Company Ltd. from Toronto to Peterborough, Ont., where he will be general manager of the motor and control department.

Mr. Bogle, who is a mechanical engineering graduate of the University of British Columbia, class of 1940, was manager of the manufacturing service department of the company in Toronto. He had previously been works manager of the same department.

Mr. Bogle obtained leave of absence from the company during World War II and served with the R.C.E.M.E., being demobilized with the rank of major.

William Rutherford, M.E.I.C., has joined the Foundation Company of Canada Engineering Corporation in Montreal as mechanical engineer, and has been sent to Edmonton to act as resident engineer on the construction of a new cement factory for the Inland Cement Company there.

Mr. Rutherford, who graduated from the University of Durham in 1936 with a degree in civil engineering, was formerly director of technical development for Rankin Company Ltd. in Montreal. He also has been with Central Mortgage and Housing Corporation in Montreal as construction engineer.

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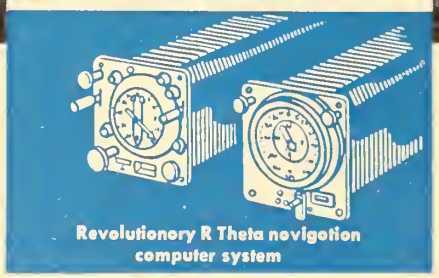

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• Personals

V. M. Wallingford, M.E.I.C., is now with the New Brunswick Electric Power Commission as resident engineer on the Beechwood Project. The project is a 135,000 h.p. development on the Saint John River estimated to cost 45 million dollars.

Mr. Wallingford, who graduated from the University of Toronto in civil engineering, was formerly general superintendent, eastern area, with Mannix Ltd. in Toronto, Ont. He has also been connected with Anglo-Canadian Pulp and Paper Mills Ltd. in Quebec City as field engineer, and with the Hydro Electric Power Commission of Ontario as project engineer.

George E. Thomas, M.E.I.C., is now with Collet Freres Ltd. in Montreal. He was previousy associated with the Foundation Company of Canada at Montreal as structural design engineer.

Mr. Thomas, who graduated from Ecole Polytechnique in 1945 with a B.A.Sc. degree, has also been connected with A. Janin & Company in Montreal, and with the Stadler Hurter Company, also in Montreal.

Robert F. Legget, M.E.I.C., director of the building research division of the National Research Council in Ottawa, has been elected chairman of the Ottawa Branch of the Engineering Institute.

A native of Liverpool, England, Mr. Legget received his early education at Merchant Taylors School. He graduated from the University of Liverpool in 1925 with a B.Eng. degree (honors) in civil engineering. He obtained his master of engineering degree from that institution in 1927. Mr. Legget had extensive experience in construction engineering in Great Britain and on the Continent before coming to Canada in 1929 to join the construction division of Power Corporation of Canada.

In 1938 he became a member of the staff of the University of Toronto where he successively was assistant professor and then associate professor of civil engineering. He was named director of the building research division of the N.R.C. in 1947.

Mr. Legget is the author of many technical papers and of two books, *Geology and Engineering*, and jointly with C. P. Disney, *Modern Railroad Structures*. He is an honorary fellow of the Royal Architectural Institute of Canada, a member of the Institution of Civil Engineers, the American Society of Civil Engineers, and a fellow of the Geological Society of America.

He joined the Engineering Institute as a Junior in 1929, transferring to Associate Member in 1931, and to Member in 1940. He has served as chairman for the Toronto Branch of the Institute.

R. F. Legget, M.E.I.C.

J. L. Aikman, M.E.I.C., has returned from Cyprus where he was assistant chief engineer with the Cyprus Mines Corporation in Skouriotissa, and has joined the staff of the Foundation Engineering Company in Montreal as mechanical engineer.

Mr. Aikman graduated from McGill University in 1950 with a B.Eng. degree, and has also been associated with Canadian Celanese Ltd. in Drummondville, Que., as power engineer.

C. F. Duff, M.E.I.C., is now with the Canadian International Paper Company in Montreal. He was for a short time with Riordon Sales Corporation before accepting his new position.

A 1940 mining engineering graduate of McGill University, Mr. Duff was associated with the Brown Corporation

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• Personals

and was vice-president and general superintendent of Meldply Limited in Montreal.

F. F. Dixon, M.E.I.C., has joined Canadian Westinghouse Company Ltd. in Hamilton, Ont., as design engineer.

Mr. Dixon, who graduated from the University of Manitoba with a B.Sc. degree in 1945, was formerly senior equipment specialist in the frequency conversion division of the Canadian Comstock Company in St. Catharines, Ont.

W. D. Adams, M.E.I.C., of Algoma Steel Corporation Ltd. in Sault Ste. Marie, Ont., is chairman of the Sault Ste. Marie Branch of the Engineering Institute.

Born in Saint John, N.B., Mr. Adams received his early education at Rothesay Collegiate School. He graduated from the Royal Military College of Canada at Kingston, Ont., in 1908 in civil engineering. He was employed first with the Grand Trunk Railway as assistant engineer and later was in charge of the engineering department of the Canadian Buffalo Forge Company in Montreal. He was also with the railway and bridge section of the department of works of the City of Toronto.

Mr. Adams enlisted with the Victoria Rifles of Canada in 1914 as lieutenant. He served overseas and was awarded the Military Cross in 1917, and was demobilized in 1919 with the rank of major.

Returning to Canada he became a partner of Adams Brothers in Toronto, later joining the Toronto Transportation Commission in 1921. Subsequently he was associated with Walter J. Francis and Company of Montreal, and with A. Bentley & Sons, in Toledo, Ohio. He returned to Toronto in 1925 as resident engineer with Toronto Waterfront Viaduct. He also spent some time in Montreal as sales engineer with Watson Jack Company Ltd. before becoming Toronto manager of H. E. McKeen and Company in 1935. Mr. Adams became associated with Algoma Steel Corporation Ltd. in 1944 as piling engineer.

He joined the Engineering Institute as a Student in 1908, transferring to Junior in 1912, to Associate Member in 1922, and to Member in 1936. He was chairman of the Sault Ste. Marie Branch in 1946.

D. G. Dunbar, M.E.I.C., has moved to the United States and accepted a position with the American Gas & Electric Service Corporation in New York City. He is with the electrical engineering division engaged on development of 330 kv. transmission lines in the eastern United States.

Mr. Dunbar, who graduated from the University of British Columbia in 1949 with a degree in civil enginering, was formerly in Vancouver, B.C., with International Engineering on the design of the 287 kv Kemano-Kitimat transmission lines for the Aluminum Company of Canada.

E. L. Miners, M.E.I.C., is now employed in an engineering capacity by the City of Prince Albert in Saskatchewan.

Mr. Miners graduated from the Uni-

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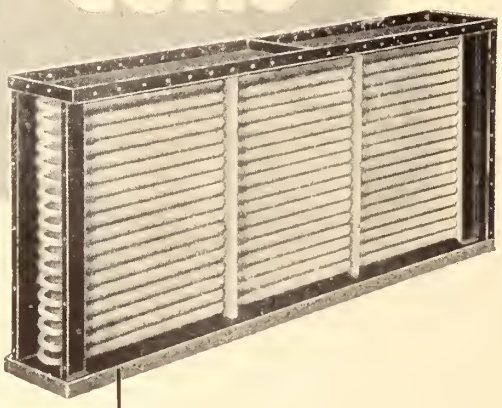

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• Personals

versity of Saskatchewan in 1936 with a degree in civil engineering. He has been with Defence Construction Company Ltd., in Ottawa as an estimator, and was for several years assistant general manager of C. M. Miners Construction Company in Saskatoon, Sask.

J. G. Notman, M.E.I.C., has been elected a director of Montreal Locomotive Works, Ltd., at the recent annual meeting. Mr. Notman is president and general manager of Canadair Ltd.; senior vice-president and director of General Dynamics Corporation; and director of Canadian Arsenals Limited, Canadian Car and Foundry Company Ltd., and of the Canadian Marconi Company.

F. E. Milne, M.E.I.C., service engineer with Otis Elevator Company Ltd. in Hamilton, Ont. ,has been elected chairman of the Hamilton Branch of the Engineering Institute.

Mr. Milne was born in Edinburgh, Scotland and graduated from the University of Edinburgh in 1922 with a B.Sc. degree in electrical engineering. He came to Canada upon graduation and joined Otis Elevator Company Ltd. in Hamilton as a student apprentice. He spent a year in New York in the chief engineer's office of the company and returned to Hamilton in 1926. In 1927 he was in charge of the Calgary office of the company. He returned to Hamilton in 1930 and was in charge of the order engineering and specifying division in the service department of the company.

Mr. Milne became a Member of the Engineering Institute in 1946.

W. J. Sutherland, M.E.I.C., assistant works manager of Hall Machinery of Canada Ltd. in Sherbrooke, Que., has been elected chairman of the Eastern Townships Branch of the Engineering Institute.

Mr. Sutherland was born in St. Louis, Missouri, and received his early education at Bishop's University, Lennoxville, Que. He graduated from Queen's University in 1948 with a B.Sc. degree in mechanical engineering. He then received his masters degree in business administration from Harvard Graduate School of Business Administration.

He served during the war with the Royal Canadian Engineers and with the R.C.E.M.E. in northwest Europe. Mr.

W. J. Sutherland, M.E.I.C.

E.I.C. TECHNICAL PAPERS

The Institute maintains a fund for the separate publication of high-calibre original technical papers. Interest in such papers is limited to a relatively small audience of specialists in the subjects to which the papers relate, and it is not economically sound to publish them in the *Journal* which aims at the interest of some 15,000 engineers in all branches of the profession.

It is an obligation of the Institute to publish original works which contribute to the reference literature of the profession. The Technical Papers are distributed to the world's major engineering societies and technical libraries. Similarly it is an obligation of those engineers qualified to write these papers to submit them for possible inclusion in the literature. The publications committee invites authors to present such manuscripts for submission to qualified reviewers and publication if warranted. Written discussion will be accepted and published as supplements.

Technical papers issued to date are:—

No. 1—Flow in Conduits and Canals:—*French and Wood.* Comprises tables and diagrams for the solution of problems of flow in open and closed channels. Price $1.50

No. 2—A Revised Manning Flow Formula:—*Blench.* A discussion of the various hydraulic flow formulae in use or proposed. The author, formerly Director of Irrigation Research, Punjab, Pakistan, and now on the staff of the University of Alberta, concludes that the Manning formula, with modifications, is the best now available. Price $1.00

No. 3—Air Entrainment by Water in Steep Open Channels:—*Priest.* A theoretical solution of a problem of interest to hydraulic engineers $1.00

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• Personals

Sutherland was demobilized with the rank of captain.

At the close of the war he became an instructor in thermodynamics at Queen's University. In 1949 he was drafting supervisor at Harvard University. The following year he joined the staff of Hudler Motor Company in Trenton, N.J., first as service manager, and in 1952, as sales manager. Mr. Sutherland returned to Canada in 1953 to take up his present position with Hall Machinery of Canada Ltd.

He has been secretary-treasurer of the Eastern Townships Branch of the Institute, having joined in 1953 as a Member.

P. H. Lavallée, M.E.I.C., has been named traffic superintendent in Quebec City for the Bell Telephone Company of Canada. He was formerly with the Saguenay Telephone Company at Chicoutimi, Que., in the same capacity.

Mr. Lavallée graduated from Laval University in 1946 with a degree in electrical engineering. He has previously been with the Bell Telephone Company of Canada's traffic departments at Montreal and Sherbrooke, Que., and at Brockville and Kingston, Ont.

D. E. Peatfield, M.E.I.C., is now associated with C. J. McCulloch & Company, consulting engineers, as resident engineer on the construction of Seaward Defence Base at Point Edward, Sydney, N.S.

Mr. Peatfield received his diploma in civil engineering from Loughborough Engineering College in 1950, and was previously with H. K. Ferguson Company Ltd. in Midhaven, Ont. as area engineer.

Charles Carter, M.E.I.C., of Great Lakes Company Ltd. in Fort William, Ont., has been promoted to the position of assistant plant engineer.

Mr. Carter, a native of Port Arthur, Ont., graduated from Queen's University with honors in civil engineering, class of 1947. He became associated with Great Lakes Paper Company Ltd. upon graduation, assuming the position of design engineer.

He is a member of the Canadian Pulp and Paper Association, serving as a member of the drying and ventilating committee. He is also a member of the Association of Professional Engineers of Ontario.

Dr. Charles D. Stewart, M.E.I.C., has been appointed professor and head of the department of agricultural engineering at the University of Saskatchewan.

Dr. Stewart graduated from the University of Saskatchewan in 1949 with a B.Sc. degree in agricultural engineering. The following year he received his master of science degree from Utah State College and in 1953 received his Ph.D. degree from the same institution.

He has been employed by P.F.R.A., Dominion Department of Agriculture, since 1949 except for the time spent in Utah. In 1953 he was acting head of the drainage division in the absence of **E. A. Olafson,** M.E.I.C., who has now returned to the department. Dr. Stewart was with the department in Medicine Hat and Vauxhall, Alta., and in Regina, Sask.

He is a member of the American Society of Agricultural Engineers, and of the Association of Professional Engineers of Alberta.

F. F. Walsh, M.E.I.C., has been elected chairman of the Brockville Branch of the Engineering Institute. He is associated with the Dupont Company of Canada at Maitland, Ont.

He was born in Toronto and received his early education in that city. Mr. Walsh graduated from the University of Toronto in 1940 with a B.A.Sc. degree in mechanical engineering. After his graduation he was employed by the Steel Company of Canada at Hamilton, Ont., until 1943, spending one year on a graduate training course and two years as foreman in the mechanical engineering department. He then joined Imperial Oil Company in Sarnia in a training course in preparation for operations at the Polymer Corporation. He was technical supervisor of steam and power plant for the Polymer Corporation for two years, subsequently becoming utilities engineer and assistant technical controller. He joined Canadian Industries Limited in 1950 and was first in Montreal for the company and then chief supervisor in the design and construction department at Maitland, Ont.

Mr. Walsh became a Member of the Institute in 1945 and has served as secretary-treasurer and chairman of the Sarnia Branch of the Institute.

Powell River Company Appointments

The Powell River Company's new expansion program has resulted in new appointments on the staff. **Mr. Norman Walton,** M.E.I.C., has been named engineering assistant to the chief engineer. He will be located in Vancouver. **J. G. D'Aoust,** M.E.I.C., has been assigned to the post of senior project engineer, reporting directly to the chief engineer. Retaining his present position of development engineer, **A. E. Chard,** M.E.I.C., will also assume the duties of project engineer on the Groundwood Mills addition in the expansion program. **A. C. Mullen,** Jr.E.I.C., will be in charge of all paper machine engineering work for the program, having been named paper mills project engineer. **W. G. Kennedy,** Jr.E.I.C., was appointed field supervisor on all construction work in the development program. Construction is expected to begin this summer.

Paul D. Mosher, M.E.I.C., has retired after 41 years of service with the engineering staff of the Department of Public Works of Canada. Mr. Mosher has made extensive contributions to the maintenance and development of harbour engineering in Nova Scotia. He was with the Halifax district office of the Department.

A native of Nova Scotia, Mr. Mosher received his education at Mount Allison University and Nova Scotia Technical College. Since leaving college in 1913, Mr. Mosher has served almost continuously with Public Works of Canada in Nova Scotia. He spent a year with the Department of Railways and Canals on construction of the Dartmouth to Deans branch of the Canadian National Railways.

E. M. Proctor, M.E.I.C., has been appointed a member of the board of directors of Standard Paving and Materials Limited. He is a senior partner of Proctor, Redfern and Laughlin, civil and consulting engineers in Toronto. He is also a vice-president of the Guaranty Trust Company of Canada.

Mr. Proctor attained life membership in the Engineering Institute in January, 1952.

P. M. Sauder, M.E.I.C., was recently honored by the Agricultural Institute of Canada. He was given an honorary membership in the Institute. Mr. Sauder is consultant to the western irrigation district in Alberta and colonization manager of the Department of Water Resources of the Alberta government in connection with the St. Mary River Development.

Mr. Sauder graduated from the University of Toronto in 1904 with a diploma in mechanical and electrical engineering. He joined the irrigation branch of the Dominion Department of the Interior upon graduation and remained with the branch until 1920 when he became associated with the Lethbridge Northern Irrigation district as division engineer. He directed the operation from 1924 to 1940 when he was named director of water resources for the province. He became general manager of the western irrigation district in 1944, a position he retired from in 1951, continuing his association as consultant, however.

Mr. Sauder received the Julian C. Smith medal of the Institute in 1947. He has represented the Lethbridge Branch on the Council, and is vice-president and past chairman of the Lethbridge Branch. He is also past-president of the Association of Professional Engineers of Alberta and has acted as the Association's representative on the Institute Council.

I. N. MacKay, M.E.I.C., has been named manager-engineering of the civilian atomic power department of Canadian General Electric Company Ltd. at Peterborough, Ont. He was formerly superintendent of the design and development branch of the National Research Council at Chalk River, Ont. He became associated with the N.R.C. in 1940 in the mechanical engineering division at Ottawa.

During World War II he was commissioned as a lieutenant commander in the Royal Canadian Navy and received an M.B.E. for his services. He returned to the N.R.C. at the close of the war and was located at Chalk River as mechanical engineer.

B. E. Shinn, M.E.I.C., is now in Jamaica, B.W.I., with Alumina Jamaica Limited at Williamsfield.

Mr. Shinn was previously in Valleyfield, Que., with Canadian Arsenals Limited working as mechanical engineer on development projects.

Donald A. Lamont, M.E.I.C., manager of the industrial engineering department of the Canadian General Electric Company at Peterborough, Ont., has been elected chairman of the Peterborough Branch of the Institute.

A native of St. Marys, Ont., he received his secondary education at Carlton Place High School. He graduated from Queen's University in 1945 with a B.Sc. degree and joined the staff of Canadian General Electric as test engineer. In 1946 he was named control engineer for the company. From 1946 to 1953 he was application engineer until his appointment as manager in 1953.

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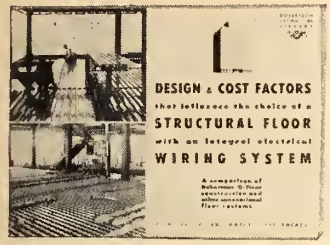

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• Personals

Mr. Lamont joined the Engineering Institute in 1944 as a Student, transferring to Junior in 1947 and to Member in 1954.

H. R. M. Murray, Jr.E.I.C., has joined the firm of A. B. Sanderson and Company in Victoria, B.C. He will be employed as resident engineer on the Nelson Bridge which will be built over the west arm of the Kootenay Lake.

Mr. Murray has been with the bridge design office of the Department of Highways of B.C. for the past three years as a design engineer, during which time he was also resident engineer on Mosquito Creek Bridge, the first prestressed concrete bridge in Canada.

He graduated from the University of Glasgow in 1946 with a B.Sc. degree in civil engineering.

Paul Donato, Jr.E.I.C., has been transferred from the Montreal East Refinery of Imperial Oil Limited to the engineering division at Sarnia, Ont.

Mr. Donato joined Imperial Oil upon his graduation in 1947 from Ecole Polytechnique in chemical and electrical engineering. He was first employed in Montreal as an engineer and then as maintenance engineer prior to his transfer to Sarnia.

Louis J. Delby, Jr.E.I.C., is presently working as research assistant on the Prestressed Concrete Project at Fritz Engineering Laboratories of Lehigh University in Bethlehem, Pa. He is also studying for his masters degree at the university. He was previously a designer and structural engineer with Giffels and Vallet of Canada in Windsor. Ont.

Mr. Debly graduated from the University of New Brunswick in 1947 with a degree in civil engineering. He has also been with the Canadian Bridge Company in Windsor, Ont., as detailer, and with the International Nickel Company of Canada in Copper Cliff, Ont., as structural detailer.

Paul T. Coté, Jr.E.I.C., has become associated with the Bay Company (B.C.) Ltd. and with the Tide Company (B.C.) Ltd., in Vancouver, B.C. Mr. Coté has been employed for the past year as project engineer on the 65 mile pipeline from Haines to Fairbanks, for the Marwell Construction Company of Vancouver.

A civil engineering graduate of the University of British Columbia, class of 1948, Mr. Coté has also been employed as civil engineer for B.C. Forest Products Ltd. in Vancouver.

Marcel L. Bussiere, Jr.E.I.C., has accepted a position with the Turnbull Elevator Company in Montreal.

A 1948 graduate of Ecole Polytechnique in electrical and mechanical engineering, he has been with Merck & Company in Valleyfield, Que., as safety engineer. He has also been with Dow Brewery Ltd. in Montreal as engineer draughtsman.

W. F. Allen, Jr.E.I.C., is now in Windsor, Ont., and is employed by the Ford Motor Company of Canada as design engineer. He was previously estimating engineer with the Department of Highways in Hamilton, Ont.

Mr. Allen graduated from the University of Cambridge in 1949 with a degree in mechanical engineering.

A. G. Turton, Jr.E.I.C., has become associated with J. Klassen, consulting engineer in Ottawa, Ont.

Mr. Turton graduated from the University of Toronto in 1949 with a B.A.Sc. degree in mechanical engineering. He was formerly with Falconbridge Nickel Mines Ltd. in Falconbridge, Ont.

C. A. Walrath, Jr.E.I.C., has been transferred from the Department of Public Works in Edmonton, Alta., to the Department of Northern Affairs, also in Edmonton.

Mr. Walrath joined the government service upon his graduation from the University of Alberta in civil engineering in 1949. He was first resident engineer in Edmonton and then construction engineer for the department.

J. C. Stewart, Jr.E.I.C., has left the Department of National Defence, Naval Headquarters, in Ottawa, and has joined the Maxim Silencer Company in Hartford, Conn. He will be a sales engineer in the evaporation division.

Mr. Stewart became associated with government service after his graduation from Queen's University in 1949 in mechanical engineering. He was on the staff

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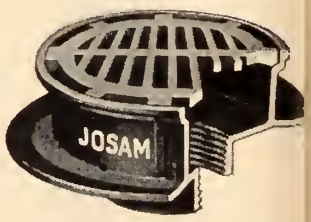

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• Personals

of the engineer-in-chief of the steam power section at Naval Headquarters. He has also been with the Hydrographic Service of the Department of Mines and Resources in Ottawa and in Stratford, Ont.

Jacques L. Vachon, Jr.E.I.C., has been transferred by the Department of Public Works to Quebec City. He was previously in Rimouski, Que., with the engineering department.

Mr. Vachon graduated from McGill University in 1949 with a degree in civil engineering and upon graduation became associated with the department at Rimouski, Que.

F. I. Morton, Jr.E.I.C., has joined the water resources division of the Department of Northern Affairs and National Resources in Ottawa, Ont. He was formerly with the special project branch of the Department of Transport in Montreal.

Mr. Morton graduated from the University of Saskatchewan in 1949 with a B.Sc. degree in engineering and physics. He has been with the Shawinigan Water and Power Company in Montreal; with Radio Engineering Products Ltd., Montreal, as junior engineer; and with the engineering department of the City of Ottawa, Ont.

M. H. Walsh, Jr.E.I.C., is with Atomic Energy of Canada at Chalk River, Ont.

Mr. Walsh graduated from McGill University in 1950 with a degree in civil engineering and has also been with Pigott Construction Company Ltd. in Toronto as field engineer; and with the Ontario Department of Highways at Brockville, Ont.

P. J. Wooding, Jr.E.I.C., is now supervisory electrical engineer with Quebec Iron & Titanium Corporation at Sorel, Que.

Mr. Wooding, who graduated from London University in 1950 with a B.Sc. degree, was formerly electrical design engineer with Canadian Johns-Manville Company Ltd. in Asbestos, Que.

John B. Nuttall, Jr.E.I.C., has joined the St. Lawrence Seaway Authority as assistant engineer of hydraulics. He was formerly in the hydraulic section of the mechanical engineering division of the National Research Council.

Mr. Nuttall graduated from the University of British Columbia in 1950 with a B.A.Sc. degree and obtained his M.A.Sc. degree the following year from the university.

A. A. Hayman, Jr.E.I.C., has joined the staff of Underwood, McLellan & Associates Ltd. in Winnipeg, Man. He was formerly field engineer for H. G. Acres & Company Ltd. at Great Falls, Man.

Mr. Hayman graduated from the University of Manitoba in 1950 with a degree in civil engineering. He was employed for a time by the Dominion Government on the Red River Basin Investigation in Winnipeg, Man.

Edgerton Dennis Forsyth, Jr.E.I.C., is now with Anglo-Canadian Pulp and Paper Mills Ltd. in Quebec City, Que.

Mr. Forsyth graduated from the University of Toronto in 1950 with a degree in electrical engineering. He was formerly with Abitibi Power and Paper Company Ltd. at Sturgeon Falls, Ont.

He has also been with Canada Electric Company Ltd. as field engineer on electrical construction of New Acme Screw and Gear Company Ltd. in Toronto; and was town engineer for Hearst, Ont., for a year after his graduation.

J. E. Miller, Jr.E.I.C., has joined the staff of Catalytic Construction of Canada Ltd. in Sarnia, Ont.

Mr. Miller has been with the British

E. D. Forsyth, Jr.E.I.C.

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• Personals

American Oil Company Ltd. since his graduation from the University of Alberta in 1952 with a degree in civil engineering. He was maintenance area engineer at the company's refinery at Moose Jaw, Sask., and then at the Montreal East refinery until his new position in Sarnia.

W. H. Coulter, JR.E.I.C., is now with the Dupont Company of Canada at their celophane plant in Shawinigan Falls, Que., as a shift supervisor.

A 1952 graduate of the University of British Columbia in chemical engineering, he was formerly a development assistant with Canadian Industries Limited at Shawinigan Falls.

Raymond H. Polischuk, JR.E.I.C., is now associated with the Canadian Johns-Manville Company in Montreal. He was with Abitibi Power and Paper Company Ltd. in Sault Ste. Marie, Ont., as mechanical engineer.

He graduated from McGill University in 1952 with a degree in mechanical engineering.

J. O. Wright, JR.E.I.C., has been transferred by the Department of Highways, bridge branch, from Medicine Hat to Edmonton, Alta. He is a resident bridge engineer with the department.

Mr. Wright graduated from the University of Alberta in 1953 with a degree in civil engineering.

D. R. Evans, JR.E.I.C., has joined the staff of Marshall, Machlin and Monaghan in Toronto as project engineer.

Mr. Evans graduated from the University of Toronto in 1953 with a degree in civil engineering and joined the Department of Health of Toronto as sanitary engineer. He was district sanitary engineer prior to his new association.

A. M. Ibrahim, JR.E.I.C., is with the Alberta Department of Highways at Picture Butte, Alta.

A civil engineering graduate of the University of Alberta, Mr. Ibrahim recently returned from Port of Spain Trinidad. He has also been with the Department of Highways at Okotoks, Alta.

Roger D. Carpenter, JR.E.I.C., has joined the maintenance engineering department of the Polymar Corporation in Sarnia, Ont., as a maintenance engineer. He was previously in the plant engineering department of A. V. Roe Canada Ltd. at Malton, Ont.

Mr. Carpenter graduated from Queen's University in 1953 with a degree in mechanical engineering. He has also been with Fraser-Brace Engineering Company Ltd. in Isle Maligne, Que.

B. Brunton, JR.E.I.C., has joined Town Planning Consultants Ltd. in Toronto as municipal engineer.

A 1953 graduate in civil engineering from the University of Manitoba, he was previously an engineer with the City of Oshawa, Ont.

Richard N. Outhouse, JR.E.I.C., is with the education department of Metropolitan-Vickers Electrical Company Ltd. in Manchester, England.

Mr. Outhouse, who graduated from Nova Scotia Technical College in 1953 in mechanical engineering, is in England on a two year scholarship course, specializing in steam power plant manufacture and operation.

Boris W. Petron, JR.E.I.C., has joined the staff of Cosmos Chemical Company Ltd. in Port Hope, Ont. He will represent the company as their official technical representative in the field.

Mr. Petron, who graduated from the University of Toronto in 1950 with a B.A.Sc. degree in chemical engineering, was formerly plant chemical engineer with Temus Products (Canada) Ltd. in Toronto.

Edward Dumalo, S.E.I.C., is presently employed as assistant resident engineer for Surveyer, Nenniger & Chenevert, consulting engineers in Montreal.

Mr. Dumalo graduated from McGill University with a degree in civil engineering in 1954.

H. Keith Allen, S.E.I.C., has joined the staff of Avro Aircraft Ltd. at Malton, Ont. He is engineer-in-training on their seventy week training program.

Mr. Allen is a recent graduate of Nova Scotia Technical College in mechanical engineering.

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MI-5

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NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

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ELECTRICAL ENGINEER, P.Eng.Ont., with post-graduate training in business administration seeks responsible position leading to sales management. 8 years sales and manufacturing experience at supervisory level. Presently in sales administration, functions including supervision of sales, product promotion, technical projects, top level customer contact in Industrial market. File No. 2975-W.

ELECTRICAL AND MECHANICAL ENGINEER, B.Sc., (Elect.) Alberta 1936, M.E.I.C., Canadian born, experience in Alberta and Quebec as follows: 4½ years oil refinery maintenance and construction and process instrument maintenance; 8 years public utility, of which 4 years high voltage substation design and operation and 4 years re operation and extension of town waterworks systems; 7 years electro-metallurgical plant, of which 2 years as electrical engineer and 5 years as works engineer and purchasing agent re bulk material handling, conveying, elevating, drying, furnacing, crushing, screening, dust collecting. File No. 3028-W.

CIVIL ENGINEER, Jr.E.I.C., B.Eng. 1949, age 28, married. Six years varied experience in public utility field mainly on design and fabrication of steel structures both light and heavy. Some experience in concrete construction as well as general supervisory, administrative and correspondence duties connected with design office. Seeking responsible position with opportunity for advancement anywhere in Canada. Available on 15-30 days notice to present employer. File No. 3845-W.

MECHANICAL ENGINEER (M.E.I.C.), age 36 married. Experience 2 years designer draftsman, 3 years industrial engineering methods and production control. Trained in time and motion study and certificate as MTM practitioner. Desires responsible position in industrial engineering methods or plant management. File No. 3900-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng. (Ont.) graduated (Univ. Vienna) 1944 (Hons.) age 39, married, left home country 1947, in Canada since 1951. Ten years experience in manufacturing methods, production engineering of high precision components and heavy machinery; design and engineering of heavy machinery, precision parts, steam engines, boiler, heating and ventilating, piping, structures, material handling equipment. Good organizer. Excellent scientific worker. Desires responsible and challenging position. File No. 3990-W.

GRADUATE ENGINEER, B.Sc. 1951, Jr.E.I.C., P.Eng. (Ont.) Age 26, married. Two years experience with consultant on municipal projects and two years mechanical handling seeks position in mechanical handling, plant engineering or general industrial engineering. File No. 4207-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng., Jr.A.S.M.E., B.A.Sc., Toronto 1950, age 32, married and family of one, 5 years experience in petro-chemical plant in pressure vessel inspection, maintenance and capital project development, field engineering on maintenance and project installation. Familiar with all phases of plant operation. Considerable practical pre-engineering experience. Desire general plant engineering, mechanical test and/or deevlopment, or maintenance or process supervisional work. Prefer Ontario or the West. Will welcome and answer all inquiries or proposals. File No. 4329-W.

EXPERIENCED MANAGER, A.M.I.Mech.E., M.E.I.C., A.M.I.Prod.E., 16 years experience in England. Engineering and manufacturing telecommunications aircraft and domestic refrigeration. Full apprenticeship served. Tooling, methods and plant layout. Presently completed 12 months tour of U.S. plants, and wishes to return to Canada in position of responsibility. Minimum commencing salary $7,500. Detailed resume on request. File No. 4356-W.

ELECTRICAL ENGINEER, P.Eng., University of Alberta, 1950, bilingual, experience in maintenance and plant engineering in heavy industry, statistical engineering and switchgear engineering. Seek responsible position in manufacturing. File No. 4427-W.

ELECTRICAL ENGINEER, Jr.E.I.C., B.Eng. (Hons.), McGill U. (1950), P.Eng. (Ont.), age 32, recently married, desires technical work with consulting engineering firm, plant engineering department or utility. Four years with plant engineering department in design, layout and drawing up of distribution and lighting systems, plant electrical services, automatic sequencing controls for process equipment; and in application of adjustable speed drives. One year with architectural firm in designing distribution lighting and services for commercial and institutional buildings. Practical experience includes construction or rural distribution lines and operating diesel power house. File No. 4448-W.

CIVIL ENGINEER, Jr.E.I.C., Sask., '49. Married. Age 27. Desirous of employment in Alberta. Experience chiefly in the field of heavy industrial equipment. Would like sales, plant engineering, application engineering. Presently located in Montreal. File No. 4517-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng., N.S.T.C., graduate 1951. Four years experience in development and design. Available on reasonable notice. File No. 4559-W.

INDUSTRIAL - METALLURGICAL ENGINEER, master of science degree in metallurgical engineering, B.Sc. (Hons.) in chemistry, P.Eng., Jr.E.I.C., National Foundry College Diploma in foundry management and technology. Applied experience includes cost savings development, work study and time standards, heat treatment, foundry work, ferrous and non-ferrous, steel melting and rolling, machining, specifications and standards writing. Particular background was specifically obtained for a supervisory or managerial position in the manufacturing or engineering field, or with a consulting firm. Location and size of company is not important. File No. 4648-W.

CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.), Queen's 1949, desires supervisory position with contractor or consultants on engineering, highway or heavy building construction. Location Canada, Ontario preferred. Experience in construction, industrial engineering and technical sales. Able administrator. Age 36, married, two children. File No. 4712-W.

SALES ENGINEER, young graduate mechanical engineer having acquired three years of sales experience with international precision machine tool corporation. Interested in position as sales representative involving responsibility and challenge in specialized technical field. 29, single, Canadian citizen presently residing in U.S.A. File No. 4721-W.

MECHANICAL ENGINEER, Jr.E.I.C., graduate from University of Denmark 1950, 32 years old, married. Two years manual shop experience. Five years experience in mechanical and structural design, materials handling, plateworks, heavy machinery, maintenance and development. Three years in Canada. Desires position with responsibility and opportunities. Available on one month's notice to present employer. File No. 4723-W.

ELECTRICAL ENGINEER, B.A.Sc., 1945, P.Eng., M.E.I.C., age 31, married with family, C.G.E. test course, presently employed. Excellent technical and practical background combined with administrative experience including 7 years complete charge of electrical engineering, design, construction, operation, and maintenance of large papermill and hydro electric station including water control, transmission, relaying, and distribution. Other experience includes substation, illumination design and sales. Desires position in Canada or elsewhere with heavy industrial, power or consulting company where experience will be an asset. File No. 4725-W.

METALLURGICAL ENGINEER, Jr.E.I.C., returning to Canada in December after two years in England on an Athlone Fellowship. B.Eng. McGill 1953. Diploma in graduate studies (industrial metallurgy) Birmingham, 1954. One year experience in a British steel plant, mostly in the melting shops (open hearth and electric furnaces). Undergraduate experience in nickel, copper and aluminum industries. Desires work in metal industry, preferably connected with production. Location open. File No. 4726-W.

CHEMICAL ENGINEER, Jr.E.I.C., M.A.Sc. U.B.C. (1953), Ph.D. (expected) Cambridge. Research experience in physical, radio, and radiation chemistry. Returning to Canada in October. Desires research or development work. Details furnished on request. File No. 4731-W.

ELECTRICAL ENGINEER, P.Eng. Quebec B.A.Sc. 1949 Laval University, test course, age 28. Four years experience in sales of electrical apparatus, motors, controls, switchgear, metallic rectifier specialist, some knowledge of water conditioning. Two years with electrical contractor and motor repair shop, layout, estimate supervision of industrial electrical installations, technical and administrative responsibility for service shop. Seeks challenging position with advancement and incentive for consulting engineers or contractor. File No. 4733-W.

YOUNG CIVIL ENGINEER, A.M.I.C.E., Jr.E.I.C., married, one child. Three years highway and bridge design (England), three years R.C. and steel, bridge and structural design (Canada). Desires interesting and responsible position in British Columbia, will consider other Western provinces. File No. 4734-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. Toronto graduate 1950, age 31, married, one child. R.C.A.F. aero engine mechanic 4 years. Wishes to offer training and experience in: pipe manufactures, sales, office half year, plant engineering 1½ years, test and development of combustion engines including design and liaison with all company departments involved in procurement and manufacture of test models 3 years. Desires work in sales or a position in industry where initiative and the ability to get a job done will lead to an executive position. Prefer Niagara or Southern Ontario. File No. 4735-W.

CIVIL ENGINEER, graduate of London University 1937, P.Eng. M.E.I.C., M.Jnr.Ins. Engineers, age 40, with the following experience: 10 years on design, estimating and construction, 2 years in supervisory capacity and 4 years in administrative post, requires post in Ottawa locality. File No. 4736-W.

CIVIL ENGINEER, Dipl.Ing., Jr.E.I.C., 37 and married, European University graduate, seeks permanent employment as design engineer with well established consulting firm. European experience: 4 years factory construction and hydraulic calculation in hydroelectric power field. Experience in Canada: 2 years engineering design of commercial and industrial buildings, involving design of foundations, R.C.-steel and wood structures. Excellent references. Presently in permanent position. Preferred location in Western Canada. Available one month after agreement is reached. File No. 4737-W.

MECHANICAL ENGINEER, Jr.E.I.C., Canadian University Graduate, 25, with 2 years experience in heavy engineering design. Mother tongue English, reasonably fluent French, some German. Presently living abroad, desires employment in machine tool sales, service, or field engineering with Canadian Machine Tools. Training period in Canada, or on the continent considered. Available on reasonable notice to present employer. Reply File No. 4740-W.

MECHANICAL ELECTRICAL ENGINEER, P.Eng. Jr.E.I.C., B.A.Sc. (Hons.) Toronto 1951. Four years field engineering (Sales) with prominent electrical manufacturer. Promotion and representative duties. Electrical layout and estimating for application and usage of electrical distribution and motor control equipment. Administrative and associated duties. Desire position offering supervisory experience with scope for initiative. Further details upon request. Travel not objectionable. Would locate in one month. Prefer S.W. Ontario, Western Canada or U.S.A. File No. 4741-W.

CIVIL ENGINEER, M.E.I.C., University of New Brunswick 1933. Experience includes considerable travel in Maritime Provinces, Newfoundland and Ontario. Fully acquainted with many phases of construction and complete knowledge of concrete design and laboratory testing. Seeks opportunity where diversified experience could be best utilized. Not adverse to travel. File No. 4742-W.

ADMINISTRATIVE POSITION sought by young (29) bilingual, mechanical engineer, Jr.E.I.C., M.B.A., married. Retired naval engineering officer. Five years industrial experience in technical sales, industrial engineering and maintenance supervision. Willing to relocate anywhere in or outside Canada. Resume sent on request. File No. 4743-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), B.A.Sc. University of Toronto, 1949. Age 30, married with 2 children. 3 years experience as electrical mechanical field engineer in steam and power plant responsible for operation and maintenance of associated equipment, supervision of new construction, liaison with consultants and contractors, etc. 2 years electrical design experience covering building power and lighting, design for new boiler installation, petrochemical plant electrical design, etc. 1 year experience in administration of large construction and building program. Seeks responsible, permanent position with good future and scope where experience can be utilized. File No. 4745-W.

CIVIL ENGINEER, Jr.E.I.C., P.Eng. (Man.), 1952 graduate. Experience in both field and office work in municipal engineering. Will consider any offer of employment for qualified civil engineer. 1 year experience with engineering department of railway, 2 years experience with consulting municipal engineers, 1 year as assistant city engineer. Single. Age 25. Location of work no object. Available on one month's notice to present employer. File No. 4747-W.

CIVIL ENGINEER, D.R.T.C., A.R.T.C. (Glasgow) 1949 P.Eng. (Alberta), M.E.I.C., age 32, eight years experience in municipal engineering. Heavy and light construction work, reinforced concrete and steel construction and design, hydraulic design, bridges, irrigation, drainage and roads. Wishes job of some responsibility in structural design with varied interest and good future prospects. Precis of experience and qualifications can be supplied on request. File No. 4748-W.

CHEMICAL ENGINEER, B.Sc., Alberta, 1951, Athlone Fellow, Jr.E.I.C., now completing research for Ph.D., University of London, desires position in chemical industry, preferably in Western Canada. File No. 4749-W.

ELECTRICAL ENGINEER, 27, married, two children, 1949 honors graduate masters degree, Westinghouse training course, four years with Montreal consultant, desires to relocate. Experience includes distribution, relaying, generation and system studies. Foreign service acceptable. File No. 4750-W.

ELECTRICAL ENGINEER, age 32, married, graduate (England), seven years experience in high voltage laboratory of a cable company, specialized in high voltage impulse testing of cables and accessories, design of portable impulse equipment, electronic impulse measuring and recording apparatus, seeks situation in Ontario. Membership of the Association of Professional Engineers applied for. File No. 4751-W.

MECHANICAL ENGINEER, P.Eng. (Alta.) M.E.I.C., graduate 1950. 30 years old, married, two children. Experience: 2 years as works manager of steel fabricating and machine shop, 3 years as estimator, project engineer and superintendent on construction of bridges, buildings, water lines, sewer lines, and road. Desires employment with opportunities for advancement. File No. 4752-W.

CHEMICAL ENGINEER patents, B.A.Sc., Toronto 1954, P.Eng., S.E.I.C., age 28, married, 2 children. Experience includes some plant experience, a year's experience in patent department of U.S. chemical manufacturing firm, patent office organization, search reports, validity investigation, preparation of patent applications and amendments. Desires position in small patent department of a chemical manufacturer or as liaison engineer with outside patent firm, offering responsibility, scope and future. File No. 4753-W.

MECHANICAL AND INDUSTRIAL ENGINEER, P.Eng., Jr.E.I.C., Physics degree, honors degree in mechanical engineering from Canadian university, 1951. Master's degree upon completion of thesis. Test course, industrial engineering course. Age 28, married. Captain, Army Reserve. Desires responsibile position in junior management, industrial engineering, design, development, or production control. Particularly interested in cost reduction. Good experience in above fields, also some plant engineering and heating experience before graduation. Prefers Toronto-Hamilton area but will take right position anywhere. File No. 4755-W.

MECHANICAL-ELECTRICAL ENGINEER, with B.Sc., in Electrical Engineering, M.E.I.C., P.Eng. and Associate Member A.I.E.E., with seven years experience desires supervisory or management level position with an industrial organization. Experience includes one year manufacturer's test course, one and and half years Sales Engineer and four and one half years as Co-ordinating Engineer on large scale projects co-ordinating design, drawings, shop contact, engineering tests and field applications. Have completed Executive Evaluation Tests and results are available to prospective employer. Travel not objectionable and will locate anywhere in Canada or the Eastern United States. File No. 4759-W.

CIVIL ENGINEER, Toronto, B.A.Sc., M.A.Sc., Jr.E.I.C., P.Eng., age 27, married. Graduating in October. Seeks employment in structural design or fabrication in or around Toronto. Varied experience, including two years draughting, two years work in welding field. Special interest in metallurgy and welding during post graduate studies. File No. 4761-W.

MECHANICAL ENGINEER, P.Eng. (Ont.), age 35, graduated 1949 from Hannover University, Germany, diplom-ingenieur. Married, one child. In Canada two years. Experience in machine design, inspection, sales engineer. In Germany six years, experience in plant maintenance, vibration research, with continental rubber industries. Consulting engineer for vibration problems. Desires employment preferably in Ontario or Quebec. Available immediately. File No. 4762-W.

ELECTRICAL ENGINEER, B.Sc. (Queens, Belfast), 1953, Grad.I.E.E. Age 28, single, seeks contacts offering position soon after arrival in Montreal, October 4th, 1955. Experience: 3 years fleet air arm; completed two years graduate apprenticeship with B.T.H. Coy. Rugby, including four months industrial electronics; 8½ months with world renowned electrical consultants as an Assistant Resident Engineer; vacation work in power station in Germany, paper mill in Sweden, and distribution in Reykjavik, Iceland. Details and credentials upon request. File No. 4764-W.

MECHANICAL-ELECTRICAL ENGINEER, B.Sc. (Mechanical), Sask. 1952, Jr.E.I.C. Age 25, married. Have 3 years experience with large electrical manufacturer including their training course. Capable public speaker and lecturer. Experienced in the problems involved in producing and marketing a quality product at customers price. Capable of contacting and negotiating effectively at management or executive level. Desire a plant manager's position or sales position with scope for initiative. Preferred location in Western Canada. File No. 4765-W.

SITUATIONS VACANT

CHEMICAL

ATOMIC ENERGY OF CANADA Limited has openings for chemical engineers for their expanding program on atomic power development. The work will be mainly the development of full preparation and processing methods, cost analysis and equipment development. Candidates must have a good academic background, preferably with some graduate training. Some industrial experience is essential. The responsibilities and salary depend on the qualifications of the candidate. State particulars including age, marital status, education and experience in first letter. File No. 5206-V.

TWO GRADUATE CHEMICAL ENGINEERS or chemists required for a newsprint and specialty mill, located in Province of Quebec. Some experience in pulp and paper desired but not essential. Excellent opportunity for advancement. Salary dependent on experience and ability. Initial letter to include full resume of experience and references. File No. 5231-V.

SENIOR PROCESS ENGINEER is required by large petrochemical cellulose acetate and synthetic yarn plant near Edmonton. Minimum of five years experience since graduation is required. Experience in field of petrochemicals is preferred. This is a permanent staff position and the opening is immediate. Write stating personal information, experience in full detail, salary required, and date available to File No. 5246-V.

TWO GRADUATE CHEMICAL ENGINEERS required with 2 to 5 years experience in the petro-chemical or rubber industries. The type of work which these men will do will be process control, raw material and product control process modification and design work. Location Ontario. File No. 5254-V.

CHEMICAL ENGINEER OR CHEMIST for medium sized manufacturer in an Ontario town on the St. Lawrence River. Experience in wire and cable business useful. Write giving age, education, marital status, complete details of experience, and salary required. File No. 5268-V.

CHEMICAL ENGINEER, required for large cement plant in Toronto area, for running the chemical and physical test laboratories. Analytical background and some industrial experience desired. A training of one year will be given at the Quebec Plant. File No. 5285-V.

CHEMICAL ENGINEER OR CHEMIST, required for position as Technical Assistant to the Plant Manager of new caustic-chlorine plant in Alberta. Preferably a young man with one to three years experience in control and development work in an Industrial plant. Position affords an excellent opportunity for a man with initiative who is willing to assume responsibility. File No. 5310-V.

CHEMICAL ENGINEERING GRADUATE, required for oil refinery in Winnipeg, as a technical assistant. One or two years experience in technical and economic studies and process design preferred. Write giving full particulars of training and experience. File No. 5316-V.

VACANCIES EXIST in a large specialty pulp and paper mill in the Eastern Townships, Province of Quebec. We require one chemical engineer and one chemist. The successful applicants will be employed in the Technical Department. Initially work will consist of technical investigations throughout the mill aimed at increased production and higher quality. The positions offer interesting work with good opportunities for advancement. Candidates must be recent graduates of a recognized university. Previous experience in the industry is not necessary. Essential qualities are initiative, self confidence and ability to work with a minimum of super-

TO THE YOUNG ENGINEER

A Chance to Perform

IN THE SERVICE OF CANADA

Today an army runs on powered wheels and muzzle velocity, cosine and stress, vanishing point and point of no return, logistics and stamina level, absolute zero and the cathode ray.

To be on top, an army must have the talents of men who can design, prove and service the machines and instruments that will keep it there.

Engineers — civil, chemical, electrical, mechanical — help keep an army functioning smoothly.

Therefore the Army can use young imaginative engineers, engineers who, in the interest of keeping the Canadian Army ahead, will be encouraged to pursue their special talents.

Request an interview with the Recruiting Officer nearest you. Ask him about careers for officers in the Engineering branches of the Army. He has the answers you need, or write:

Directorate of Manning,
Army Headquarters, Ottawa, Ont.

vision. Apply in writing giving full details of education, experience and career. All applicants will be handled in strict confidence. File No. 5321-V.

CHEMICAL ENGINEER, required by large oil company located in Toronto to work into sales. Applicant will start in Toronto area, but must be willing to move elsewhere in Canada. Canadian graduate preferred. Salary commensurate with ability, etc. File No. 5324-V.

CHEMICAL ENGINEER or chemist required for training to manage a new department in an established chemical manufacturing concern in Montreal. Practical industrial experience in chemical operations helpful, but not essential. Apply giving training, experience and salary expected. File No. 5331-V.

CHEMICAL ENGINEER required to fill the position of junior research engineer. Interested in young engineers recently graduated and who are interested in research work. The position is available immediately. Good starting salary. File No. 5334-V.

PROCESS ENGINEER required by manufacturer located in Montreal. Applicant should have B.Sc. degree in chemistry with experience in metal processing field. Knowledge of aircraft metal working and plating industries. Age 28-35 years. File No. 5340-V.

CIVIL

CIVIL ENGINEER preferably recent graduate, for bridge section of large transportation company with headquarters in Montreal. Duties include design for steel and reinforced concrete structures preparation of reports and some travelling. File No. 5127-V.

QUALIFIED CIVIL ENGINEER for road work and excavating. Man required should have at least five years experience in the field. Duties would require him to be able to accurately estimate costs on this type of work and supervise the field work. Location Ontario. File No. 5222-V.

CIVIL ENGINEERS. Continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and developing communications systems involving uses of the latest types of microwave equipment, network TV transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known, it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary: commensurate with experience and ability. File No. 5227-V.

YOUNG ENGINEER required by a Montreal construction company. Applicant must be bilingual and have experience in construction. State age, education and business experience in first letter to File No. 5232-V.

UNIVERSITY TEACHERS WANTED

A Canadian university wishes to receive applications from engineering graduates, preferably Civil, Mechanical or Electrical, under thirty-five years of age, to teach engineering problems and drawing. Applications should be sent to File No. 5325-V, Engineering Institute of Canada and should give applicant's age, university and experience. The salary offered is $2,200.00 and up for the session depending on qualifications. Might lead to permanent appointment.

FIELD ENGINEER required in Montreal who has preferably had experience in working on housing projects, relative to instrument work for elevations, etc., blue-print reading etc. File No. 5263-V.

CITY OF WINNIPEG, engineers' department requires design engineer (civil). Applications are invited from engineers, with pump or other hydraulic municipal services design experience. This is a permanent position. Salary in accordance with experience. File No. 5264-V.

ASSISTANT CIVIL ENGINEER required by an established public utility supervisory-consulting organization. Age 30-45, minimum 5 years experience on structural steel, reinforced concrete and foundation design of steam electric power plants. Location New York. Some travel field future. Reply stating age, education, experience, personal particulars. File No. 5271-V.

SALES ENGINEERS, recent graduate civil engineers required to train for positions as field sales engineers with firm engaged in engineering manufacturing and erection of industrial and commercial building products. Extensive training program provided. Immediate location, Niagara Peninsula. Salary open. File No. 5275-V.

GRADUATE CIVIL ENGINEER for head office sales work with firm engaged in engineering manufacturing and erection of industrial and commercial building products. Responsibilities to include administration, technical and structural calculations and product application engineering. Prefer applicant with minimum two or three years experience in structural steel design and potential for eventual position as field sales engineer. Location Niagara Peninsula. Salary open. File No. 5275-V.

CIVIL ENGINEER, 1955 or 1954 graduate for the position of planner with paper company located in Quebec. The applicant should be interested in detailed maintenance and construction of buildings. His duties would be to assist in planning work of building maintenance. File No. 5295-V.

MUNICIPAL ENGINEER, with one or two years experience, required by the Department of Municipal Affairs and Supply in Newfoundland. Man to be employed on topographic surveys, preparation of water and sewer design and road and bridge construction. Salary $4,600-$4,900. Replies should state qualifications, age and experience. File No. 5297-V.

APPLICATIONS ARE INVITED, from engineers with at least five years experience to act as assistant to City Engineer. Must have experience in design, planning, grading and paving roads and streets. Good permanent position for right person. Pension plan and other fringe benefits. Official application forms may be obtained at the Executive Director Office, City Hall, Saint John, N.B. File No. 5305-V.

STRUCTURAL STEEL DESIGNER. Outstanding opportunity for Ontario Professional Engineer with minimum of five years experience in the design of structural steel buildings. Excellent starting salary, modern office and good working conditions. Please state age, experience, references and salary required. File No. 5306-V.

GRADUATE ENGINEERS, for large structural steel plant in Ontario. Recent graduates from Canadian Universities preferred. Excellent opportunities for two young men who are willing to train for positions in design, contracting and production. Salary is in line with 1955 schedules as recommended by Assoc. of Prof. Eng. File No. 5318-V.

STRUCTURAL ENGINEERS AND DRAUGHTSMEN. General industrial steel and concrete design, draughting. Salary commensurate with experience. Location Montreal. File No. 5326-V.

PROVINCE OF NOVA SCOTIA, requires an architect for Department of Public Works. Applicant should be registered or qualified for registration with Nova Scotia Association of Architects. Forms may be obtained by applying to the Civil Service Commission, P.O. Box 943, Halifax, N.S. File No. 5328-V.

SENIOR PROJECT ENGINEER required by young municipal engineering firm to supervise both design and construction of complete water supply and sewage disposal systems, qualifications, thirty to forty years of age with applicable experience in Canada. Please reply giving full details of academic training, professional experience, references and salary requirements. File No. 5332-V.

CIVIL ENGINEER, required by Canadian general contractor for position as resident engineer on hydro electric development in Pakistan. Married man preferred. Duration of job approximately three years. Good

Province of Nova Scotia

requires an

ARCHITECT

for

Department of Public Works. Applicant should be registered or qualified for registration with Nova Scotia Associatian of Architects.

Forms may be obtained by applying to the Civil Service Commission, P.O. Box 943, Halifax, Nova Scotia, or by telephoning 2-7341-Branch 230.

living conditions and excellent prospects for an experienced man. File No. 5335-V.

SENIOR STRUCTURAL DESIGNER required by firm of consulting engineers in Toronto. Salary negotiable. File No. 5342-V.

CIVIL ENGINEER required by firm of consulting engineers to act as resident engineer for large highway job. Location Ontario. Living quarters provided for wife and family. Well experienced man required. Duration of present work approximately 3 years, with possibility of permanent employment. Salary negotiable. File No. 5342-V.

MUNICIPAL ENGINEER OR DIRECTOR of Public Works for the Corporation of the District of Kitimat, B.C. Salary range $575 $690 per month plus housing bonus. Position entails development of public works department for fast growing planned municipality—population now 6,000, estimated 20,000 by 1960—and supervision of up to $8,000,000.00 of construction in next 5 years. Requirements: university degree in civil engineering or equivalent. At least 5 years responsible experience, preferably in Municipal engineering and or public works construction. Eventual registration with B.C. Association of Professional Engineers. Maximum age 50. Apply before August 20th, 1955. File No. 5347-V.

ELECTRICAL

SENIOR ELECTRONIC ENGINEERS and physicists are required by a leading Canadian firm to carry out design and development work in the fields of radar, microwave communications, telephony and AM and TV broadcast equipment. All replies are confidential and will be acknowledged. Location Toronto, Ontario. File No. 5135-V.

PROJECT ENGINEER (electrical and electronic) to design electrical and electronic installations in aircraft and to supervise a small section of electrical and mechanical draughtsmen. Applicants should have a degree in electrical engineering or mechanical engineering with electrical subjects as a strong secondary and preferably 5 years experience in design of electrical and electronic installations in aircraft. Experience in supervision of draughtsmen desirable. Salary commensurate with experience and qualifications. Reply stating age, education, experience, personal particulars and salary expected. File No. 5147-V.

ELECTRICAL ENGINEER university graduate of two or three years experience in electrical field and above average literary ability. Permanent employment in Ottawa with well known industrial association, pension plan. File No. 5217-V.

ASSISTANT PROFESSOR electrical engineering duties: to instruct undergraduate studies and develop post-graduate work. Time and facil-

ities for research. Qualifications university graduate, preferably some post graduate training, several years practical experience which may include industrial graduate engineer training course. Location Maritime Province. File No. 5220-V.

ELECTRIC AND ELECTRONIC ENGINEERS continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and developing communications systems involving uses of the latest types of microwave equipment, network T.V. transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known, it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary commensurate with experience and ability. File No. 5227-V.

A GRADUATE ELECTRICAL ENGINEER to assist in the laboratory and lecture work of the department of electrical engineering. The appointment will be made initially on the basis of sessional lecturer after which the appointment may be made permanent. Duties to commence September 1st, 1955. Apply to Dean of Engineering, University of Alberta, Edmonton. File No. 5233-V.

THE LARGEST CANADIAN OWNED electronics company has immediate openings in its engineering department. These are highly paid permanent and interesting positions with excellent opportunities for advancement. Successful applicants will be employed as project supervisors or senior design engineers in a field exclusive to this company in Canada. The applicants should possess a degree in electrical engineering from a Canadian, British or American university, or hold equivalent academic standing such as the Higher National Certificate and have 3 to 5 years industrial experience. Starting salaries are commensurate with proven ability and experience. Local interviews will be arranged. Pleasant working conditions in modern plant, 5 day week, full program of employee benefits. File No. 5240-V.

ENGINEERS required for development in connection with telephony magnetic amplifiers, radar, transistor circuits, fire control systems and other servo operated instruments for both military and commercial application. The continuing expansion of work in our engineering department offers opportunity for both senior and intermediate engineers. Previous experience in fire control or electro-accoustical systems is desirable and supervisory ability would be an asset. Location Montreal. File No. 5244-V.

SALES ENGINEER, required to sell communications equipment in the Montreal area. Applicants must be bilingual and have an extensive electrical background. Above average remuneration on a base salary plus commission arrangement. Car, company benefits and excellent future with expanding company. File No. 5245-V.

ELECTRICAL ENGINEERS required with experience in the design of power transformers. Full employee benefits. Large manufacturer in Ontario. File No. 5242-V.

ELECTRICAL ENGINEER, Toronto manufacturer requires graduate electrical engineer with some mechanical design experience for product development work on transformers and substations. File No. 5247-V.

AMERICAN ELECTRONIC CONCERN seeks a top-notch microwave engineer to head up a newly formed division. The corporation, which is located in Boston, Massachusetts, desires a person thoroughly capable of designing highly precision microwave components to operate in the "C", "K", "S", and "X" band regions. The initial objective of the candidate would be to develop a line of microwave components which could be catalogued and sold to the United States electronic industry in general. In addition to moving expense; salary, commensurate with ability to produce; the successful candidate would be given an opportunity of voting-stock participation at division level. Every opportunity for further advancement and financial interest in the parent corporation would be encouraged. Write full details of marital status, education, accomplishments and experience. File No. 5250-V.

GRADUATE ELECTRICAL ENGINEER to eventually superintend maintenance and operation of electrical equipment underground and on surface at a mine in Newfoundland. Should be about 35 years of age and have mining experience. File No. 5252-V.

RADIO COMMUNICATIONS ENGINEERS for Research and development on HF and UHF equipment required by Ontario manufacturer. Some practical experience in this field essential. This is a varied and interesting position with a small but rapidly expanding communications company with excellent opportunities for future progress. File No. 5256-V.

TELEVISION BROADCAST ENGINEER required by Ontario manufacturer. Must be familiar with television transmission equipment including camera chains, transmitters, antennas, etc. Must be qualified to lay out television studio broadcast equipment and prepare technical briefs covering television station operation. Considerable customer contact will be involved. Position may develop into sales engineering in the television field. File No. 5256-V.

ELECTRICAL ENGINEER required by engineering consultants engaged in the thermal and electrical power field. While employees may expect to be located in Toronto, it is possible that successful applicant spend a year or more in Britain, becoming familiar with the nature of the work. File No. 5267-V.

JUNIOR ELECTRICAL ENGINEER required by paper company located in Province of Quebec. Graduate engineer preferably 1950, interested in working in the engineering and operating fields. File No. 5269-V.

GRADUATE ELECTRICAL engineer with several years experience in plant mechanical work required by a prominent Montreal industrial engineering firm. Experience in air conditioning and plant mechanical design desirable. Position involves supervision of all mechanical and electrical design and offers possible participation in the firm for the right man. Five day week with Blue Cross and pension plan. Reply should detail education, experience, personal qualifications and starting salary required. File No. 5286-V.

JUNIOR ELECTRICAL ENGINEER (P.Eng. Prov.Ont.), required as Assistant to Chief Electrical Engineer for large new industrial plant in Toronto area to be built by established Canadian industry. Should have reasonable experience in layout drawings and wiring diagrams for distribution, control instrumentation and lighting, experience in field supervision or other practical experience desirable. Please give details of age, education, experience and other relevant information to File No. 5290-V.

ELECTRICAL ENGINEER required by paper makers with at least two years experience in paper mill or other industrial work. Initially, his work will consist of design on specification of paper mill electrical equipment. Good starting salary. File No. 5295-V.

IMMEDIATE OPENINGS, for electronic engineers. General company expansion has created several opportunities for men with proven ability and experience for the design and development of complex electronic apparatus. There are openings for electrical and mechanical engineers in the following fields: electronic computors, microwave relay systems, test equipment design and development. Systems engineering, transistors. If you are interested in improving your professional status and knowledge by joining a firm that offers the security and prestige of leadership send full details as to age, education and past experience by mail. All replies will be held in strict confidence and will be acknowledged. File No. 5299-V.

ELECTRICAL ENGINEER required with 4 to 8 years experience in electronics, electrical or electro-magnetic circuits. Capable of doing and directing development in these fields; interested in developing his own ideas with those of others in exchange for an opportunity to participate in a small progressive engineering company. File No. 5304-V.

ASSISTANT SALES MANAGER, for electrical industry. Graduate electrical engineer preferred with experience of sales organization, in the switchgear and transformer field. Please state experience, age and salary expected. Application to be accompanied by a recent photograph. File No. 5308-V.

McGILL UNIVERSITY, requires demonstrators in Electrical Engineering, starting October first. Salary $300 a month, with time and free facilities for study and research. File No. 5315-V.

ELECTRICAL ENGINEERS AND DRAUGHTSMEN. Industrial, electrical light and power distribution. Salary commensurate with experience. Location Montreal. File No. 5326-V.

ELECTRICAL ENGINEER up to $7,200.00 to supervise the installation and the design, preparation of plans, specifications and estimates of electrical systems for public buildings. For further information write to File No. 5330-V.

ELECTRICAL ENGINEER required by Canadian General contractor on construction of hydro-electric development in Pakistan. Married man preferred. Duration of job approximately three years. Good living conditions. Applicant must have a general experience in the electrical branch of construction work. File No. 5335-V.

ELECTRICAL ENGINEER for the production department. This man to have a maximum of two years experience in production detailing and checking on low voltage distribution equipment of all kinds. Location S. Ontario. File No. 5346-V.

MECHANICAL

MECHANICAL ENGINEER for plant engineering work in the viscose rayon industry. Duties will include investigations, reports, design, and supervision of plant engineering activities, including maintenance, alterations. Must be graduate engineer age 26 to 35 with several years of practical experience in plant engineering work. Must have ability to take over leadership of a group and be prepared to make his own decisions and be responsible for them. Preferably should also have had full or partial trade apprenticeship training in industrial or plant. Position will be permanent, and offers excellent opportunity for advancement to the right man. Applications should contain all necessary personal data and full information about previous engineering experience. File No. 5207-V.

MECHANICAL ENGINEER required by plant engineering department in Montreal. Responsibilities will be to design processing equipment for plating, anodizing, cleaning, degreasing, etc. 5-7 years experience in plant engineering or process planning is a requirement. Please apply in writing giving full details of education experience, past earnings and personal history. File No. 5221-V.

MECHANICAL ENGINEER required by American chemical company establishing in P.Q. Applicant should have some experience in plant maintenance and general engineering. Position offers good opportunity and will include training in U.S. plant. File No. 5224-V.

MECHANICAL ENGINEERS. Continuing progress and expansion of this company's operations have created many interesting new career opportunities. Costing, selecting and development communications systems involving uses of the latest types of microwave equipment, network TV transmission, telephone switching systems, carrier systems, cable distribution systems. In addition to employee security and benefit plans for which this company is well known it offers its engineers opportunity to advance to higher executive positions in both engineering and administrative capacities. Salary commensurate with experience and ability. File No. 5227-V.

ENGINEER BETWEEN 30 and 40 years of age with sound knowledge of mechanical engineering to take up responsible position as sales engineer with a St. John's, Newfoundland, company. Applicants should write stating education, training and experience. Knowledge of selling desirable but not essential. Field of sales would cover a wide line of heavy engineering items. An applicant should be prepared to travel fairly frequently within the Province. All applications will be strictly confidential and salary etc. can be discussed when application is received and suitability of applicant determined. Reply in own handwriting to File No. 5229-V.

A GRADUATE MECHANICAL ENGINEER to lecture in thermodynamics and/or machine design and assist in laboratory instruction. Appointment to be on sessional basis for the first year after which a permanent appointment as lecturer may be made. Duties to commence September 1, 1955. Apply to Dean of Engineering, University of Alberta, Edmonton. File No. 5233-V.

YOUNG MECHANICAL ENGINEER, preferably not over thirty years of age required for newly constructed plant in Montreal by large world wide manufacturer. To act as supervisor of building and mechanical maintenance departments. Experience not entirely necessary but useful. File No. 5234-V.

MECHANICAL ENGINEERS with or without paper mill experience required for large pulp and paper company in the Province of Quebec. Work available in either engineering or operating departments. Salary commensurate with experience and ability. Please reply to File No. 5235-V.

GRADUATE ENGINEER required as plant engineer. Duties entail supervision of three draughtsmen in the engineering department, and estimating miscellaneous metal contracts for construction of buildings, shop drawings, mechanical design such as conveyors and platework. This position will be permanent and salary will be commensurate with experience and ability. Location Maritimes. File No. 5241-V.

MECHANICAL ENGINEER required with six to eight years experience on pressure vessel design, medium to heavy structural steel or

ENGINEERS

Required for expanding clay products industry in British Columbia and Alberta. Opportunities available in Plant Engineering, Process Engineering, Production Engineering and Sales Engineering. Please reply stating personal information, experience, and qualifications, etc. to:

Plant Manager,
Clayburn Company Limited,
P.O. Box 160,
Abbotsford, B.C.

plate design. Full employee benefits. Large reputable manufacturer in Ontario. File No. 5242-V.

MECHANICAL ENGINEER newly graduated or with two or three years experience to work in the development and research engineering department of large mechanical manufacturer located outside Montreal. File No. 5243-V.

TWO DESIGN ENGINEERS for commercial vehicle design. Good opportunity with a sound future for a graduate mechanical engineer, who has had practical experience in structural design. Location Ontario. File No. 5251-V.

MECHANICAL ENGINEER required, and whose duties will include general mechanical design on a variety of projects associated with the commercial application of atomic energy. Applicants shoud have a minimum of 4 years experience, a small portion of which should be in the electrical field. Engineering graduates of Canadian or British universities preferred. Please reply in writing giving full details of education and experience to File No. 5259-V.

OPPORTUNITIES IN A GROWING organization for production engineer for methods tooling, and estimating in precision machine shop, engaged in manufacture of machine parts and machine tools. Under 35 years of age, with time and motion study experience and university degree preferred. Location Southern Ontario. File No. 5260-V.

TOOL ENGINEER REQUIRED BY automotive manufacturing company in Southeastern Ontario. Applicants must have experience in design of small single purpose dies and general tool and machine problems. Applicant should be between the ages of 25 and 35 and when applying state experience and salary expected. Duties include layouts and designing on board and supervising of draughtsmen and clerical help. Engineering degree not necessarily required. File No. 5262-V.

THOROUGHLY EXPERIENCED INDUSTRIAL engineer required by manufacturer of large range of heavy mechanical equipment. Applicant should be of department head calibre and capable of setting up and administering an industrial engineering group. A mechanical engineering degree and five years of applicable experience are preferable qualifications. File No. 5265-V.

GRADUATE ENGINEER required for heavy clay products plant in southeastern Alberta. Duties will consist of plant layout re plant expansion, equipment replacement, materials handling, and related matters. Please reply in own handwriting. All replies will be held in strict confidence. File No. 5270-V.

WANTED 1 SENIOR MECHANICAL ENGINEER, 1 senior civil engineer, 3 junior mechanical or civil engineers for mining and concentrating plant for design and layout. Please state full details of qualifications, experience and age in first letter to File No. 5272-V.

MECHANICAL ENGINEER required in construction department of pulp and paper company located in Maritime Provinces. Engineer with experience in design and installation of power plant equipment. We are contemplating the installation of an 850 p.s.l., 200,000 lb./hr. power boiler, oilfired. File No. 5277-V.

MECHANICAL ENGINEER, required for supervision of design for a variety of heavy machinery. Applicant must be an engineering graduate or have equivalent status, 35 to 40 years of age, capable of promoting design for both economy and practicability as well as control of quality consistent with design intent and facilities of manufacture. Please reply in detail, stating experience, education, etc. All replies will be kept in strict confidence. Salary commensurate with experience and qualifications. Office and shops in Montreal area. File No. 5282-V.

RECENT GRADUATE OR ENGINEER with experience required to act as assistant plant engineer for paper mill located in Province of Quebec. Duties include design and general plant maintenance. Good starting salary. File No. 5283-V.

MECHANICAL ENGINEER to take charge of mechanical department of a prominent Montreal industrial engineering firm. Experience in air conditioning design, steam plant and plant mechanical services required. For an experienced man with good personality this position offers an unlimited future including participation in the firm. Five day week with blue cross and pension plan. Reply should detail education, experience, personal qualifications and starting salary required. File No. 5286-V.

INDUSTRIAL ENGINEER required by large manufacturer in Toronto. Applicant should be a recent graduate with one to two years experience in time-study, budgetary control, cost reduction, preferably in the metal industry. File No. 5289-V.

INDUSTRIAL OR MECHANICAL ENGINEER required for the industrial engineering department of a large organization in the Montreal area. Excellent opportunity for a progressive engineer who is interested in acquiring a sound, industrial training and is capable of eventually assuming a responsible position. Preference will be given to an engineer with one to three years practical experience in industrial engineering. Please write giving full details, including experience, age, references, etc. File No. 5293-V.

MECHANICAL ENGINEER or engineering physics graduates of 1953, 1954 or 1955. We have an opportunity for an engineer with a desire for a future in sales engineering work in heating, ventilating, air conditioning and power plant equipment. You would take a training program which includes a five months graduate engineering course in sales, research, design, and product engineering in United States, after which you would return to a branch office of our company in Canada. Your inquiry for further information will be treated as highly confidential. File No. 5298-V.

MAINTENANCE SUPERINTENDENT, required in Montreal for large chain of supermarkets. Position requires a qualified mechanical engineer with strong administrative ability and a background including refrigeration and electrical installation. Age 30-40. Salary $7,500 to $10,000. File No. 5300-V.

MECHANICAL ENGINEER, experienced in plate fabrication work with some selling experience to assist in developing an industrial business. Location Province of Quebec. File No. 5307-V.

MECHANICAL ENGINEER, to take complete charge of engineering department in medium sized, aggressive electrical manufacturing plant in Montreal. The right man must be a good draughtsman with some practical experience and be prepared to re-organize the present engineering department. There is an excellent opportunity that position would lead to executive level and company participation. File No. 5311-V.

YOUNG ENGINEERS, required for training in the Industrial Engineering Department of a progressive Ontario firm. The men we are looking for must have some engineering training and are willing to accept responsibility. There are excellent chances for advancement for men who can develop the ability to deal effectively with all levels of management. Starting salary $4,000 to $5,000, depending on experience and ability. Reply giving full particulars on experience, education and interests. File No. 5312-V.

MECHANICAL ENGINEER, required by architectural firm in Winnipeg. Heating, ventilating, plumbing design and layout experience preferred. To work with Chief Engineer. File No. 5314-V.

TWO YOUNG GRADUATE ENGINEERS, required in the production study and methods department. Age 23 to 27 years. Applicant should possess a desire to learn new methods, the ability to work with a minimum of supervision, and practical industrial experience. The first nine months of employment would consist of training in the Production Study Section learning labour controls before being transferred to the Production Methods Section. The salary would be based on the experience and qualifications of the applicant. File No. 5320-V.

MECHANICAL ENGINEER, with 3 to 5 years experience in the design and construction of materials handling equipment. Working knowledge of electricity and the strength of structures helpful. Position offers good salary and opportunity for advancement with full employee benefits. Location Niagara Peninsula. File No. 5322-V.

MECHANICAL ENGINEERS AND DRAUGHTSMEN, for industrial installation of equipment, piping, etc. Salary commensurate with experience. Location Montreal. File No. 5326-V.

MECHANICAL DESIGNERS (Engineers or draughtsmen), capable of doing the work of machine design including pulleys, gear, etc. Location Ottawa and Montreal. Salary commensurate with experience. File No. 5326-V.

JUNIOR MECHANICAL ENGINEER, qualified to be a member of the Association of Professional Engineers in Ontario. British and foreign engineers speaking and writing English are eligible. One to two years related industrial experience desirable but not essential. Applicants should have good personality and a definite liking for mechanical problems is imperative. As assistant to the Plant Engineer the successful candidate will work on projects involving building maintenance, new construction, piping and electric power layouts, steam plant operation, water, steam electrical and compressed air distribution systems, road construction, reinforced concrete design pumps, gasoline motor and electric motor maintenance. File No. 5333-V.

GRADUATE MECHANICAL ENGINEER required by a heavy industry with extensive mining and milling operations in the Eastern Townships (Quebec). Duties will include machine design, plant layout, work scheduling etc. Preference will be given to applicant with one year's experience or recent graduates. Good opportunity. Interesting and permanent position with attractive salary. Numerous employee benefits. Replies should

ELECTRICAL ENGINEER

up to $7,200

To supervise the installation and the design, preparation of plans, specifications and estimates of electrical systems for Public Buildings.

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For further information, write to

Civil Service Commission, Ottawa

Quote Competition 55-1151

include complete record of education, also salary expectation should be mentioned. File No. 5338-V.

FACTORY MANAGER REQUIRED to be responsible for all manufacturing and related service activities. He is to be accountable to the President and general manager for quality and economy of the following activities: direction and co-ordination of all direct manufacturing operations, through a superintendent, including departments as: machine shop, tool room, welding (principally electric), press-for light and medium sheet and plate, assembly, finishing and painting. To direct through a chief engineer, service and modification engineering and product design as required. Applicant should be a graduate mechanical engineer with practical experience in similar manufacturing operations. Age 38-45 years preferred. Should be a leader and co-ordinator with a good cost-consciousness and demonstrated ability in methods improvement. File No. 5336-V.

MECHANICAL ENGINEER HAVING design and detail experience in ore handling or mechanical plant equipment, is required by a large Kingston manufacturing company. Reply giving complete information on personal history, education and experience. File No. 5339-V.

WORK EQUIPMENT MANAGER required by large transportation company headquarters in Montreal. Applicants must be graduate mechanical engineers, not over 40 years old, with at least 10 years experience in the selection, operation and repair of contractors' work equipment or mechanical equipment used in woodlands operations. Apply to the undersigned by letter, giving complete information in regard to person, education and experience. Personal interviews will be arranged if applications justify. Salary depends on capability of successful applicant. File No. 5343-V.

ASSISTANT MECHANICAL SUPERINTENDENT required for Southern Quebec pulp and paper mill. Recent mechanical engineering graduate preferred. To assist mechanical superintendent in all phases eventually taking over complete responsibility for mechanical maintenance. Position offers excellent opportunity for advancement. Hospitalization and life insurance, pension plan, etc. available. Please include in application all details regarding education and experience. File No. 5349-V.

MISCELLANEOUS

SALES ENGINEER LOCATED Northern Ontario, required by established manufacturers' representative. Selling to pulp and paper, mining, industrial and heating contractors. Applications are invited from graduate engineers with civil or mechanical background and an aptitude for sales work. Address full details of education and experience to File No. 5216-V.

SALES ENGINEER required for Province of Quebec with experience in automatic heating with gas etc. Applicant should be bilingual. Good opportunity. Salary plus commission. File No. 5226-V.

PERFORMANCE ENGINEER required by Lucas-Rotax Limited, who, in addition to having a degree in engineering or science should possess a strong mathematical background. A knowledge of hydraulics and aerodynamics essential and experience in servo-mechanisms most desirable. By manufacturer of aircraft engine fuel systems located in Toronto. Apply with full details as to experience, age, education, etc., and state approximate starting salary required. File No. 5228-V.

ENGINEERS WITH 2 or more years experience required for rapidly expanding chemical company. Civil, electrical, mechanical. Good opportunity and permanent positions with central engineering office in downtown Toronto. Top salary for right men. Applications will be confidential. File No. 5230-V.

MECHANICAL OR CHEMICAL engineers with 2 to 4 years experience, required for positions in the engineering division of textile industry located in Cornwall, Ontario. Duties will include investigations, reports, design and other affiliated duties connected with the engineering division. The successful applicant must have the ability to assume leadership of a group and to take full responsibility for their work and the decisions made. This position offers an excellent opportunity to the right man for future advancement to an executive position. File No. 5236-V.

ENGINEER REQUIRED TO develop sales for continuous vacuum filtration equipment. This equipment manufactured in the United States by a leading firm and consisting of drum filters, disc filters, precoat filters, pressure filters, etc. The sales engineer would reside in Toronto and make calls, from time to time, throughout the Dominion of Canada. Previous sales experience would be an advantage but not a necessity. Full details supplied during interview. Reply giving age, education, marital status and previous experience. File No. 5237-V.

MECHANICAL OR METALLURGICAL ENGINEER interested in sales work required by progressive steel foundry to assume sales promotion responsibilities. Foundry experience an asset. Bilingualism a help. Location Montreal. Salary open. Car provided, pension plan and other benefits. Write outlining experience, qualifications and approximate salary required. File No. 5238-V.

YOUNG GRADUATE ENGINEERS required who would like to begin their career in the electrical and mechanical phases of power transformer design. Full employee benefits. Large reputable manufacturer located in Ontario. File No. 5242-V.

SALES AND SERVICE ENGINEER required by water treatment engineering firm to work in the Quebec City area. Require man who is completely bilingual and preferably with an engineering degree. File No. 5248-V.

MECHANICAL OR CIVIL ENGINEER, graduate of this year or one with a few years of experience. The duties will consist of layout and design work in a paper mill engineering office. Salary $375.00 per month. Location Province of Quebec. File No. 5249-V.

FOR LARGE INDUSTRIAL development in Middle East, several engineers are required. Salaries from $15,000. to $30.000., tax free. Expenses of family to and from destination included. Following are general qualifications: 1) Civil Engineer, in charge of general expansion and construction of all capital works. 2) Civil engineer familiar with water power development. 3) Electrical and mechanical engineer for industrial expansion and co-ordination of industries. 4) Agricultural engineer. 5) Transportation engineer for construction and extension of roads, railways, airports, docks, canals, etc. 6) Industrial engineers, to advise on processes, operations, maintenance, expansion. 7) Mining and metallurgical engineer to develop coal, iron ore, lead, tin, etc. Holiday allowance—30 days per year. Two-year contract with possibility of extension. Salaries guaranteed by international organization. Age limit, generally from 45 to 60. File No. 5253-V.

A NATIONAL ORGANIZATION requires an engineering staff manager to coordinate departments supplying product engineering services for their very diversified lines. The man will have engineering training and experience but will also be strong in administrative ability and experience and able to build an outstanding organization. He will motivate his staffs to design in terms of sales appeal, manufacturing costs and production. He himself will be seriously concerned with the mutual impacts of market trends, sales forecasts, service and engineering. He will determine policy, guide and direct organization to provide information for order negotiation, manufacturing, quality control, production and industrial engineering, product development and design, selection and training of personnel. He will maintain close liaison with sales, manufacturing and purchasing. This position will be both demanding and challenging. If your experience and ambitions line up with our description send us all pertinent information as to training and experience. File No. 5255-V.

CHIEF ENGINEER, responsible to the president. Age 35 to 40. In charge of all product engineering activities. Duties through a group of four to five product engineers, to direct experimental engineering activities, conceive, develop and design new products, supervise re-design of all regular line products for improvement and cost reduction. To supervise engineering department of fifty persons, through unit heads. To maintain adequate engineering records, including drafting and blue-printing sections. Engineering graduate in mechanical or electrical with experience in the direction of product engineering, preferably in the field of consumer durables. File No. 5255-V.

SENIOR CHECKER to lay out and check details of aircraft installations. Applicant should have had at least 15 years experience in drawing offices of aircraft manufacturers or in drawing in connection with allied light engineering work. This is a position suitable for an engineer who is retired or nearing retirement age. Reply stating age, education, experience, personal particulars and salary expected. File No. 5257-V.

TECHNICAL ASSISTANT to director of maintenance and operations required by Sask. department of public works. Salary range $382-$464 per month. Competition No. c/c 3582. Applicants require considerable experience in building construction repair and maintenance preferably including electrical and mechanical design and installation; supplemented by engineering degree or equivalent in training. Incumbent is expected to provide professional advice to the director on repairs and maintenance of government buildings and to assist the director in formulating repair and maintenance programs and to administer these programs. Competition will close when suitable applicant is obtained. File No. 5258-V.

ENGINEERING - PHYSICIST required, and whose duties will consist of development engineering in group engaged in the commercial application of radioactivity to the medical and industrial fields. Minimum of 3-4 years experience in the field of nuclear physics, or alternately in the electronics field with some knowledge of radiation physics. Graduates of Canadian or British universities preferred. Please reply in writing giving full details of education and experience to File No. 5259-V.

PRODUCTION SUPERINTENDENT for supervision over a department of hand screw machines and grinders. This is a newly created position which requires a sound operational background and a good degree of organizing ability. Location Southern Ontario. File No. 5260-V.

SALES ENGINEERS required by Montreal manufacturer of a wide range of heavy mechanical equipment. Applicants should be graduate engineers, in the age bracket of 25 to 35, with a minimum of perhaps three years sales experience in mechanical equipment or allied lines. They must be mature and personable with strong sales or sales administration interests and aptitudes. File No. 5266-V.

ASSISTANT PLANT ENGINEER required for heavy clay products plant located on the lower mainland of British Columbia. Duties will consist of plant layout, equipment replacement and installation, time studies, materials handling and related matters. All replies will be held in strict confidence. File No. 5270-V.

PRODUCTION MAN REQUIRED for heavy clay products plant in Southeast Alberta to understudy plant superintendent. Engineering training desirable but not essential. Please reply in own handwriting. All replies will be held in strict confidence. File No. 5270-V.

PROCESS ENGINEER required for heavy clay products plant in south eastern Alberta. Duties will consist of quality control, specifications, laboratory and field work, process studies, and related matters. Please reply in own handwriting. All replies will be held in strict confidence. File No. 5270-V.

GRADUATE Canadian engineer, preferably with manufacturing experience, required by financial institution to make surveys of and write reports on industries in Eastern Canada. Salary according to qualifications. File No. 5273-V.

TWO GRADUATE ENGINEERS wanted for permanent position, one civil and one mechanical with 2 or 3 years experience, pulp and paper preferred but not essential. Location at Northern Ontario Lakehead, with progressive, expanding company, having all employee benefits. Furnish qualifications, salary expected and availability for interview with application. File No. 5274-V.

THE QUEEN'S COMMISSION in the Regular Army offers a career of unusual importance, challenge and opportunities. It offers many rewards. The financial returns, the pension plan, the opportunities for advancement match, and in some ways, exceed those of any civilian profession or career. However, no one can measure the many intangible rewards of a leadership career in the service of Queen and Country. There are special opportunities and need for graduate engineers in The Royal Canadian Engineers, The Royal Canadian Corps of Signals, The Royal Canadian Electrical and Mechanical Engineers. File No. 5276-V.

TWENTY-FIVE OPPORTUNITIES, for electrical and mechanical engineers to undergo training as patent examiners with the Federal Government at Ottawa. Good careers, numerous benefits. Starting salaries up to $4,620. For additional information write to Civil Service Commission of Canada, Ottawa. Ask for circular B297. File No. 5278-V.

SALES ENGINEER required by water treatment engineers located in Ontario for the Hamilton and Niagara Peninsula area. Prefer man with engineering degree. File No. 5281-V.

SALES ENGINEER required to sell and service the application of specialized chemicals to industrial accounts. Largest and most progressive company in its field. Applicants may be graduates of any field with 1 or 2 years experience in industry or sales. Applicants will probably travel Quebec area but should

CIVIL ENGINEERS
for Highway Research Project

GRADUATE RESEARCH ASSISTANTS for research work in Highway Engineering. Candidates must be qualified for admission to the School of Graduate Studies, University of Toronto, in a course leading to the degree of Master of Applied Science. The time required to complete the work for this degree would be two years. Salary: during the academic session, $200 per month; during the summer period, $300 per month.

ASSOCIATE DIRECTOR OF HIGHWAY RESEARCH to direct investigations and preparation of reports on various HIGHWAY RESEARCH problems.
Salary: dependent upon qualifications.

Apply by letter stating qualifications and experience to Professor Carson F. Morrison, Department of Civil Engineering, University of Toronto, Toronto 5, Ont.

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be willing to work across Canada. File No. 5287-V.

ASSISTANT PROFESSOR OF metallurgical engineering for appointment September 1, 1955, to give undergraduate instruction in ferrous, non ferrous, and general metallurgy. Salary range $4,000 to $5,000 with superannuation, hospital insurance, and other benefits. Applicant should be university graduate, preferably with some years experience in process metallurgy. Location Maritime Provinces. File No. 5288-V.

PLANT MANAGER AND TWO production superintendents for new plant operation to be located north of Toronto. Established multi-plant manufacturing organization. Successful applicants will have practical experience background in ground wood pulp or paper mill. May be superintendents or senior production supervisors who have reached a standstill through lack of scope. Chemical or mechanical engineering background desirable. Ages 32 to 45. Sound salary plan and full benefit program. These are permanent challenging positions for men of proven production ability, drive and vision. Excellent opportunity for growth in international expanding organization. Reply giving full details of industrial experience, age, educational background, etc. All serious applications will be acknowledged and treated on a strictly confidential basis. File No. 5291-V.

MECHANICAL OR ELECTRICAL ENGINEER, graduate of recent years with some industrial experience. The responsibilities would include sales and also engineering required for our products and services. We are electrical and mechanical contractors. Electrical construction work and the sale of electrical apparatus represents a major portion of our business. The starting salary is a matter we would consider individually with each applicant and would depend upon experience, however, we feel that this can be arranged to mutual satisfaction. File No. 5292-V.

SALES ENGINEER in industrial water treatment department to work in the city of Montreal. We would prefer to have a bilingual man if at all possible, but it is not absolutely necessary that he be able to speak French. File No. 5294-V.

ENGINEERING REPRESENTATIVE, required by new progressive organization handling a variety of specialized building materials. Company is well represented in Ontario the Western Provinces and British Columbia. The opening is for the Quebec territory. File No. 5301-V.

CIVIL OR MECHANICAL ENGINEER, for the engineering staff of a two machine high speed newsprint mill. Applicants should preferably but not necessarily have had some experience in engineering work in the paper industry. Salary commensurate with experience and qualifications. Reply stating age, education, experience, personal particulars, and salary expected to File No. 5302-V.

APPLICATIONS ARE INVITED, for the position of Director of The Saskatchewan Research Council. The Director will be responsible for the initiation and supervision of the activities of the Council, including overall direction of a program of laboratory and pilot plant research, and for co-ordination and liaison with research carried on by the University of Saskatchewan, the National Research Council and other agencies. He will be expected to take an active part in the design and planning of a proposed new laboratory which will be located on the campus of the University of Saskatchewan. This laboratory is to operate as a centre of knowledge covering current developments in the utilization of provincial resources and conduct research into methods for their more effective utilization. It will contain within it the present industrial minerals research branch of the department of mineral Resources of the Province of Saskatchewan, the office of the Technical Information Service, and administration of research grants in aid provided by the Council. File No. 5309-V.

SALES ENGINEER FOR vitrified sewer pipe (Western Provinces). Write stating experience and references. Excellent opportunity. File No. 5313-V.

MACHINERY SALESMAN, required by leading manufacturer of machine tools in Southern Ontario. Applicants should have some practical machine shop experience, plus a proven sales record. Reply in writing, stating age, salary expected and experience, etc. File No. 5317-V.

SALES ENGINEER, required, age 25-32, with about 3 years experience, to handle fairly large accounts for company selling industrial finishes to manufacturers such as enamels, lacquers used by paper industry, to work out of Ottawa. File No. 5319-V.

SALES ENGINEER, chemical, mining, metallurgical or mechanical graduate with some experience. Will be based in Toronto, Ontario. References and reputation most important. This is a large foundry and the position has an excellent future with best possible salary and benefits. File No. 5323-V.

A CANADIAN UNIVERSITY wishes to receive applications from engineering graduates, preferably, civil, mechanical or electrical, under thirty-five years of age, to teach engineering problems and drawing. Applications should give applicants age university and experience. The salary offered is $2,200 and up for the session depending on qualifications. Might lead to permanent appointment. File No. 5325-V.

MECHANICAL, CIVIL OR ELECTRICAL ENGINEER, for work in mechanical goods sales division. Company located in Montreal. The job deals with the larger industrial concerns and involves many individual problems that require originality and imagination, together with technical know-how and selling ability. Applicant should be 25 to 35 years of age and anxious to show his ability. File No. 5327-V.

CHEMICAL ENGINEER or mechanical engineer with chemical plant experience required for plant development and process improvement in a chemical plant in Toronto. Must have 5-10 years experience in chemical plant operation or maintenance some design or engineering experience desirable. Salary commensurate with ability, pension, health and hospitalization benefits provided. File No. 5329-V.

SALES MANAGER FOR SCIENTIFIC instrument division of international company. Instruments include spectro-photometers, PH meters, goniometers, precision electronic instruments and nucleonic instruments. A general knowledge of application of above equipment plus some experience in sales to industry or research establishments preferred but not essential. Remuneration on salary bonus and expense arrangement. Location Toronto, periodic travelling throughout Canada necessary. File No. 5337-V.

ENGINEERS REQUIRED for expanding clay products industry in British Columbia and Alberta. Opportunities available in plant engineering, process engineering, production engineering and sales engineering. Please reply stating personal information, experience and qualifications etc. to File No. 5341-V.

THE UNITED NATIONS TECHNICAL ASSISTANT ADMINISTRATION require candidates for assignments in Turkey, Pakistan and Israel.
1). Petroleum Geologist required October 1955 for a period of one year. To assist in the organization of the Exploration Department of the Turkish Petroleum Corporation; to direct the exploration of new oil fields; to evaluate previous geological surveys; and to train local geologists. Sound theoretical training in petroleum geology and 10-15 years of field and executive experience with particular emphasis on evaluation of underdeveloped oil fields; experience with limestone reservoirs is also required.
2). Coal miner required for a period of one year, to carry out a detailed survey of the coal mining areas in West Pakistan, to determine the total available reserves of coal and particularly of Deghari and related coal fields in Baluchistan. An expert with extensive practical experience in all phases of soft coal mining, including planning and mechanization of underground surface operations.
3). Phosphate miner required in Israel duties to commence October 1st, 1955. The expert will advise on the following matters pertaining to phosphate mining: improvement in size reduction and classification methods, study of gravity separation and flotation possibilities, training of available chemical engineers in setting up and running of laboratory and pilot equipment on various mineral dressing methods, research on some of the difficulties encountered followed by application of results of such research. The expert should have wide experience in beneficiating phosphate mines of similar constitution. File No. 5344-V.

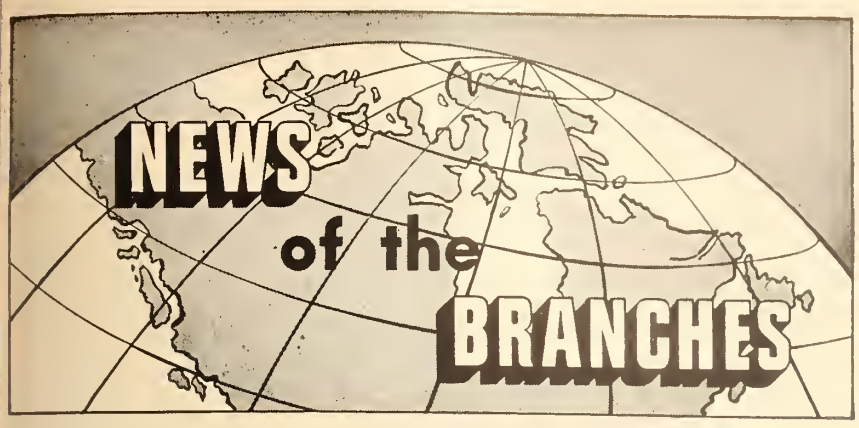
A MAJOR INDUSTRIAL ORGANIZATION WITH CANADA-wide distribution facilities requires applicants who have all or more of the following classifications. Degree in Engineering, statistics, mathematics or physics; post graduate degree in business administration, statistics or economics; experience in distribution and profitability studies or operations research; ability to work efficiently on projects with minimum supervision. Age 25-35, with thorough knowledge of Canadian and U.S. business practices. File No. 5345-V.

PULP AND PAPER MILL executive engineer wanted for full partnership established Pacific Coast Consulting Engineering Firm—No investment required—submit complete qualifications to File No. 5348-V.

INDUSTRIAL SALES ENGINEER required by major oil company. Recent graduate, or one with 2 or 3 years experience, not necessarily oil industry. Duties include, sale of petroleum products and technical service to industrial accounts. Territory Montreal. File No. 5350-V.

WANTED

Chief operator for hydroelectric power plant. Must have experience, ability to direct, and be responsible for operation and maintenance of power plants, dams and equipment. Northern Quebec. Full company benefit plan. In reply state age, education, experience, marital status, date available and salary expected in reply to Box 5353-V.



Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Hamilton

A. F. Barnard, Jr.E.I.C.,
Secretary-Treasurer

R. R. Packer, Jr.E.I.C.,
Branch News Editor

1955 Engineers' Ball

The Hamilton Branch Engineers' Ball Committee have announced Friday, October 7th, at the combined Century and Burgundy Rooms of Fischer's Hotel as the date and place for the 1955 Ball. This is the dance that has proved so popular in past years and was a tremendous success last year despite the deluge of Hurricane Hazel which occurred the same evening.

The Ball will feature music from 9.00 to 1.30 by Ted Hader and his orchestra. Favours, prizes and a midnight buffet lunch promise a complete evening for everyone.

Since accommodation is limited, the Committee is urging members and friends to obtain their tickets early, available from the Branch Executive and Committee members at $5.00 each.

Kingston

E. C. Reid, M.E.I.C.,
Secretary-Treasurer

J. A. Smythe, Jr.E.I.C.,
Assistant Secretary

Annual Branch Dinner

Forty members of the Kingston Branch and their wives attended the Branch annual dinner on June 10 at the RCEME Officers' Mess.

Chairman C. H. R. Campling, who presided, reviewed the year's activities, outlining in detail the steps taken to bring about a renewed interest in membership by Queen's University and R.M.C. students. He stated that a committee had been established to investigate the possibility of holding an annual series of meetings on specialized technical subjects. This program should commence next year, and would be carried out in addition to the regular monthly meetings of the Branch.

E. C. Reid, the secretary-treasurer, presented the financial report and gave a summary of the membership situation. He stated that seven meetings of the Branch were held during the year covering a wide range of subjects.

The Branch representative on the Institute Council, D. L. Rigsby, told the members of his attendance at the Council and annual meetings of the E.I.C. The major topic under consideration at these meetings was that of confederation with the provincial professional associations and other technical bodies.

1955-56 Branch Officers

The Branch officers for 1955-56 will be: Prof. A. V. Corlett, chairman; Col. C. W. Jones, vice-chairman; Prof. W. B. Rice, Prof. J. W. Dolphin and W. A. Trotter, executive committee; Prof. C. H. R. Campling, past chairman; Dean H. G. Conn, Branch representative to the E.I.C. Council; E. C. Reid, secretary-treasurer; and J. A. Smythe, assistant secretary.

Queen's Business Administration Course

On September 28, 1955, there will commence at Queen's University a two-year evening course in business administration. The course will be given by the School of Commerce and Administration through the Department of University Extension. It will consist of 20 lectures per session, and the fee is $50.00 per session. Class periods will be on Wednesday evenings from 7.30 to 9.30. Topics in the first session (1955-56) include control by the use of accounting statements, control of assets, business law, and marketing. In the second session (1956-57) industrial organization and management, taxation, and financial organization and management will be treated.

Information about this course has already been disseminated among the major industries in Kingston. The course has also been drawn to the attention of the Kingston Branch of the E.I.C.

Ottawa

Gordon A. Sutherland, M.E.I.C.,
Secretary-Treasurer

Carl B. Crawford, Jr.E.I.C.,
Branch News Editor

Nuclear Weapons

At the last luncheon meeting of the season on May 26 the Ottawa Branch was privileged to have as its guest speaker Major-General F. F. Worthington, Federal Civil Defence Co-ordinator. Major-General Worthington had recently returned from the Nevada proving grounds where he had witnessed the well publicized nuclear weapon test. He reported on those aspects of the test that were of particular interest to engineers.

The weapon that was used released energy equivalent to about 40 kilotons of TNT. The energy potential of present nuclear weapons ranges from 1 kiloton to 20 or more megatons. The characteristics of explosions resulting from these weapons are: first an intense heat flash, then follows the shock wave, and

ANNUAL GOLF TOURNAMENT

for

MONTREAL BRANCH MEMBERS

Sponsored by the Junior Section, E.I.C., Montreal

All members are invited to take part with the Junior engineers for a friendly day on the greens.

Club	St. Hyacinthe Golf Club, St. Hyacinthe, Que.
Date	Saturday, September 24, 1955
Green Fees	$3.50
Dinner	$2.00

Announcements as to starting times will be forwarded by special notice.

JOY Champions on the Seaway...

58 B.H. Heavyweights again prove their worth!

The two 58 B.H. Heavyweight Champion Blast Hole Drills now being operated on the Lachine section of this great development are repeating their record Niagara performance.

Drilling costs in excavating this ship channel have been held to a new record low figure by the contractor, Miron Freres, who is drilling 6¾" holes to a depth of over 40 ft. without changing steel. The overall footage drilled has so far exceeded 80 ft. per hour including all moving between holes, setup time etc. For high production, low cost blast hole drilling on large construction projects JOY Champions are the answer.

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Joy 58 B.H. Heavyweight Champions on the Niagara Hydo-Electric Development.

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finally immediate and residual nuclear radiation.

Shock Wave Extinguishes Fires

The initial heat flash, of the explosion witnessed, did not cause ignition of exterior surfaces in many instances. This was probably due to the short duration of the intense heat. Fires that did start were generally extinguished by the shock wave as it passed. The ignition of interior finishes by radiant heat was demonstrated to be a considerable hazard. Ordinary whitewash on the windows is apparently a good preventative.

Buildings of standard masonry or frame construction at 4,700 feet from ground zero were completely destroyed by the force of the shock wave. Reinforced masonry and concrete on the other hand withstood the blast well.

The nuclear radiation initially emitted by the weapon was of short duration; at most 90 seconds. Concrete or earth shelters provided excellent protection. Residual radiation in the form of radioactivated earth particles presented a more severe hazard. The "fallout" area of these particles could be extensive, warned Major-General Worthington. He emphasized the need for a well coordinated civil defence program if such areas were to be decontaminated effectively.

Right, the Kingston Branch 1955-56 executive. Front Row, l. to r., Dean H. G. Conn, Branch representative on the E.I.C. Council; Col. C. W. Jones, vice-chairman; E. C. Reid, secretary-treasurer. Back row, J. A. Smythe, assistant secretary; W. A. Trotter, executive committee member; and Prof. C. H. R. Campling, past chairman.

Below, forty members of the Kingston Branch and their wives attend the annual dinner on June 10 in the RCEME Officers' Mess.

Second Annual

PROFESSIONAL ENGINEERS' BALL

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Niagara Peninsula Branch of the E.I.C.,
Niagara Chapter of the Association of Professional
Engineers of the Province of Ontario

FRIDAY, OCTOBER 7th, 1955

at the

Hotel Sheraton-Brock, Niagara Falls, Ontario

DINNER 7:00 p.m. DANCE 9:00 p.m. to 1:00 a.m.

Dress Optional Music by "The Solidaires"

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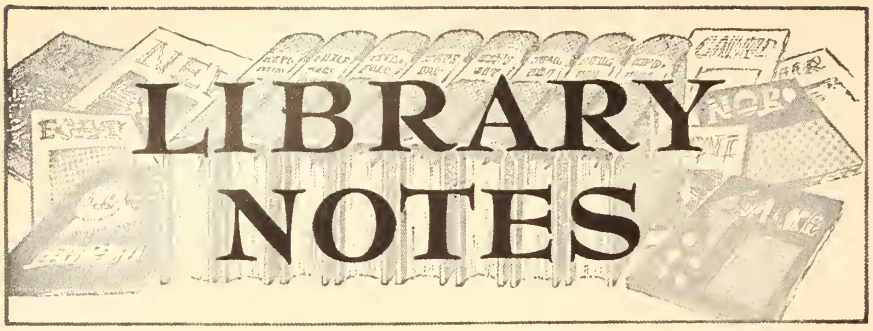

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Precast concrete. Kurt Billig. Toronto, Macmillan. 1955. 341pp., illus., $5.50.

Dr. Billig, the author of many articles and books on concrete construction, is at present the Director of the Central Building Research Institute in India, and previously worked for many years in England.

Much material has been written on precast reinforced concrete, but this is the first book on the subject, and it attempts to give a survey of existing practices. Dr. Billig mentions that while the idea of precasting is old, its use is relatively restricted, although it has many advantages to recommend it, two of the most important being economy and speed. The disadvantages are also pointed out, although the author feels they are out-weighed by the advantages.

The book is divided into four sections, the first of which deals with general principles, design and production, including such topics as concrete, moulds, transport and efficiency. The second section considers the various structural units and members, while the third discusses the different types of joints employed. The last part is a survey of the types of structures built with precast sections.

Throughout the book the author cites specific examples to illustrate his point, and there are many diagrams and photographs, the majority of the structures being European or British. One of the best known examples of precast construction is Mulberry Harbour, but others include factories, houses, bridges, churches, water-tanks, and aircraft hangars.

The author gives many references for further reading, ranging from the 1930's to date, and this will prove to be a very useful text on precast concrete. The subject of prestressed concrete, which is closely allied with precast is not considered in detail in this book, but readers are referred to Dr. Billig's book on this topic which was published in 1952. S. C.

LIBRARY REGULATIONS

Hours

Mon.-Fri. . . . . 9 a.m.-5 p.m.

Bibliography and Reference Service

Short subject bibliographies are compiled on request. When placing these requests, please give as much detail and background information as possible.

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BOOK NOTES

Prepared by the Library
The Engineering Institute of Canada

* Review provided through the courtesy of the Engineering Societies Library in New York.

ACI manual of concrete inspection, 3rd ed. Detroit, American concrete institute, 1955. 232pp., illus., $2.50 (U.S.).

While concrete inspectors will find this manual of particular use, others working with concrete will also find it a valuable aid. New subjects in this edition include air entrainment, ready-mixed concrete, and the latest special concrete construction methods.

The basic fundamentals of concrete which affect the work of inspection are presented, followed by sections on control of proportions, inspection and testing of materials, inspection before and after concreting, and types of records and reports for various operations. The last chapter deals with special methods of concreting, including hot and cold-weather construction, shotcreting, architectural concrete, etc.

Standard specifications and test methods issued by various organizations are listed at the end of the manual.

Les applications pratiques de la luminescence, 3e éd. M. Déribéré. Paris, Dunod, Montreal, Fomac, 1955. 399pp., illus., $14.85.

The author is well-known in the field of colour and lighting and has had a number of books published on these subjects. In this volume he deals with the phenomenon of luminescence in nature and its practical applications in industry and science.

The first section of the book deals with the physiology and biology of luminous objects. The use to which this luminous quality is put in the chemical industry is then discussed, followed by similar chapters on its applications in the food industry. Many other industries are touched on in which luminescence is an important factor, including the oil, plastic, paper, textile and perfume industries. The use of luminous products in advertising, signalling, X-rays and decoration is dealt with in the last part of the book.

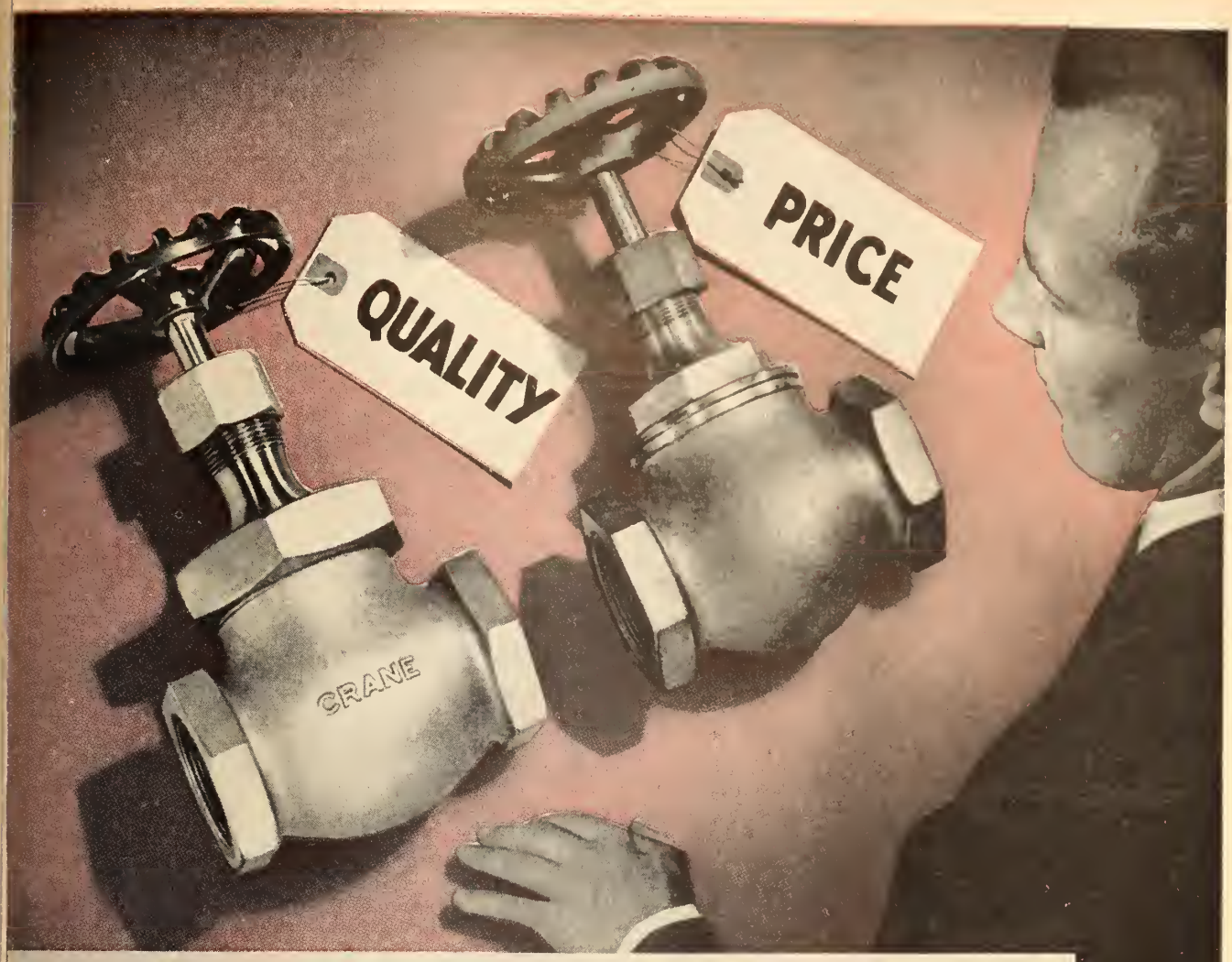
Art in science; a portfolio of 32 paintings, drawings and photographs from Scientific American. New York, Simon and Schuster, 1954. 32pl., $6.00 (U.S.).

The thirty-two plates comprising this portfolio appeared in Scientific American from 1948 to 1954, the subjects ranging from early cave drawings to a photograph of the radiation from a reactor. The paintings of scientific instruments, the line drawings and the photographs all have the object of showing the art in science.

The plates are very nicely reproduced, and are suitable for framing.

An introductory essay on the subject of art in science has been written by Gyôrgy Kepes, Professor of visual design at Massachusetts Institute of Technology.

***Automatic protection of A.C. circuits.** 4th ed. rev. and ed. by C. M. Dobson, G. W. Stubbings. Toronto, British Book Service, 1954. 355pp., diagrs., $8.50.



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This study deals with the theory of protective transformers, with their characteristics under normal and fault conditions, and with their interconnection in the various ways required for automatic protection. It also treats the theory, construction, and operating characteristics of protective relays, and the assembly of transformers and relays for the protection of electrical machinery and cable networks. A separate chapter is devoted to testing and maintenance of equipment.

The case for the UFO: unidentified flying objects. M. K. Jessop, Toronto. McLeod, 1955. 239pp., illus., $4.00.

The author, who is an astronomer, archeologist and explorer, has written a "history" of flying objects, going back as far as 1500 B.C. to cite cases of people seeing flying saucers. His aim, as he states it in the preface, is to make an intelligent evaluation of the subject.

Taking the theory of space flight as his framework, the author touches on such fascinating matters as the source of flying objects, the relation of meteorology to the subject, disappearing ships and planes, fireballs and legends connected with all these phenomena.

While many people, scientists in particular, scoff at the idea of unidentified objects coming from outer space this book will nevertheless be thought-provoking. To some readers it will be the proof they've been waiting for to present to the unbelievers!

Cost accounting and the engineer. K. B. Mitchell. London, Iliffe, 1954. 126pp., diagrs., 10/6.

The author has attempted to meet the needs of the smaller industries by demonstrating the value of cost accounting and how it can become a successful part of these organizations.

The first part of the book deals with such aspects of the problem as accounting for materials and for labour, control of overhead expenses and their application to production, final costing and presentation, the influence of fixed and variable costs and costing by standards.

In the second section budgeting and budgetary control are discussed under the heading of material and labour budgets, calculating expense budgets, administrative and master budgets, and budgetary control.

La couleur dans les activités humaines. M. Déribéré. Paris, Dunod, Montreal, Fomac, 1955. 242pp., illus., $9.30.

The use of colour has become a science, as well as an art, in many businesses and industries and another book on this subject will be welcomed. The coloured illustrations showing the effects of colour schemes will add to the interest in the volume.

The physical aspects of colour are first discussed, followed by two chapters on the link between lighting and colour. The subject of the psychological and physiological effects of colour on human beings is also covered. The last part of the book is devoted to colour in various environments, e.g. the office, store, home, school, restaurant, and hospital. One chapter of special interest deals with colour as it is used in codes and signals.

Design of concrete structures, 5th ed. L. C. Urquhart, C. E. O'Rourke and George Winter. Toronto, McGraw-Hill, 1954. 508pp., illus., $9.50.

This is a standard work on the fundamentals of designing concrete structures and the fact that this is the fifth edition shows the book is widely accepted.

The entire field of the usual reinforced concrete design is covered with the exception of some highly specialized and involved structures such as shell construction. In this edition greater emphasis has been given to a thorough discussion of basic structural performance, fundamental mechanics and physical explanation.

In the section on rigid frames there is a revised treatment of slope deflection and the moment-distribution method, including side sway.

The last chapter covers such new developments as ultimate or plastic design and the use of prestressed concrete.

Dictionary of television, radar and antennas in six languages. W. E. Clason, comp. Houston, Elsevier. 1955. 760pp., $21.50.

A new technical dictionary in these rapidly expanding fields will be greatly appreciated by all engineers who are concerned in any way with television, radar and related subjects. Its value is greatly increased by the fact that it is multilingual, giving definitions in English (British and American usages are clearly distinguished), French, Spanish, Italian, Dutch and German.

Besides the three subjects included in the title the dictionary covers electronics and wave guides, cinema, acoustics and music, amplifiers, transmitters and receivers, measuring and control. Arrangement is alphabetical and the basic word-list is English with the other languages numerically keyed to the English list in special sections at the back of the dictionary.

The definitions in most cases are brief —a necessary feature in a volume of this size—and are not connected by any system of cross references.

A bibliography of dictionaries, encyclopedias, glossaries, and terminologies, as well as textbooks, is found at the end of the book.

Dynamics of machinery. A. R. Holowenko. New York, Wiley, 1955. 464 pp., illus., $7.50.

Both the senior engineering student and the practising design engineer will find this a useful text. Beginning with velocity analysis the author, a well-known authority in this field, discusses relative accelerations, acceleration equation for two coincident points, equivalent mechanisms, static forces and graphic statics, and inertia forces. This part of the book leads to a presentation of dynamic analysis and later chapters cover flywheel analysis, balancing rotating masses, balancing machines, balancing masses reciprocating on one or several planes, vibrations in shafts and gyroscopes.

A variety of problems is presented with the slider-crank mechanism used extensively for velocity, acceleration, force, and dynamic analyses. An attempt has been made to give all the steps in a process, including all the step-by-step free body diagrams which should be used in analysis. Both differential and integral calculus are used.

Electric wiring. 9th ed. W. S. Ibbetson. C. R. Urwin, ed. Toronto, British Book Service, 1954. 296pp., illus., $2.00.

Although this standard work on electrical installation practice first appeared in 1909, the present edition has been revised to include the latest developments and practices. It remains a text for beginners and students as well as a reference tool for practicing wiremen.

Among the basic subjects in the field

• Library Notes

of electric wiring these are discussed: resistance, Ohm's law applied to d.c. and to a.c. circuits, instruments, insulation, distribution systems, testing installations, illumination, primary and secondary cells, small generating plants, and motors.

Elementary theory of nuclear shell structure. M. G. Mayer and J. H. D. Jensen. New York, Wiley, 1955. 269pp., figs., $7.75.

Written for the physicist and nuclear chemist this book concentrates on one aspect of theoretical nuclear physics, i.e. the use of the shell model in studying the structure of the nucleus.

The authors have brought together all the pertinent processes and data connected with nuclear shell theory and have attempted to present them in as elementary a manner as possible. The use of tables aids in making important correlations clear.

Among the topics discussed are individual orbits in the nucleus, properties of nuclear ground states, nuclear spins and magnetic moments, quadrupole moments, nuclei of even A, nuclear spectroscopy, isomerism in nuclei of odd A.

Experimental data are treated only in so far as they are connected with the shell model and long mathematical deductions are placed in the Appendix.

***Engineering cybernetics.** H. S. Tsein. Toronto, McGraw-Hill, 1954. 289pp., figs., $6.50.

This study, presented on the mathematical level of the research engineer, is concerned with the parts of cybernetics which have direct engineering applications in designing controlled or guided systems. The emphasis is on theoretical analysis and on the principles underlying different areas of practice rather than on the design and construction of components. Some of the topics treated are non-interacting controls of many variable systems, non-linear servomechanisms, control design by perturbation theory, noise filtering, and theory of error control.

The Financial Post survey of oils, v. 13, 1955. Toronto, McLean-Hunter, 1955. 384pp., maps., $3.00.

This year the interest in Canadian gas and oil is at a high peak and an authoritative survey of this industry is invaluable to many executives, investors and the public in general.

The data included by the Financial Post in this new edition gives price range of oil and gas stocks, production statistics, property acreages and locations, drilling plans and results, financial statistics, and names of officers and directors for each company. There are sections as well on pipelines, the oil market as a whole, and dormant and inactive companies. Other features are the maps which show location of wells.

Heating, ventilating, air conditioning guide, 1955. New York, American society of heating and air conditioning engineers, 1955. 1680pp., illus., $12.00 (U.S.).

The 33rd edition of this well-known reference work is again arranged in seven broad sections: fundamentals; human reactions; heating and cooling loads; combustion and consumption of fuels; systems and equipment; special systems; instruments and codes.

The latest technical and equipment information is included and among the additions to the text are a new chapter on schoolhouse heating and ventilating, new information on heating systems using high temperature hot water and new data on the cost of operating residential year-round air conditioning systems. Of special note is the fact that the winter design data for Canada has been augmented to include sixty-six cities.

The reference list of codes and standards has been brought up to date.

Hydrodynamique. G. Birkhoff. Paris, Dunod, Montreal, Fomac, 1955. 228pp., illus., $8.70.

Translated from the original English edition, this book is written by a widely recognized authority in the field of hydrodynamics.

The subject matter is concerned with two aspects of the mechanics of fluids: the relation between theory and practice, and the applications of the theory of symmetry. There are five chapters, in which the author discusses hydrodynamical paradoxes, the theory of discontinued surfaces, dimensional analysis, the theory of groups and fluid mechanics, and potential mass.

***Modern petroleum technology,** 2nd ed. E. B. Evans, hon. ed. London, Institute of Petroleum, 1954. 702pp., 35.-.

In this outline of the scientific and technical background of the petroleum industry, various specialists review the present state of knowledge of specific topics under the following broad headings: exploration and production; manufacture and refining; properties and utilization of products; testing; transport and distribution; and economic aspects. Many of the articles in this edition have been rewritten, and some are completely new.

L'organisation de l'entreprise et l'imprimé, 2e éd. C. Duval et J. Lepanot Paris, Dunod, Montreal, Fomac, 1955. 204pp., illus., $7.75.

The use of printed matter in a business organization is the subject of this volume, now in its second edition. The authors consider this means of communication as one of the best ways of directing and unifying a modern business concern. Because it is such a common practice they feel that newer and better methods of making use of printed directives are sometimes overlooked.

The book is divided into three broad chapters in which are discussed the value and technique of issuing printed instructions, an analysis of the basic instructions needed in any organization, and particular circumstances in which printed matter can be of great use.

This is a small subject, covered in minute detail, and would benefit any readers particularly concerned with this phase of business administration.

L'organisation scientifique et les relations humaines dans l'entreprise industrielle, 4e éd. R. Lambert. Paris, Dunod, Montreal, Fomac, 1955. 230pp., figs., $9.10.

The scientific organization of an industrial concern, with particular emphasis on human relations, is discussed in this French language book. The subject is treated in logical fashion, beginning with a general survey of the physical and financial aspects of an industry as they affect the employee.

This is followed by a chapter on administrative organization in which the functions of administrators at different levels are described. The remaining sections are devoted to methods of organizing the manufacturing, selling and accounting divisions of an industry and cover the individual problems of each.

Les poutres en béton armé soumises à la flexion composée. G. Colonio. Paris, Dunod, Montreal, Fomac, 1955. 98pp., figs., $4.50.

The subtitle of this book reads: "Cal-

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Effect of Drying Shrinkage is Dramatically Illustrated in this Clay Specimen.

Whatever the cement content of a mix or the water-cement ratio, drying shrinkage is governed mainly by *unit water content** (water required per cubic yard of concrete).

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*See U.S. Bureau of Reclamation's current Concrete Manual, Page 130.

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cul rapide, direct, au moyen de tableaux et de diagrammes, applications au calcul des poutres de noues des grandes croupes à voûtes," and as this suggests, the author's solution of the problem of the subjection of reinforced concrete beams to compound deflection is given in the form of tables and diagrams. He explains that the use of diagrams is a quick and explicit means of effecting a solution.

Rectangular and L beams are the two types dealt with in this practical study, but far from suggesting that it is the complete answer to the problem, the author points to the need for further work in the field.

The book should be of interest to the practical worker for these formulas may be applied to beams used in arch construction, etc.

Principles of electric utility engineering. C. A. Powel. New York, Wiley, 1955. 251pp., illus., $6.00.

In an attempt to consolidate the essentials of the whole field of utility engineering in one volume the author has outlined those problems which he finds basic to the design and operation of a utility.

Before going into the engineering aspects of his subject the writer explains the corporate structure of the typical utility, definitions used in business, federal and state controls to which it is subject, and the financial return to be anticipated with given rates.

The later chapters deal with such fundamentals as steam generating stations and auxiliaries, hydroelectric stations, transmission equipment, power system fault control, lightning phenomena and insulation, and power distribution.

The text of this book is essentially the notes that formed the basis for a course of lectures in electrical engineering at the Massachusetts Institute of Technology.

Standard methods for the examination of water, sewage, and industrial wastes, 10th ed. New York, American public health association, 1955. 522pp., illus., $7.50 (U.S.).

This anniversary edition incorporates the greatest amount of revision and new material since the original publication. Among these additions is a review of statistics for analysts, nomograph for alkalinity and CO_2, the complexiметric EDTA titration method for hardness, spectrophotometric and photometric methods for colour, and a membrane filter technique.

The volume is divided into six parts dealing with physical and chemical examination of natural and treated waters in the absence of gross pollution, examination of sewage, treatment plant effluents, polluted waters, industrial wastes, sludges and bottom sediment, routine bacteriologic examinations of water to determine its sanitary quality, and biological examination of water, sewage sludge, or bottom materials.

The contents of the first four parts of the book are arranged in alphabetical order, and the organization of the whole text has been improved.

Third international conference on hot dip galvanizing, Oxford, 1954. Oxford, Zinc Development Assoc., Montreal, Consolidated Mining and Smelting Company, 1954. 268pp., illus., $6.00.

Published by the Zinc Development Association of Great Britain, the contents of this report have an international flavour for contributors come from six countries. The papers, discussions, and written contributions contain the latest expert opinions from Europe and the United States on the subject of galvanizing and the use of steel.

The book has been arranged in twelve chapters, some of general interest to all galvanizers and others devoted to special processes and problems. They include discussions on sheet and strip galvanizing, faults in galvanized sheet, galvanized tubes, wire galvanizing, galvanizing threaded parts, costing of general work, heating the bath, dross formation, inspection of galvanized structural steelwork, after-treatment, incentives and productivity.

The reports of the first and second of these conferences on hot dip galvanizing have become permanent works of reference and this volume is intended for similar use. Unlike many conference papers brought together in a similar fashion this collection has the great advantage of a comprehensive technical subject index.

Transform calculus, with an introduction to complex variables. E. J. Scott. New York, Harper, 1955. 330pp., $7.50 (U.S.).

This is a text for senior-graduate courses in operational mathematics and advance calculus, centering around the Laplace transform.

The book begins with a chapter on the functions of a complex variable with the necessary theory for understanding the Laplace transform. The next two chapters discuss the Laplace transform theory and its relation to the residue theory and contour integration.

The remaining sections deal with matrix algebra, linear differential equations and the finite Fourier sine, cosine, and Hankel transform. Emphasis has been placed on the uses of transforms in the solution of physical problems which have been selected from the fields of chemical, mechanical, civil and electrical engineering, including such topics as diffusion, vibrations of rods, beam deflection, and transmission lines.

Turboblowers. A. J. Stepanoff. New York, Wiley, 1955. 377pp., illus., $8.00.

Recent developments have been very rapid in the field of application of turbomachinery for the compression of gases and vapors. An important addition to the literature of this field, this book discusses the hydrodynamic and thermodynamic aspects of the turboblower design, and discusses methods of building turbocompressors in the United States and abroad.

The author presents a theoretical treatment of the compressor impeller based on a single pattern of flow, and extends this treatment to similar design procedure for centrifugal and axial flow impellers. Other chapters describe the hydrodynamic nature of pressure generation as contrasted with the indirect thermodynamic basis usually adopted in the past. A design method for water cooled compressors is given and ways to improve the performance of fans are presented.

This book should be of practical value to engineers working with turboblowers.

Union decisions in collective bargaining. R. R. France. Princeton, University. Industrial relations section, 1955. 49pp., $2.00 (U.S.).

In the economic life of a nation today practically no other force is as powerful as the trade union. This is a study of a particular aspect of a union's function and the observations and results contained in this report are equally applicable to trade unions in Canada.

In analyzing the decision-making process in unions in the specific area of collective bargaining the preferences of unions for centralization or decentralization on these matters is taken into account. There is also an attempt to determine the level at which unions

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Figure 1
With Guy Strand and Guy Grip in position as shown, start to wrap one leg of Grip around strand. Take 3 complete turns. Repeat procedure with other leg of Grip (See Fig. 2).

Figure 1

Figure 2
With end of Grip in each hand, twist legs of Grip around strand as far as possible.

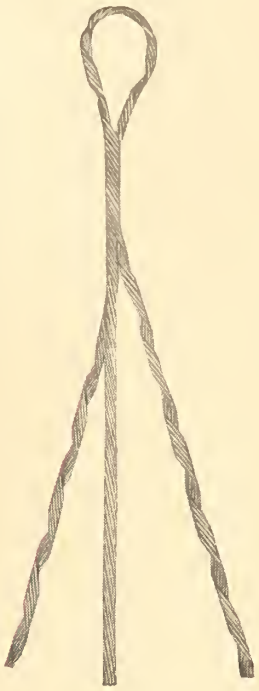

Figure 2

Figure 3

Figure 3
With screw driver lift ends of Grip over strands of Guy Wire till they snap into position. Guy Grip properly installed should look like Grip illustrated.

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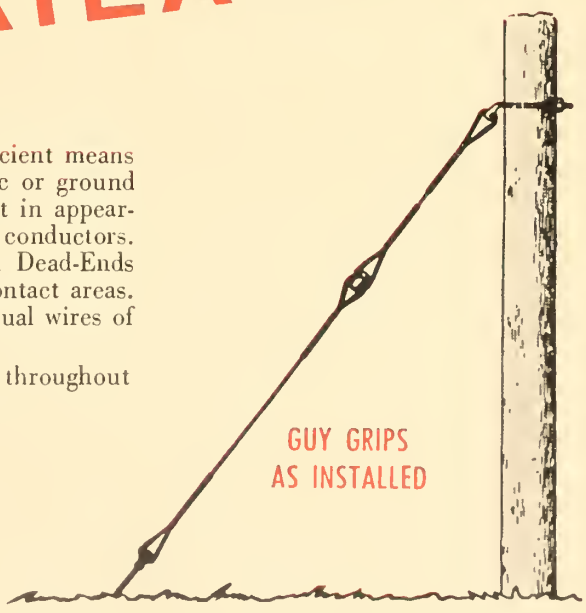

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make decisions on contract negotiations and the application of agreements. In addition, the impact of the degree of centralization and decentralization on industrial relations and on the internal problems of the union is studied.

NEW BOOKS RECEIVED

Basic theory in electrical engineering. R. G. Kloeffler and E. L. Sitz. Toronto, Macmillan, 1955. 334pp., illus., $5.50.

The birth and development of the geological sciences. F. D. Adams. New York, Dover, 1954 [c. 1938]. 506pp., illus., $1.95 (U.S.) pa., $3.95 (U.S.) cloth.

Depreciation. E. L. Grant and P. T. Norton, Jr. New York, Ronald Press, 1955. 504pp., illus., $7.50 (U.S.).

Electrical characteristics of overhead lines. S. Butterworth. Leatherhead, Surrey, Electrical Research Association, 1954. 238pp., illus., £2.2.0.

Fishing boats of the world. Jan-Olaf TRAUNG, ed. London, "Fishing News" for food and agriculture organization of the United Nations, 1955. 579pp., illus., $12.50 (U.S.).

Gas turbine principles and practice. H. R. Cox, ed. Toronto, British book service, 1955. Various paging, illus., $18.00.

How to estimate for the building trades, 2nd ed. Gilbert Townsend, J. R. Dalzell and James McKinney. Chicago, American technical society. Toronto, General, 1955. 699pp., illus., $6.75 (U.S.)

Hydraulic operation and control of machines. Ian McNeil. London, Thames and Hudson, 1954. 324 pp., illus., 35/-.

Introduction to nuclear engineering. Richard Stephenson. Toronto, McGraw-Hill, 1954. 387pp., illus., $9.75.

Lake Superior milling practice. C. H. Benedict. Houghton, Mich., Michigan college of mining and technology press, 1955. 137pp., illus., $3.00 (U.S.).

Metal industry handbook and directory, 1955. London, Cassier for "Metal Industry", 1955. 472pp., illus., 15/8.

Metallurgical progress: a series of critical reviews, 1 and 2. London, Cassier, 1954-55. 4/6 each (reprinted from *Iron and steel*).

Principles of management. Harold Koontz and Cyril O'Donnell. Toronto, McGraw-Hill, 1955. 664pp., $7.95.

Process control. A. J. Young. Pittsburgh. Instruments publishing, 1954. 132pp., illus., $2.00 (U.S.).

Protective coatings for metals, 2nd. ed. R. M. Burns and W. W. Bradley. New York, Reinhold, 1955. 643pp., illus., $12.00 (U.S.).

Symposium on prestressed concrete. Institution of engineers (India) and Concrete association of India. Hyderabad, The Association, 1955. 17 papers, some mimeog.

The testing and inspection of engineering materials, 2nd ed. H. E. Davis, G. E. Troxell and C. T. Wiskocil. Toronto, McGraw-Hill, 1955. 431pp., illus., $7.80.

Vapor-plating; the formation of coatings by vapor-deposition. C. F. Powell, I. E. Campbell and B. W. Gonser. New York, Wiley, 1955. 158pp., illus., $5.50.

Water supply engineering, 5th ed. H. E. Babbitt and J. J. Doland. Toronto, McGraw-Hill, 1955. 608pp., illus., $10.50.

Wilco blue book. V. G. Mooradin, ed. Union, N.J., Wilson, 1954. 192pp., illus., $3.00 (U.S.).

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

American society of mechanical engineers:
Diamond jubilee book of facts.

British electrical and allied industries research association. Technical reports:
F T183—Current ratings for paper-insulated cables to B.S. 480:1954 and varnished-cambric-insulated cables to B.S. 608:1955.

Canada. Dept. of mines and technical surveys:
The Saint Lawrence deep waterway project. Bibliography.

Canada. Dept. of northern affairs and national resources. Forestry branch:
Effect of rays on radial shrinkage of beech, by D. C. McIntosh. Logging waste in eastern Canada, by J. A. Doyle (Bulletin No. 115).

Canada. Dominion bureau of statistics:
Summary of traffic accident statistics.

Canadian standards association. Approvals laboratories:
List of approved equipment, fifth ed., supplement "A", January, 1955.

Carnegie Corporation of New York:
Annual report, 1954.

Cimon, Jean:
Suède, pays de l'urbanisme.

Engineers joint council:
Annual report, 1954.

Iowa state college. Engineering experiment station. Bulletin:
The use of good English in technical writing, by J. H. Bolton (Report No. 24).

Kungl. Tekniska Hogskolans. Handlingar:
No. 89—Further investigations into iterated sine- and cosine-integrals and their amplitude functions with reference to antenna theory, by Erik Hallen. No. 90—On the transverse strength of tankers, by Erik Steneroth.

Professional engineers conference board for industry:
How to train engineers in industry (Executive research survey No. 4).

Purdue university. Engineering experiment station. Bulletin:
Synthesis of RC networks, by H. J. Smead (Research series No. 123).

United States. Beach erosion board. Technical memoranda:
No. 71—Re-analysis of existing wave force data on model piles, by R. C. Crooke. No. 73—Graphical approach to the forecasting of waves in moving fetches, by B. W. Wilson.

United States. Highway research board. Bulletins:
No. 100—Soil freezing. No. 102—Tests on large culvert pipe.

STANDARDS REVIEWED

A.S.T.M. standards, American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.M.T. standards on rubber products, 1954.

Among the tests in this compilation are chemical and physical tests of vulcanized rubber, aging, weathering and low-temperature tests of rubber. There are also methods of test for automotive and aeronautical rubber, packing and gasket materials, hose and belting, tape, rubber-coated fabrics, latex foam, rubber adhesives, crude rubber and non-rigid plastics.

A.S.T.M. standards on mineral aggregates, concrete, and nonbituminous highway materials. $3.50.

Some of the subjects covered in these standards are specifications and methods of test for aggregates; ready mixed concrete; air entraining admixtures; brick and block pavement materials; concrete curing material; expansion joint fillers; cement. Producers and consumers of these materials, and engineers and contractors in building and heavy construction will find this a useful publication.

American standards, American standards association, 70 East 45 Street, New York 17, N.Y.

A.S.A. A40.8-1955 — National plumbing code. $3.50.

A number of interested organizations combined to produce this first true American national plumbing standard. In addition to general regulations the code sets down specifications for such details as materials, joints and connections, fixtures, drainage systems, vents and inspection tests. The appendices include added information on individual sewage-disposal systems, air gaps and drinking fountain standards. The code is published by the American Society of Mechanical Engineers.

British standards, British standards institutions, 2 Park Street, London, W.1. British standards are available from Canadian standards association, National research building, Ottawa, Canada.

B.S. 1549: Part 2: 1955—Methods for sheet metal pattern development: incidence of the neutral line. 5/-.

Part 1 of this standard appeared in 1949. Part 2 gives recommendations for the determination of the position of the neutral line for use with mild steel of from 14 to 20 B.G. and duralumin and half-hard aluminium of from 14 to 20 S.W.G., where the inside radius of the bend lies between a figure equal to the thickness of the metal and a figure equal to four times its thickness.

B.S. 2537: 1955—Screwdrivers and screwdriver bits for recessed head screws. 4/-.

This specification is designed as a safeguard against the supply of inferior imitations of these tools and gives a full dimensional and quality standard including requirements for the screwdrivers and the bits and also for the gauges and the testing dies which are a necessary part of the scheme.

• Library Notes

B.S. 2564: 1955—Control chart technique when manufacturing to a specification, by B. P. Dudding and W. J. Jennett. 10/6.

First published by General Electric in 1944, this manual describes acceptable procedures when introducing and operating Quality Control methods as factory routine. It is divided into two parts, one concerning the utilization of results of measurement (quantitative data) and a second part covering the classification of a product by quality (qualitative data) which is of use wherever sampling technique can be applied to regulate production. Directions are given for the construction and interpretation of Control Charts appropriate to various types of process.

B.S. 2566: 1955 — Broad flange beams, heavy flange T bars and long-legged T bars. 2/6.

This specification was prepared to fill in the gaps existing in the British standards for welded steel construction. The sectional properties of the beams and heavy flange T bars covered in this standard have been derived on a different basis from the conventional one used hence the values given differ slightly.

B.S. 2567: 1955—Steel roller conveyors. 2/6.

This new standard specifies important dimensions of the principal components of fixed and portable roller conveyors, within the range of maximum loading from 10 lb. to 320 lb. per roller. It does not apply to power-driven roller conveyors.

B.S. G.146: 1955—D.C. motors for aircraft. 3/6.

The general design and test procedure for d.c. motors for use in aircraft, other than motors classed as engine starter motors, are the subjects of this standard. The two types of motor covered are those operating over a terminal voltage range of 25-29 volts d.c. on a nominal 28 volt d.c. supply, or over a range of 100-116 volts d.c. on a nominal 112 volt d.c. supply, and those operating over a terminal voltage range of 18-29 volts d.c. on a nominal 28 volts d.c. supply, or over a range of 72-116 volts d.c. on a nominal 112 volt d.c. supply.

B.S. G.147: 1955—A.C. motors for aircraft. Part 1—Three-phase 400 C/S squirrel-cage induction motors. 3/6.

This standard outlines specifications for this type of motor covering supply voltage and frequency; types of duty; general construction; particular requirements such as rotation, rating, air cooling, shafts and flanges, flameproofness, type tests and production tests.

B.S. 153 Pt. 3A:1954—Girder bridges: loads. 6/—.

This part of the revision supersedes Clauses 1 to 12 of the original standards issued in 1937. The major changes cover highway and footway loadings, railway impact effects and the treatment of wind pressure.

B.S. 807:1955 — Spot welding electrodes. 3/—.

In the present edition electrodes of the following types are included: vertical centre, vertical off-set, angle off-set, and crank off-set, for sizes from ¼ inch to 1¼ inch with a preference shown for ¾ inch electrodes. Particular reference is given to the relationship between the welding surface and the holder.

B.S. 970:1955—Wrought steels in the form of bars, billets and forgings. 12/6d.

Requirements for wrought steels in these forms are specified up to 6 inch ruling section. Chemical compositions of En steels are also covered, as well as the case hardening steels of the En 350 and En 360 series. Service requirements are set out as far as they correspond with those of industry as a whole.

B.S. 1728:1955—Methods for analysis of aluminium and aluminium alloys. Part 6—Iron (volumetric titanous chloride method); Part 7—Zinc (Zinc oxide method). 2/— each part.

Part 6 relates to the volumetric determination of iron for use with alloys containing between 0.1 and 5.0 per cent iron. The zinc oxide method presented in Part 7 is for use with alloys having a zinc content of 2-15 per cent. Both methods specify the reagents to be used, recommended methods of sampling and test procedure.

B.S. 2561:1955 — Forged steel pipe fittings, screwed with A.P.I. thread for the petroleum industry. 3/6.

The following forged carbon and alloy steel screwed fittings are the subject of this standard: elbows; tees; crosses; laterals; caps; bull plugs; hexagonal, square and round head pipe plugs; couplings; reduced couplings; hexagonal head bushings. Range of sizes is from ⅛ inch to 6 inch and the range of ratings from 600 to 1500 lb./sq. inch within plot limits.

B.S. 2573:1955 — Report on permissible stresses in crane structures. 4/—.

In this tentative report tables are given of basic stresses in certain materials which are related to the specified yield points of those materials e.g. steel to B.S. 15, 548 and 968. Cranes are classified on this basis in order to select the correct class for the work required and to economize in the use of material.

B.S. 2579:1955—Solid drawn copper alloy tubes for the manufacture of screwed ferrules and copper alloy screwed ferrules for condenser, evaporator, heater and cooler tubes. 2/6.

The alloys included here are 70/30 brass and 70/29/1 (Admiralty mixture) brass, aluminium brass, copper nickel and aluminium bronze.

B.S. 2587:1955 — Open-surface milk coolers. 3/6.

These items are classified for both raw and pasteurized milk, and for use with various means of cooling. Materials for construction, certain design features and standard conditions for rating tests are specified. The appendices cover the installation, maintenance and operation of milk coolers and the use of calcium chloride brine.

B.S. G148:1955—Platinum wire thermometer bulbs and connectors for aircraft. 3/6

Two types of bulbs are dealt with: normal response bulbs designed from the viewpoint of range of temperature operation rather than for speed of response; and a high response bulb designed to achieve the highest practical response. The connectors are appropriate for these types of bulbs.

B.S. G149:1955—Nickel wire thermometer bulbs and connectors for liquid temperature measurement in aircraft. 2/—.

Specifications are given for bulbs with temperature sensitive elements made of nickel wire contained in a metal sheath. The nickel resistance elements are suitable for measuring temperatures up to +200°C.

Canadian standards, Canadian standards association, National research building, Ottawa, Canada.

C.S.A. C22.2 No. 38:1955 — Rubber-insulated wires and cables, 3rd ed. $2.00.

The following types of wires and cables are covered: types R, RW, RH, RWU and RW-60C:RH-75C, having voltage ratings from 600 to 5,000 volts. New requirements include the use of a polychloroprene jacket and braided rayon covering.

C.S.A. C22.2 No. 45:1955 — Rigid conduit, 3rd ed. $1.00.

This applies to rigid conduit made from mild steel, aluminum, copper, or copper-silicon alloy and also covers couplings, nipples, elbows, and bends used in installing a straight length of conduit.

The Institute of petroleum, 26 Portland Place, London, W.1 IP engine test methods for rating fuels, 1955. £1.

This book contains methods for determining the knock rating of motor and aviation fuels and the ignition quality of diesel fuels. In general both British and metric units of measurement of volume, dimension, and temperature have been used. In the section covering knock-rating of aviation fuels the aviation method and the supercharge method are given. The knock-rating of motor fuel shows the motor method and the research method.

Standard methods for testing petroleum and its products (excluding engine test methods for rating fuels), 14th ed., 1955. 40/-.

This is a companion to the preceding standard and includes specifications for normal heptane, petroleum spirit—40/60, 60/80, 100/120—benzene, benzole, toluene, toluole, and acetone. Specifications for IP petroleum hydrometers and standard thermometers are also given. The appendices give a boiling point conversion chart, conversion of kinematic viscosity to Redwood No. 1 viscosity, heat of combustion, evaluation of crude petroleum and interpretation and recommended usage of IP precision data.

Business & Industrial Briefs

A Digest of Information

received by

The Editor

Appointments and Transfers

B. F. Goodrich Appointment.—M. G. Morgan has been appointed vice-president, manufacturing, of B. F. Goodrich Canada Limited, and elected a director of the company, it was announced recently by president Ira G. Needles.

●

Technical Service Laboratories.—The appointment of Ernest Bolton to its chemical department has just been announced by Technical Service Laboratories, Toronto.

●

C-I-L Appointment.—H. J. Desbarats has been appointed assistant manager of the explosives division of Canadian Industries (1954) Limited.

●

Union Carbide Vice-President.—Announcement is made of the appointment of A. A. Cumming as vice-president, Union Carbide Canada Limited. Mr. Cumming will also retain the presidency of National Carbon Company, Division of Union Carbide Canada Limited.

●

Peacock Brothers Limited Changes.—Peacock Brothers Ltd. announce that a new department has been formed, known as the Mechanical Equipment Sales Department. The department will be responsible for the promotion of mechanical equipment from coast to coast and will be headed by E. J. M. Exworth, formerly manager of the company's Montreal Branch office. Succeeding Mr. Exworth as manager of the Montreal Branch office is R. W. Maskell, formerly assistant manager.

●

University of Toronto.—Recent appointments in the engineering faculty, University of Toronto include: W. F. Graydon and W. G. MacElhinney, associate professors in chemical engineering, and W. A. M. Hewer in mining engineering; F. C. Hooper and R. T. Waines associate professors in mechanical engineering; G. R. Slemon assistant professor, electrical engineering.

●

Stelco Appointments.—An announcement by Lee T. Craig, vice-president, The Steel Company of Canada, Limited, states that G. K. Laidlaw becomes manager, flat rolled products sales, Eastern Division, and E. A. Frazer becomes manager, bar mill products sales, Eastern Division. Both are natives of Hamilton, Ontario.

●

Neptune Meters Appointment.—At a recent meeting of the board of directors, the appointment was announced of W. O. Randall as a director of Neptune Meters Limited and Neptune Patterns Limited.

Mr. Randall will continue in his current capacity as assistant to the president while taking up his new duties.

●

Fluor Corp. of Canada Changes.—J. P. Wiseman, president of the Fluor Corporation of Canada. Ltd. for the past two and a half years, has been named to head a newly established products company of the Fluor Corporation, Ltd., and will be succeeded by J. G. Bounds. The appointments are effective November 1.

●

Seaway Appointment.—J. L. Jerome, of Toronto, has been appointed division administration officer for The St. Lawrence Seaway Authority at Iroquois, Ontario, succeeding Lt. Col. J. P. Donihee, appointed division administration officier at Cornwall.

●

Toronto Iron Works.—Appointments to top executive posts in the management of Toronto Iron Works Limited have been announced by G. E. Ellsworth, president.

Benton Dixon has been appointed executive vice-president and general manager. Mr. Dixon was formerly vice-president and general sales manager of Dominion Wheel and Foundries Limited.

R. A. Baggott who has been with Toronto Iron Works Limited as comptroller, goes to the position of secretary-treasurer.

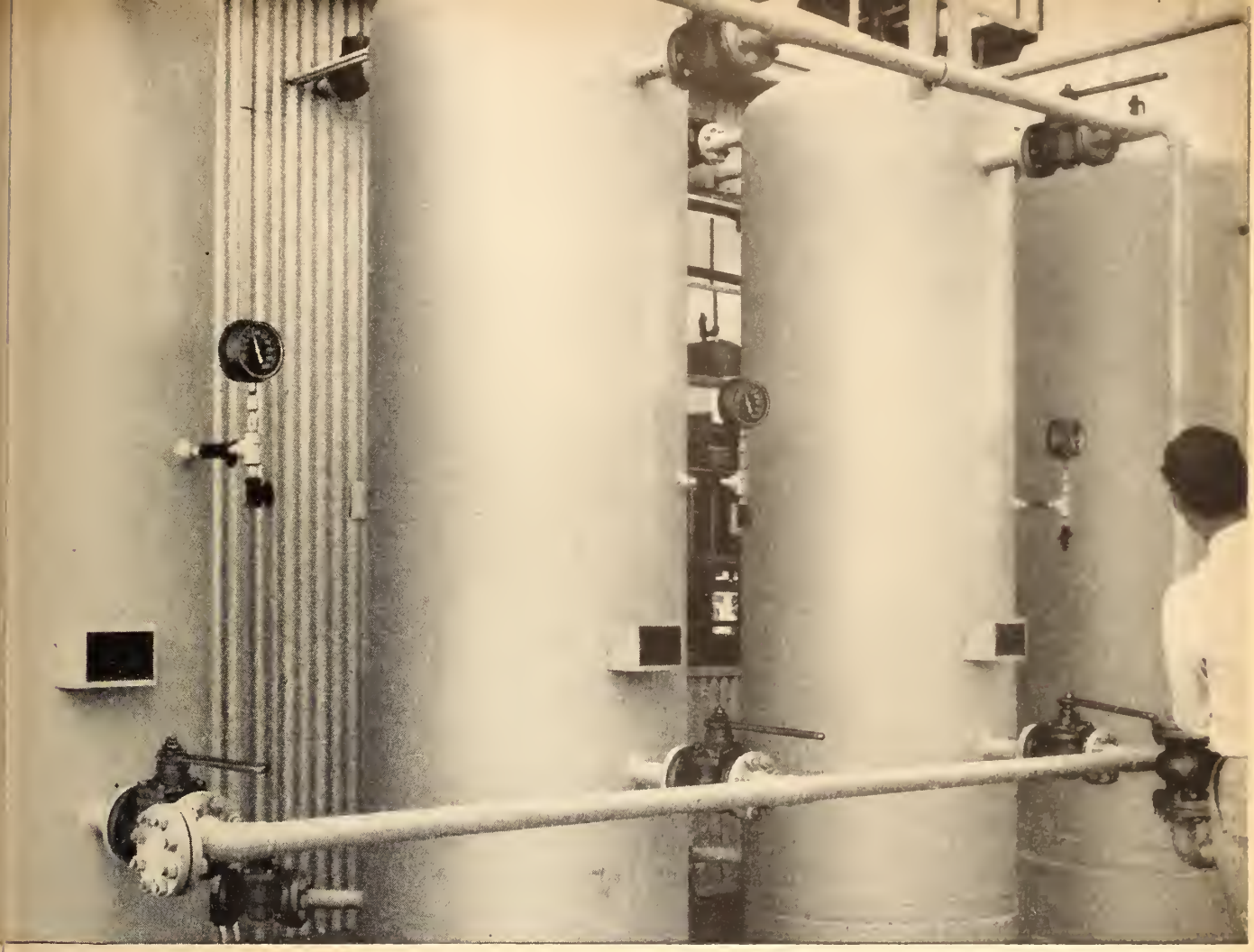
Benton Dixon

George Raine, formerly chief of plate and boiler department, Canadian Vickers Limited, Montreal, becomes manager of engineering.

●

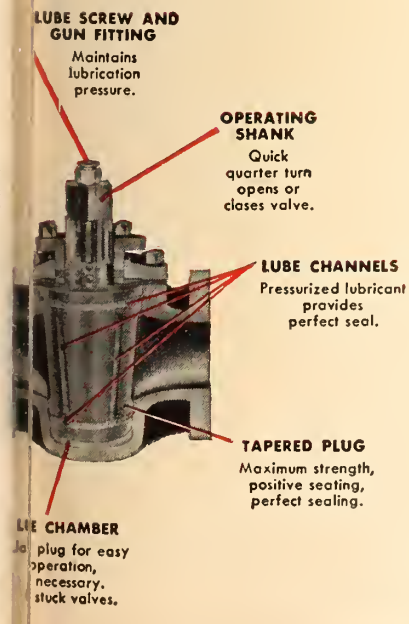
New Equipment and Developments

Plug-Holding Sockets.—Design of two spark plug sockets with a special rubber insert for holding plugs has been announced by Proto Tools of Canada,



Find out all the ways

Rockwell-Nordstrom Valves Can Cut Costs for YOU



In your plant there are probably scores of places—on degreasing equipment, or on air conditioning, fuel, hydraulic, and compressed air lines, for example—where Rockwell-Nordstrom valves can cut costs by doing their job better, longer, for less money per year.

The reason is simple. Forty years ago Rockwell-Nordstrom lubricated valves were created for tough oil field jobs ordinary valves couldn't handle. If they're a good investment for these rugged services, they're a doubly good investment for valve jobs in your plant.

Here's why:

—***Sure shut-off.*** A film of pressurized lubricant around the plug provides a tighter seal than is possible with ordinary metal-to-metal contact.

—***Easy, quick operation.*** Rockwell-Nordstrom valves *glide* open and shut on lubricant, which also hydraulically jacks the plug free from the seat. And because only one-quarter turn is needed, positive control response is assured. They're ideally suited for plant automation.

—***Longer Life.*** Lubricant prevents grinding wear of metal-to-metal friction. Rockwell-Nordstrom valves last longer—cut maintenance, replacement and down time cost. And initial cost is no more than ordinary valves.

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A booklet showing Nordstrom principles and applications in industrial and process plants is yours for the asking. Send the coupon for Bulletin V-215.

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Bus. and Ind. Briefs

Ltd., London, Ont. The patented rubber insert holds a spark plug securely in the socket and thus provides a means of removing and installing plugs quickly in the hard-to-reach places on many V-8 overhead valve engines. It also enables a user to change plugs without burning his hand on hot manifolds. Extensions of various lengths can be used with the sockets.

●

Analogue Computing Service Available.—Data Processing Associates, Limited, Ottawa, Ontario have been appointed exclusive representatives of Dian Laboratories, Inc., 611 Broadway, New York, who have available a complete analogue computing centre and are prepared to accept problems for analysis and solution. The computing centre has the following electronic analogue computer equipment: summing and integrating amplifiers; servos; scale-factor potentiometers; diodes; relay amplifiers; function generators; six-channel recorders; plotting board.

Companies interested in using this service are invited to write to Data Processing Associates, Ltd.

●

New Cement Plant.—The St. Lawrence Cement Co. of Villeneuve, Quebec, plans to commence construction of a new cement plant at Clarkson near Toronto, Ontario. This new plant will be similar to the existing Quebec one, with an annual capacity of 1,500,000 barrels or 6,000,000 bags of Portland Cement.

The new project will be worked out by the engineering staff of the St. Lawrence Cement Co. Most of the mechanical and electrical equipment will be ordered in Canada, and local contractors will be charged with the construction.

●

Diploma in Town Planning.—The University of Toronto has recently inaugurated a new Diploma in Town Planning with instruction to be given in a new division of the School of Architecture by Professor Gordon Stephenson, recently appointed to the University of Toronto.

The new diploma is available only to post graduates. It is a short course lasting a single academic year. As those taking it will come with very different academic backgrounds such as engineering, geography, sociology, and architecture, instruction will be tailor made to suit the student.

●

Air Cooled Packaged Compressor.—A 125 horsepower electric-driven air compressor has been added to the Ingersoll-Rand line of air-cooled two-stage Type 40 stationary compressors. The new size is expected to fulfill the need of contractors and industries for a lightweight compressor of this size that can easily be moved from job to job. A 4-page flier, form 3188, describing the new unit, is available from branch offices or Canadian Ingersoll-Rand Co. Ltd., 620 Cathcart Street, Montreal, Que.

●

Honeywell Expands Aero Activity.—Minneapolis-Honeywell Regulator Co. Ltd., has announced the establishment of an aeronautical division at its Leaside plant. Named manager of the new division is Carl A. Anderson, formerly assistant director of service engineering of Honeywell's aeronautical division in Minneapolis. The new Canadian division will operate independently of Honeywell's main aeronautical division in Minneapolis.

●

Unit Fueller.—The McIntosh Unit Fueller, is a compact unit that unloads from tank cars to storage, fuels from storage, and de-fuels if required, as in the case of aircraft. This unit can be made portable and includes water separator, micronic filter, Smith meter, pump, and hydraulic re-wind hose reel. The McIntosh units were designed and

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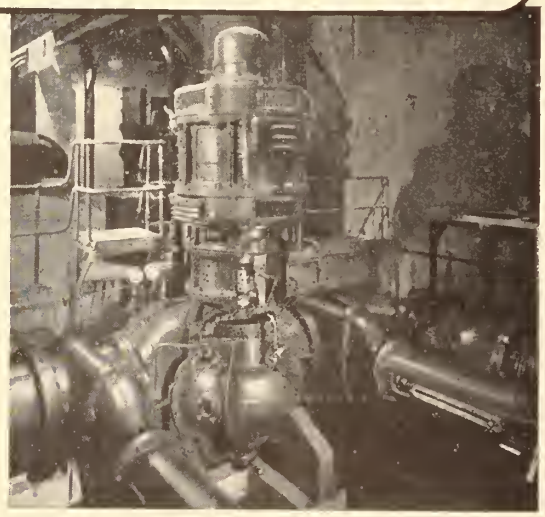

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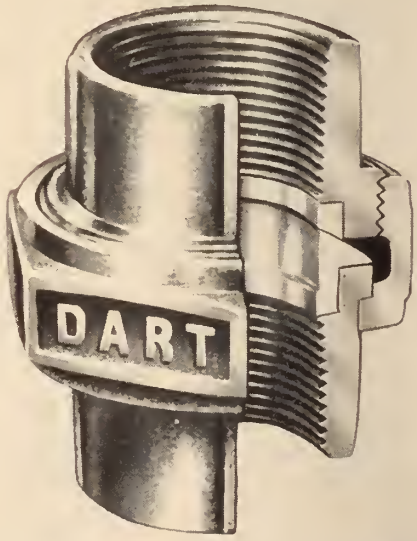


Two Bronze Seats Ground to a True Ball Joint

DART UNION COMPANY OF CANADA LTD.
TORONTO CANADA

Bus. and Ind. Briefs

are being built by McIntosh Supply Limited, Vancouver, B.C. They are available in any size or capacity.

●

Band-It Clamps.—The complete Band-It tool and clamp line is now being distributed in Canada by Canadian Line Materials Limited.

Made of special high-carbon-coated steel, the range of uses includes: securely fastening racks to poles, street and highway signs to poles, for stubbing line poles, clamping guy wire guards, repairing split beams, crossarms and posts. Also for economical, strong installation of television masts to vent pipes or chimneys.

●

Increased Soda Ash Capacity.—Brunner Mond Canada, Limited, plans to expand soda ash production capacity of its plant at Amherstburg, Ontario, to meet increasing demand for the product by Canada's basic industries. The primary product, soda ash, is used by a large number of industries to manufacture a variety of products including glass, aluminum and other metals, pulp and paper, silicates, soaps and cleansers. It is also used extensively in the production of chemicals, textiles, lumber and wood products, paints, plastics and many other products.

Brunner Mond also produces calcium chloride, used to control dust nuisance, to build compact gravel roads, as an additive to concrete to reduce curing time and increase strength, in refrigeration, and to weight tractor tires to give better traction and longer tire life.

●

Engine-Driven Welder.—A new 200-ampere engine driven welder for pipeline welding and all types of construction and maintenance work is now available from Canadian General Electric Company. Designated Type WD20AG, the new welder is NEMA-rated for a current range of 40-250 amperes and will handle all d-c or a-c/d-c electrodes from 1/16" to ¼" with excellent welding characteristics, according to company engineers.

●

New Line Voltage Regulator.—A new voltage regulator, designed for use with the Philips diffractometer and spectrograph units as well as for other applications, has been announced by the scientific apparatus department, Rogers Majestic Electronics Limited, 11-19 Brentcliffe Road, Leaside, Toronto 17, Ontario.

The new voltage regulator utilizes standard electronic tubes, and a magnetic amplifier. It operates on a line voltage of 185 - 250, 60-cycles at an ambient temperature of 40°C. maximum. Output voltage is 220, output current 12.5 amperes maximum, output load 2.75 Kva maximum. Load power factor 0.7 — 1.0 inductive, regulation is 0.05 per cent, harmonic distortion is less than 5 per cent, time constant is 0.2 second.

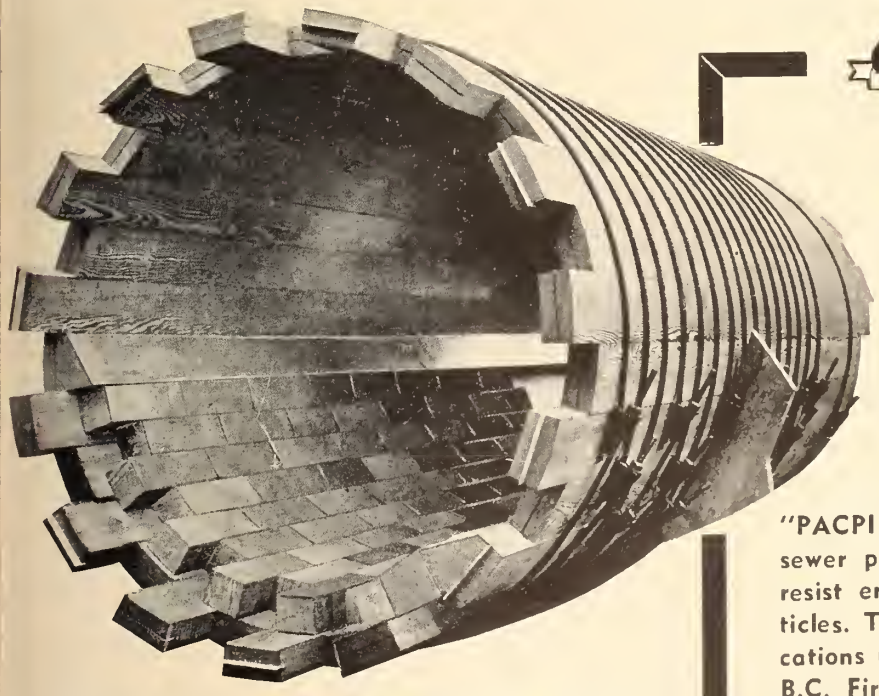
When the line switch is turned on, voltage will stabilize in approximately one minute. If the overvoltage protective relay operates, output falls to less than 150 volts.

●

Exposed Bolts on Couplings.—For quick dismantling with standard wrenches, a new line is announced of gear type Dominion Gearflex couplings, without shrouds, having exposed type bolts. Developed primarily for the steel industry, but applicable to any drive, the couplings are said to minimize down-time when changing motors or engines. Couplings are manufactured and stocked in Canada for shafts up to 5¼ in. diameter. Bulletins and dimension sheets from Industrial Division, Dominion Engineering Company, Ltd., P.O. Box 220, Montreal, Quebec.

●

Canadian Johns-Manville Plant.—A. D. Margison & Associates, Ltd., of Toronto, have been named as architect-engineering consultants for the construction of Canadian Johns-Manville's insulating board plant at North Bay, Ont. The design and construction of the plant will be handled by Johns-Manville's general engineering organization, of which George S. Smith is director. It is expected that construction of the buildings will be completed during the summer of 1956. The plant



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"PACPIPE" continuaus Waod Stave sewer pipe is especially designed ta resist erasian by abrasive waste particles. This is one of the many applications using the special properties af B.C. Fir Woad Stave Pipe, manufactured by Pacific Coast Pipe Co.

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will consist of a main manufacturing plant having an operating area of 150,000 square feet, a separate office building and various outlying auxiliary structures.

●

Mixed-Bed Demineralizer.—For the demineralization of relatively small quantities of water—up to 360 gallons per hour—a compact unit, the Model MBD-15 Demineralizer, has been developed by The Permutit Company, New York 36, N. Y. The device contains a resin bed consisting of an intimate mixture of cation exchanger, Permutit Q, and strongly basic anion exchanger, Permutit S. It will produce a water of low total dissolved solids, low CO_2, low silica content and extremely low conductivity. The manufacturer claims that the treated effluent from this unit will have an average conductivity of 0.15 micromho which is equivalent to approximately 6,000,000 ohm.-cm. specific resistance or 0.05 p.p.m. total electrolyte content. Also, carbon dioxide will be reduced to 0-1 p.p.m. and the silica to about 0.1 p.p.m. When the unit is exhausted, the resin bed is regenerated with sulphuric acid for the cation exchanger and caustic soda for the anion exchanger. The same regenerating tank is used alternately for both the acid and caustic soda regenerants.

●

Canadian Distributor.—United Steel Corporation Ltd., specializing in all phases of materials handling, has been appointed Canadian distributor for Albion casters, manufactured by Albion Industries Inc., of Albion, Mich.

●

Canadian Manufacture of British Pumps.—The Goodenough portable self-priming centrifugal pump is now being manufactured in Canada by Godfrey Engineering Co. Ltd., Montreal. The Canadian units will be known as Godfrey-Goodenough pumps and are being produced in sizes from 1½ in. to 6 in. in both engine-driven and electric-motor-driven models. Standard American engines are fitted to facilitate engine service and the mounting trolleys, cradles, etc., have all been designed for Canadian operating conditions.

●

Furnace Door Hose.—A rubber hose that conducts water to cool the doors of open hearth furnaces has survived 637 heats, the longest service record ever set by a hose of its type, according to B.F. Goodrich Canada Limited.

On test at a steel plant for 360 days, the hose was flexible, uncrushed and in serviceable condition when finally removed. Due to a newly developed construction, slag did not build-up on the hose, which is required for the unusual furnace door application to permit a flexible connection to the water circulation system so that the doors may be opened to charge the furnaces. Because of its light weight and flexibility, the new hose may be installed by one man.

●

Adjustable Pallet Rack.—A new all steel pallet rack, the Rapid Rack, is made from either structural or formed channel depending upon the requirements of the particular application. The vertical frames are composed of two vertical channels and two channel or angle cross members welded to form a rigid unit. The bed frames are of smaller all-welded construction. Holes are punched in the vertical posts on 4 in. or 6 in. centres to suit the adjustability desired. Manufactured and sold by Service Steel & Engineering Ltd., 232 King St. East, Hamilton, Ont.

●

Ultrasonic Testing of Structures.—For the first time in Canadian building construction, ultrasonic testing of electric arc welding is being used on the structural steel of the 13-storey Toronto General Hospital addition, according to an announcement by Dominion Bridge Company, who are erecting the steel. The company is using ultrasonic testing as a spot check on the quality of the welded joints. The tests are being carried out by Canadian Inspection and Testing Co. Ltd. with portable equipment operated by a small generator on the ground. The operator carries out the actual testing as he moves from weld to weld on the structure.

●

Canadian Colombo Plan Contracts.—The Canadian Colombo Plan Administration recently announced the awarding of two contracts for the provision of an ultimate 240,000-kw. hydro-electric power and irrigation project to be constructed in Pakistan.

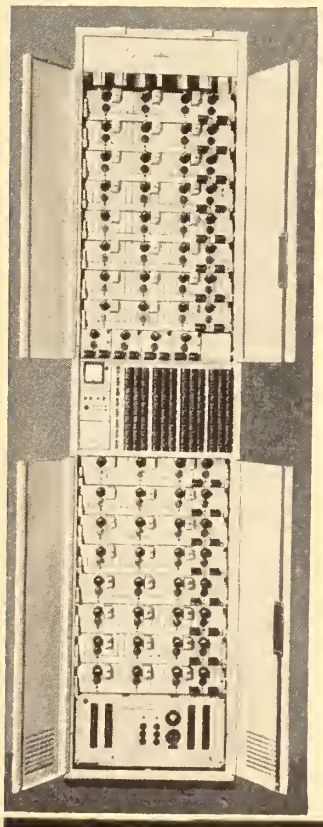
The contract for the design, preparation of specifications and supervision of the project went to the H. G. Acres & Company Limited, Niagara Falls, and the civil construction requirements have been placed under contract with Angus Robertson Limited, Montreal.

The project, known as the Warsak Hydro-Electric Power Project, will take approximately 3½ years to complete, and will involve an expenditure of about $50,000,000. The cost of the development is being shared by the Government of Canada and the Government of Pakistan.

The first consignment of construction equipment being sent to Pakistan for this project was loaded in Montreal on August 1.

●

Canadian Western Pipe Mills.—The start of a second multi-million dollar pipe and tube mill development by Canadian Western Pipe Mills Ltd., whose first plant was officially opened at Port Moody, B.C., last July is anticipated. A second mill probably would be geared to produce pipe in a full range of large sizes, possibly up to 16 inches in diameter. The Port Moody plant is equipped to turn out black and galvanized pipe ½ inch to 4½ inches in diameter, as well as electrical conduit, furniture and mechanical tubing.



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●

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Bus. and Ind. Briefs

Dawe Instruments Move.—Dawe Instruments Ltd., (Canadian Division) have moved to new and larger premises on 1654 Bank Street, Ottawa, Ontario. The parent company in London, England, are manufacturers of a wide range of electronic instruments for communications and industrial applications.

●

Traffic Paint.—An improved traffic paint for marking traffic lanes on highways, streets, parking lots and industrial plants, has been introduced by the paints division of Canadian Industries (1954) Limited. Available in both white and yellow, the new formulation dries with a low sheen in 15 to 30 minutes and resists heavy traffic and "bleeding" over blacktop surfaces. One gallon is sufficient to paint a line four inches wide and 500 to 600 feet long. The paint will be marketed under the code numbers 6404-5789 (for white) and 6404-5788 (for yellow).

●

Inspection and Testing Companies Join.—Two large independent inspection and testing organizations, The Warnock Hersey Company Ltd., and Canadian Inspection & Testing Co. Ltd., have joined forces according to a statement issued by R. B. Jones, chairman of the board of Warnock Hersey. The statement emphasized that both companies will continue to operate under their original names and with the same staffs.

●

Deep-Freezing Aids Machining.—Application of a deep-freezing process to aluminum castings before machining has given substantial savings according to the Canadian Westinghouse Company.

Considerable difficulty had been experienced with heat-treated aluminum castings "moving" during and after machining. A three-stage operation was used involving considerable man-hours and expense. Castings were first over-all machined to within 0.032" and then removed for a minimum of 24 hours. Machining was then repeated, leaving 0.010" of material on all surfaces, and this second operation was followed by another 24-hour rest period. The casting was then reset-up for machining to finished dimensions. For all complex castings which were liable to "move", therefore, three set-ups and three complete machining operations were required.

After successful experiment with the deep-freezing process castings are now heat-treated and deep-frozen before machining and no special time interval is necessary between the three operations. Instead of the former three-stage machining practice, castings are now set up, machined on all surfaces leaving 0.010/0.015 in. and then finished to specifications. Thus the deep-freeze process eliminates two set-ups and one complete machining operation and no time is lost between the two machinings.

On a single order involving several hundred castings of eleven different types, savings of close to $40,000 were recorded with the new technique.

●

Change of Address.—Morton Engineering Ltd., have moved to larger premises at 1340 Commercial Dr., Vancouver, B.C. Head of the company is Stanley Morton, M.E.I.C.

●

New Plant and Offices.—American Air Filter of Canada Ltd. announced completion of their new plant and offices at 400 Stinson Boulevard, Montreal 9.

●

Frequency Changer Installation. — English Electric Company of Canada Limited are to build a 20,000 kva., 6,600 volt, 50/60-cycle frequency changer for the B.C. Electric Company for installation in the Powell River plant of the Powell River Company Limited. The machine will be installed in 1956 and will enable the Powell River Company to take 60-cycle power from B.C. Electric and convert it to 50 cycles for use in their own system. The frequency changer consists of two direct coupled salient pole synchronous machines, either of which can be run as a generator or motor.

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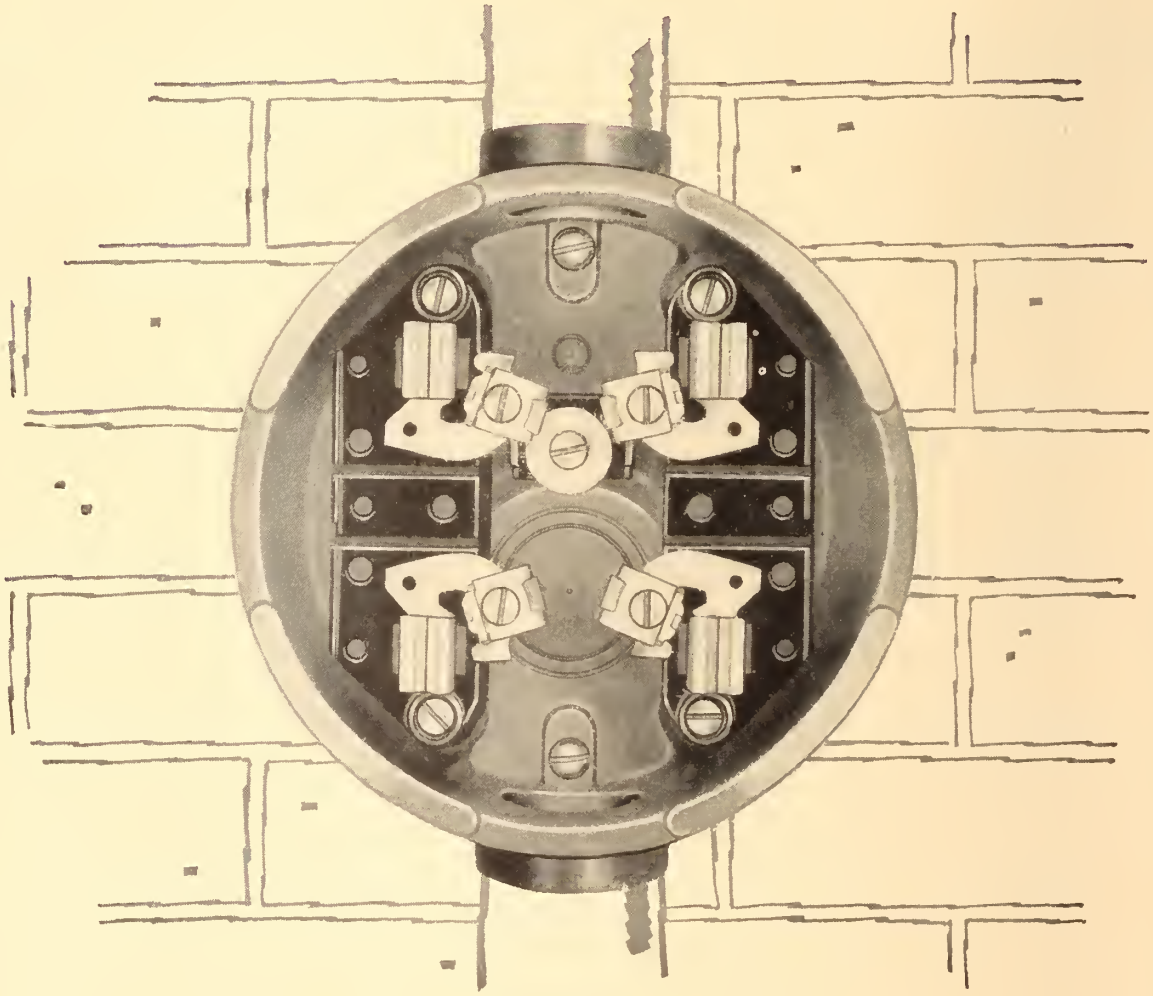

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Some Engineering Aspects of the

Montreal General Hospital

F. J. Friedman, M.E.I.C.
D. W. Heywood, M.E.I.C.
McDougall & Friedman, Consulting Engineers, Montreal, Que.

Although in modern practice each new building achievement is almost daily surpassed by another, there must be some milestones. One of these is the new Montreal General Hospital. Equipped with the latest aids to medical science, this building has posed many engineering problems so that it may incorporate the best practices and conform with the various standards stipulated. How some of these problems have been met is described in the accompanying article.

The Montreal General Hospital, founded in 1821, is one of the oldest teaching hospitals in Canada and is affiliated with McGill University. It is renowned as the hospital where Sir William Osler introduced his bedside teaching of medicine. The hospital moved to its new site between Cedar and Pine Avenues, just east of Cote des Neiges Road, at the end of May, 1955. The land area comprises 385,000 square feet or about 8.85 acres with a difference in level between the two avenues of one hundred and twenty feet.

The architects for the entire project are McDougall, Smith & Fleming of Montreal.

General Description

In general the hospital proper consists of three wings or buildings which are: the Pine Avenue building, the Cedar Avenue building, and the connecting wing.

The Buildings

The Pine Avenue building, among other units, contains the outpatients' department, emergency department, the McGill Dental School, general medical treatment, psychiatric department, and an amphitheatre seating two hundred and twenty-six. The laundry, food preparation and refrigeration and shops are among the services also located in this building. The Cedar Avenue building takes care of all in-patients; other units including the dining rooms are also located in this building. The boiler plant is at the east end of the Cedar Avenue building. The connecting wing contains all the auxiliary services such as laboratories, operating rooms and kitchen.

All the buildings except as mentioned further on, have a steel frame with concrete slab floors. All the steel work is fireproofed in terra cotta. All walls are 8 in. brick with a one-inch air space and speed tile. Wherever air-conditioning occurs the walls have a two-inch foam glass insulation and vapour barrier. In front of the Pine Avenue wing there is a two-storey reinforced concrete structure with roadway over it. This structure houses the stores, laun-

dry, etc., and is connected to the Pine Avenue wing.

Operating Suite

The operating room suite is situated on the eighth floor and has eleven major operating rooms, one minor, and a plaster room. Two operating rooms have viewing galleries with plate-glass screens and two others have a television booth between so that operations may be televised to student class rooms in other locations. Major operating rooms have no outside windows and the entire area is fully air conditioned. The operating rooms are built in pairs with a scrub-up room and sub-sterilizing room between them and serving each pair.

All the operating rooms and areas in which explosive anaesthetics are administered have static-arresting floors in order to control the discharge of the static electricity from personnel without causing electric sparks. These floors are grounded to the steel frame of the building.

On the operating suite floor are the recovery rooms, where the patients are taken after their operation. The central sterilizing and surgical supply room is also located on the operating suite floor. In this room all the dressings and materials are cleaned, sterilized and stored, and distributed to the various parts of the hospital. The operating room instruments are cleaned in the clean-up room. The patients' utensils and bedpans are sterilized in the utility rooms on the various ward floors.

Food Service

All food is received at the Pine Avenue service entrance where bulk storage, the necessary refrigeration, and a preliminary vegetable preparation section are located. Deliveries are made to the main kitchen on the fourth floor level via the Pine Avenue elevators. The food is served to the cafeteria and dining rooms at the north end of the fourth floor and by means of elevators to the ward kitchens. Supplementing the elevator service, there are three electric push-button dumbwaiters serving directly to all ward kitchens.

The cooked food is transported by heated electric trucks to the ward kitchens on the patients' floors where the trays are prepared for the patients. The ward kitchens are also equipped with refrigerator, ice-making machine, coffee-maker, milk dispenser, toaster and dish-washing machine. All the dishes are washed and stored in the ward kitchens; no dish-washing is done in the main kitchen.

Patients' Wards

The patients' wards are located on the 9th to 19th floor of the Cedar Avenue building. No rooms have more than four patients. Each room has its own toilet room containing a lavatory and W.C. Some of the private patients' rooms have baths.

Each patient floor consists of two nursing units of approximately thirty-two beds each. The four-bed rooms are inter-connected by means of a folding door. Each nursing unit has a clean and soiled utility room, a treatment room for the ambulant patient, a small clinical laboratory, and a doctor's office. Each floor also has a waiting room and ward kitchen.

Various Departments

The laboratories, including biochemical, pathology, bacteriology, and the test centre are located in the connecting wing. The outpatient test and specimen centre is located on the sixth floor and consists of a series of small examining rooms where tests can quickly be made on ambulant patients.

The radiology department occupies most of the fifth floor. The situation of the radiology department permits the cobalt-therapy bomb being placed outside the building itself at Cedar Avenue.

The psychiatric unit occupies the entire fourth floor of the Pine Avenue building.

The outpatient department occupies two floors and includes a surgical, medical, and casualty department and specialty clinics. The casualty department is close to the ambulance entrance.

Pneumatic Tube System

The hospital has an automatic pneumatic tube switching system which provides a twenty-four hour service without operators, facilitating the distribution of specimens, laboratory samples, documents, and other small articles from one point to another.

Nurses' Home and Internes' Building

The nurses' home is situated at the west end of the hospital buildings and houses two hundred and fifty-five nurses in single rooms together with the usual living rooms; it includes a school for undergraduates with class rooms and laboratories.

The internes are housed at the opposite end of Cedar Avenue wing to the east, in an apartment house which was reconditioned to meet the new requirements. Accommodation for approximately one hundred internes is provided.

Patients' Accommodation

There are a total of 761 patients' beds located in 367 wards. There are also 51 basinets in the nurseries. The 761 beds are made up of 127 private patients' beds, 528 semi-private and public beds, 43 beds in obstetrical department, 11 operating recovery beds and 7 beds in outpatient department.

Volume and Floor Area

The architects' volume of hospital buildings (including boiler house) is 8,117,167 cubic feet. The nurses' home volume is 1,577,188 cubic feet. Both of the above volumes include one foot below floors for foundations and one foot above roof.

The total square feet of floor area for the hospital buildings (including boiler house) is 615,847 square feet. The floor area of the nurses'home is 136,130 square feet.

Boiler Plant

The boiler plant is located in a separate building connected to the third, fourth and fifth floors of the Cedar Avenue building.

General Description

The ground floor of the building contains the boilers, house pumps and auxiliary apparatus, and the mezzanine contains the hot water tanks and converters for the hot water heating system for the Cedar Avenue building. The top floor of the building over the boilers, houses the refrigeration compressor for the air conditioning system and some of the ventilating equipment for the Cedar Avenue building. The photographic and hematology departments are also in this building.

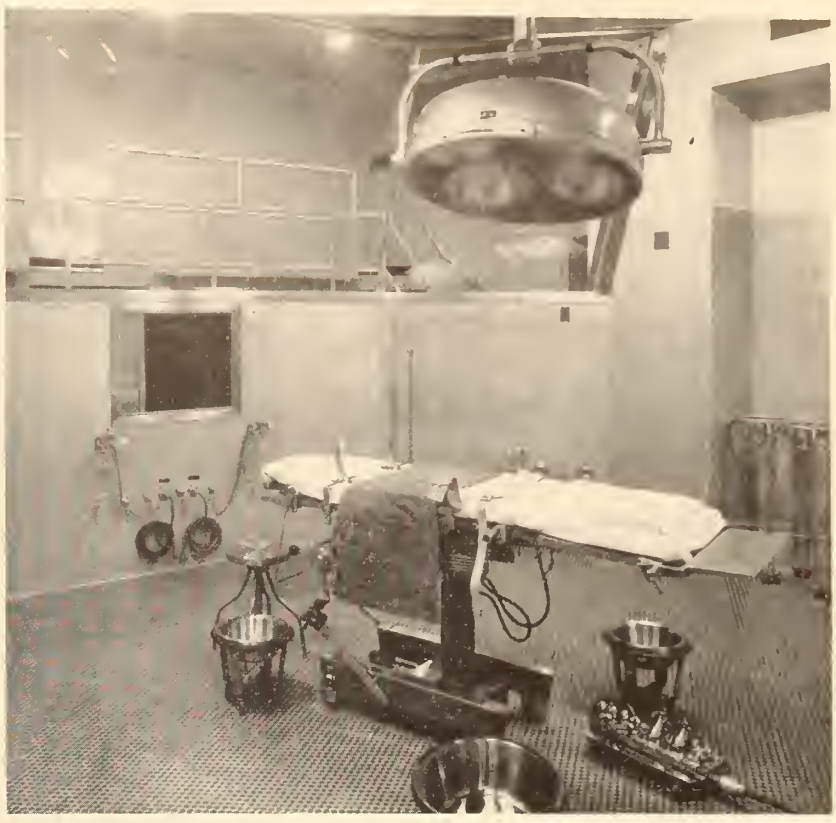
High-pressure steam originates in three water-tube boilers and is distributed to the various buildings of the group and, after the pressure is reduced, supplies steam to hot water heating converters, domestic hot water tanks, kitchen and laundry equipment, sterilizers, ventilating systems, and boiler plant equipment requiring steam. All condensate from the above equipment is returned to the boilers.

Heavy oil is used as fuel and is fed to boilers by means of steam-atomizing oil burners, from three 20,000-gallon (U.S.) tanks located under Cedar Avenue roadway. There is also a 5000-gallon light oil tank that is used for starting purposes and also to fire the incinerator.

The boilers are arranged so that spreader stokers can be installed should it ever be necessary to use coal as fuel. Allowance is also made in the concrete work for the future installation of ash conveyors and the storage of coal.

Two boilers can carry the load and one acts as a spare. Each boiler has a capacity of 30,000 lb. of steam per hour for continuous operation, which is approximately equivalent to 870 boiler horse power. (The rough rule of thumb method of so many boiler horse power per bed should not be used in comparing the installed boiler horse power with that of other hospitals, because less than 20 per cent of the total floor area of the hospital (not including nurses' home) is patients' bedroom space and there is a large ventilating system requiring steam for heating the air).

All the condensed steam from all equipment enters a hot well in the boiler room. The condensate is pumped from the various machinery and converter rooms throughout the various parts of the building to the hot well or it enters by gravity. From the hot well the water is pumped by means of a transfer pump up to a de-aerating type feed-water heater located near the ceiling of the boiler room where it is heated by the exhaust from pumps, etc., and oxygen and non-condensible gases removed, to reduce corrosion and pitting. The water is then pumped to the boilers by the boiler feed pumps.



One of the eleven major operating rooms. Below the window to the left are grouped the outlets for oxygen, nitrous oxide, compressed air, and vacuum; above, is the viewing gallery. Below the operating table, right, is a portable explosion-proof electrical "spider."

Generating Units

Each of the three generating units has two main drums that run thwartwise, vertically one above the other and have integral furnaces, completely water-cooled sides, fronts and roof. At present, units are fired at the front end by oil, but are designed so that they could be fired with coal by means of spreader stokers, with continuous-discharge end-grate.

Each unit has a forced and induced draught fan, and provision is made for a dust collector. Each unit is designed for a maximum continuous capacity of 30,000 lb. of steam per hour with a peak capacity not exceeding four hours at 35,000 lb. per hour and with a combined efficiency of 84.7 per cent.

Each unit has an air-preheater of the tubular type, remote reading eye-hye water line indicator, steam-actuated soot blowers for unit and air-preheater, and two-element air-operated feed water control.

In arriving at the size of the boilers, a load factor of 80 per cent was used. This amount is an average figure and was obtained from the steam flow charts of several hospital boiler plants over several years. A large part of the load, almost 30 per cent, is the steam required for heating the outside air for the ventilating systems.

Boiler Plant Equipment

Each boiler is equipped with a boiler meter to indicate, record, and integrate steam flow and to record air flow; a boiler drum-level recorder with high and low level alarm; multiport draught gauge to indicate furnace draught, boiler and preheater outlet draughts, secondary air pressure; preheater performance recorder showing the temperature of flue gases and air leaving and entering the preheater; ammeters to indicate the electrical loads in forced and induced draught fans; and smoke density recorder with warning contactor and signal lights.

There is a system of air-operated, automatic combustion control equipment for the three boilers, designed to regulate the fuel supply in accordance with load requirements as indicated by steam pressure variations and to regulate induced and forced draught air supplies.

The feedwater is phosphate-treated for scale control direct to boiler drums by means of a solution tank with agitator and timer, and three (one for each boiler) chemical feed pumps regulated by means of three boiler steam flow meters, and sulphite-treated for corrosion control to the hot well, treating condensate and make-up by means of a solution tank with agitator and timer and one chemical feed pump.

Each unit has a forced draught fan having a capacity of 10,000 cubic feet per minute at 3.75 in w.g. total static pressure with a 10 hp. motor. This fan is suitable for operation with spreader stok-

er, with larger motor. Each unit also has an induced draught fan having a capacity of 16,200 c.f.m. at 2.75 in. w.g. total static head, with 15 hp. motor. The fan is driven by a motor through a variable output-speed hydraulic coupling arranged for automatic control. This fan is suitable for oil firing only.

The de-aerating heater is of the tray type, of cast iron construction, and has a capacity of 60,000 lb. per hour of feed water from 170° to 212°F. with steam at 5 p.s.i.

There are three boiler feed pumps, two steam-driven and one motor-driven Steam-driven pumps are each 13 x 8 x 24 in. vertical boiler feed pumps having a capacity of 7800 U.S. gal. per hour against a discharge pressure of 175 p.s.i. The motor-driven pump is a 1½ x 3 in. horizontal 2-stage centrifugal pump having a capacity of 40 U.S. gal. per min. against a friction head of 175 lb., directly connected to a 15 hp. 3-phase, 550v., 3600 r.p.m. motor. Feed water filters are installed on the discharge of the pumps.

The hot well is made of ¼ in. steel plate and is 8 ft. long by 6 ft. wide by 6 ft. deep with cover. Make-up water for the tank is controlled by means of two outside float chambers and balanced valves. There is a water meter in the make-up water line to measure the amount used.

Oil Burning Equipment

Each boiler is equipped with two wide-range dual-stage, steam-assisted mechanical atomizing burners for burning Bunker "C" oil. Each burner has a forced-draught register with sliding air control disc and quick-reversible air vanes, venturi tile burner blocks, and steam regulating valves. There is one wind box for each boiler. Two interchangeable mechanical atomizing burners for light oil for cold starting are used when steam for atomizing is not available.

Each burner and register has a continuous-duty capacity of 15,000 lb. of steam per hour, and a peak duty of 17,500 lb. per hour with adequate reserve capacity. Individual burner fuel-capacity is 124 imp. gal. of oil per hour at 150 lb. oil and 60 lb. steam pressure. Wind box pressure required for this condition is 3 in. w.g.

All burners have flame safeguards, low-water cut-off and operating controls. There is also an air flow switch in each forced and each induced draught fan.

Oil supply to burners first goes to an oil control valve which regulates the oil feed in accordance with load requirements, as indicated by steam pressure variations. There is also a differential oil control valve regulating the pressure drop across the main valve to provide accurate control whether one or two burners on a boiler are in operation. The steam for atomization for each burner also goes through a steam control valve.

The electric wiring provides for all the necessary interlock circuits between the flame safeguards, the air flow switches, the low water cut-offs, and the auxiliary contacts in the induced draught and forced draught fan motor starters so as to require correct functioning of all apparatus before the oil solenoid valves will open. A safe start relay system provides for proving of the torch flame before the main oil valve can be opened through the flame safe guard.

All heavy oil piping is wrapped in a common insulating wrapper with a steam line, thereby ensuring continuous use of oil piping without any danger of congealed oil lines. This allows for the minimum time delay to revert to heavy oil firing, should there be a loss of steam pressure necessitating the use of light fuel oil.

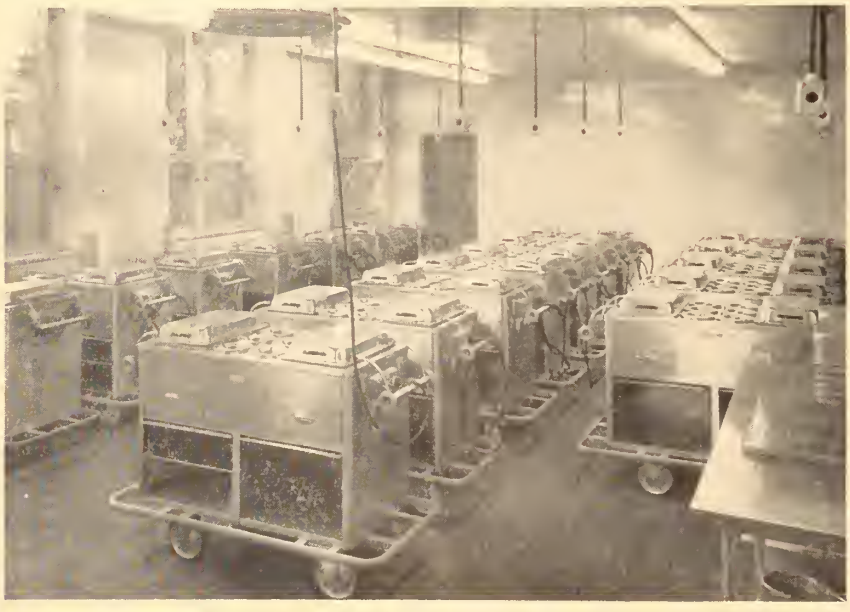
Heavy oil is stored in three 20,000 (U.S.) gal. tanks located under Cedar Avenue roadway. There is also one 5,000-gal. light oil tank located alongside. The three tanks will take care of one week's supply of oil during the coldest months. Each of the large tanks is 11 ft. in diameter by 31 ft. long, is made of ¼ in. steel plate, and has a baffle with door.

There is a spiral heating coil around the suction pipe in each tank. This coil is thermostatically controlled with the bulb located in a perforated thermo-guide pipe. The temperature controllers are combination regulator and indicating thermometer; the thermometers are located on a gauge board in the boiler room. There is also an auxiliary heating coil, for initial tank heating, which is controlled from the boiler room. Each tank has an oil tank level gauge located on a gauge board near the pumping set.

Oil piping connects the tanks with an oil pumping and heater set consisting of duplex suction and discharge strainers, one duplex steam pump, one motor-driven rotary fuel oil pump, duplicate oil preheater, electric starting preheater, pressure regulators, relief valves, and gauges. All equipment is in duplicate for the complete plant load. The heating and pumping set has a capacity for a total plant load of 90,000 lb. steam per hour. The oil is then pumped to the burners on the boilers. All oil not used at the burners is returned to the tanks.

There is a spring-loaded self-closing valve for emergency closing of the oil line to the pumping and heating set, in case of high ambient boiler room temperature.

Heated food conveyor section of the main kitchen. Trucks are used to take hot food to the ward kitchens on the patients' floors.



This self-closing valve is held open by means of a wire cable and pulley system terminating in a fusible link set above the centre line of each boiler and anchored at the last link. A tension type cable disconnecter is also provided for manual closing of the valve.

Incinerator

To handle the kitchen waste, other garbage, and paper waste from the hospital an institution type incinerator was installed. This unit, with over-all dimensions of 7 ft. 2 in. x 12 ft. 6 in. x 8 ft. 6 in. consists of an ignition chamber with a grate area of 25 sq. ft., and a secondary combustion chamber separated from the ignition chamber by a bridge wall. Material is charged into the ignition chamber through two charging openings, on an upper floor, which lie directly above the grates. The second of these two charging openings lies directly above the drying arches, so that wet material can be charged and remain suspended on the drying arches where it is exposed to the flow of combustion gases which assist in removing the excess moisture preliminary to final combustion.

From the combustion chamber the gases pass to a flue where they rise vertically about 8 ft. and then pass horizontally some 12 ft. to the main boiler breeching and thence to the stack. The incinerator has a capacity of 1000 lb. per hour.

In order to assist the combustion during the periods when the average moisture content of the garbage rises above 50 per cent, the unit is equipped with an auxiliary oil burner. This installation consists of an oil burner and an air blower to supply primary and secondary air and is protected with electric eye devices to cut out the oil supply in case of flame failure.

The incinerator proper is constructed of high heat duty firebrick 9 in. thick backed up by a 4 in. wall of common brick and encased in a steel frame, the whole being tied together by a system of buck stays and tie rods. The roof of the unit is a sprung arch of firebrick 9 in. thick covered with 3 in. of insulation. The flue to the chimney is suspended from the ceiling joists.

The entire unit is installed in an incinerator room adjoining the boiler room, and on the upper charging floor there is ample room to handle the garbage cans and some storage space.

Steam cooking area in the main kitchen, showing kettles and steamers. The large ventilation hood can be seen at the top of the picture.

Chimney

The chimney consists of a radial brick column 238 ft. 9 in. high by 78 in. inside diameter at the top. Since this column was built entirely within an encasing structure there was no need to take wind pressure into account and the column was built plumb throughout with the exception of a slight batter in the lower section to increase the diameter in the area where a 4 in. radial fire-brick lining was added at the breeching level.

The column touches the concrete floor structure at every third floor where four brick nibs built out 3 in. from the column allow the chimney to touch the concrete structure for support of any lateral thrust. Within the building the column is framed in by building walls and tile inside walls. The upper 25 ft. is surmounted by a large cast iron cap extending from the circular chimney column to the square outside walls. The chimney has a capacity of approximately 2500 boiler hp., and at an average temperature of 550°F., the draught will be approximately 1½ in. of water.

Heating System

The buildings are heated by hot water with forced circulation. Converters for heating the water and circulating pumps are located in "machinery" or "converter" rooms in the various buildings. There are six separate heating systems (including nurses' home and internes' building), each having their own converters and circulating pumps.

Steam for the converters is supplied from the boiler plant at 125 p.s.i. and reduced to 5 p.s.i. at the converters. Condensation is returned to the boiler plant by means of condensation return pumps.

All rooms are heated by means of convector radiators with steel cabinets, except certain areas which have unit heaters. Convector radiators are "custom" built according to engineer's design. All window stools are of aluminum and are part of the convector radiators. The lower part of the convector, which contains the return grill, is hinged so that the heating element can be easily cleaned. Most of the convectors are concealed except in a few areas where there are no windows. There is a total of approximately 109,000 sq. ft. of equivalent direct radiation installed in all the buildings.

Each convector has two valves, one on the supply which is either a hand-operated valve or a diaphragm valve (thermostatically controlled) and a lockshield valve on the return to regulate the flow. With these two valves, a convector can be removed without affecting the rest of the system.

All air-conditioned areas, all patients' rooms, and rooms that have variable occupancy such as waiting rooms and laboratories, are thermostatically controlled by means of diaphragm valves on radiators and thermostats in the rooms. In the Cedar Avenue build-

ing patients' wards, it was determined that individual room control was no more expensive than zone control, which is necessary for a building of this height and exposure. The cost of the controls was more than offset by the cost of the extra piping, extra converters and pumps, and the space saved. Besides, individual room control is more satisfactory and has more economy of fuel than a zoning system.

The hot water temperature for each heating system is controlled separately by means of an outdoor-indoor temperature regulation system consisting of a three-way mixing valve, outdoor bulb and controller, flow bulb and controller and manual adjusting switch. A master thermostat outdoor bulb controller resets a submaster thermostat flow bulb controller in accordance with the demand for heat, as evidenced by the outdoor temperature and sun load peculiar to the location. The submaster thermostat in turn operates the three-way mixing valve which varies the temperature in the system by means of the return water, to maintain the proper temperature of the water for the system. The converters are not controlled and are kept at a temperature of 215°F. constantly with 5 p.s.i. steam pressure.

Expansion of all mains and rising lines where required are taken care of by means of expansion loops. No expansion joints are used.

All converters are horizontal forced-circulation converters of the instantaneous water tube type. Each heating system for the various buildings has two converters, each being designed to take care of 2/3 of the load. Both converters are necessary in very cold weather. One converter can take care of the load for the short period that the other one might be out of commission. Heating capacity is based on a temperature rise from 180° to 215°F. with steam at 10 p.s.i. Converters are designed for a test pressure of 150 p.s.i. throughout.

Each heating system for the various buildings has duplicate circulating pumps, each being capable of taking care of the total load. Pumps are of the centrifugal single-stage, double-suction, horizontal split-case type, with bearings of the sleeve, ring oiling, babbited type, fitted with a constant-level oiling device. Pumps are operated through multi-V-belt drives at not more than 1200 r.p.m. from 1750 r.p.m. motors. Each motor has a magnetic starting switch.

All condensation from the Cedar Avenue building, including the kitchen equipment, and condensation from converters, hot water tanks, etc., in the boiler house returns to the hot well by gravity. All other condensation from equipment in the various "machinery" or "converter" rooms is returned to the hot well by means of condensate return pumps of the split-case, single-stage, single-end suction type. All condensate return units consist of duplicate pumps, each capable of handling the whole load, and one common receiver with electric float switches of the totally enclosed type. Each pump is directly connected to a 60-cycle, 3-phase, 550-volt motor.

To take care of flash steam which is produced when the high or medium pressure condensate from equipment and traps is reduced in pressure, flash tanks are installed. The vents from the tanks are connected to low pressure steam lines so that the flash steam can be utilized and the condensate returned to the hot well.

All reducing valves are extra-heavy pilot-operated, spring-loaded with single seats. Reducing valves, when grouped, have a valved by-pass; where they are single they have a three-valve by-pass. Each valve has a Y-type dirt strainer in the inlet steam line and a pop safety valve is installed on the low pressure side, capable of receiving the full amount of steam handled by the valve.

Traps on low-pressure steam systems are in general heavy-duty float-type with thermostatically controlled air by-passes. High and medium pressure steam systems generally have inverted bucket steam traps with free-floating valves.

In general all piping 2 in. and over, except heating risers, connections to converters and connections to fixtures, have electrically welded connections. All high-pressure steam systems and condensate return from high-pressure steam has extra heavy steel piping with extra heavy cast iron fittings. All medium and low pressure steam and hot water heating systems have standard black steel piping with standard cast iron 125 p.s.i. steam fittings. Condensate return from medium and low pressure systems has standard weight iron pipe size brass piping with extra heavy brass, cast iron pattern fittings.

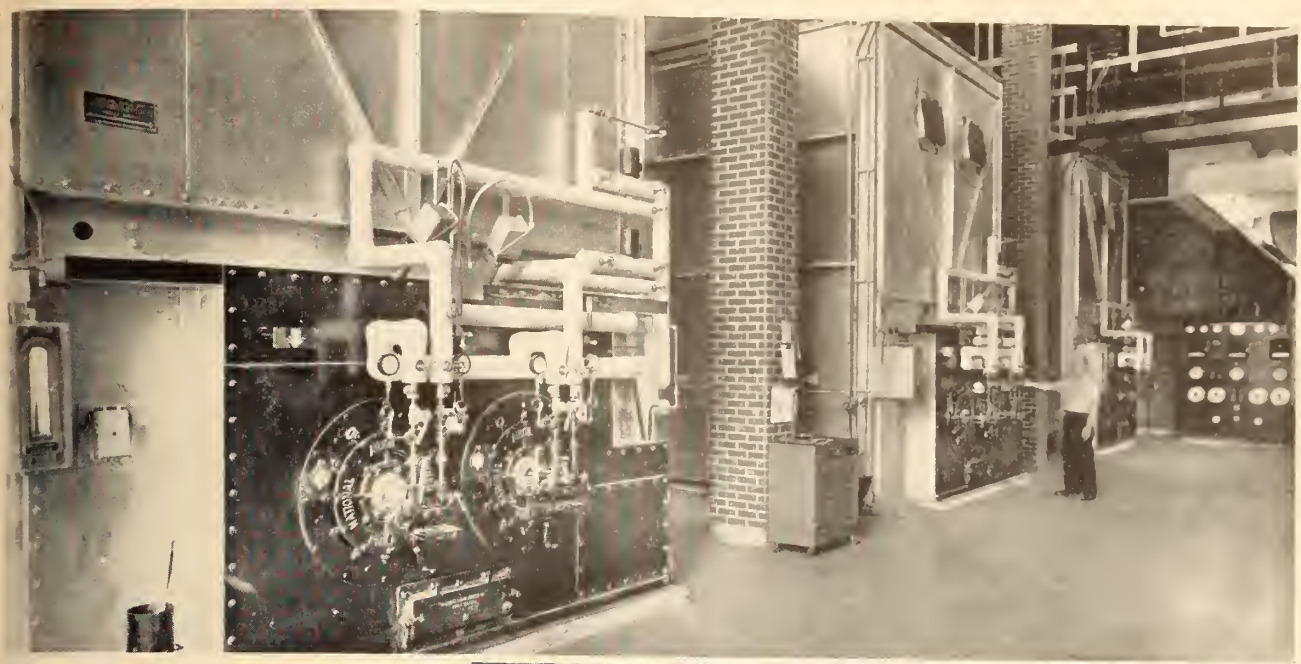
Plumbing

Cold Water Supply

The cold water supply is divided into a high-level system which takes care of all floors above the seventh and a low-level system which takes care of all floors below that. The high-level system is fed from a steel tank located in Cedar Avenue penthouse. The low-level system is fed direct from the city mains. The tank in the penthouse is 9 ft. wide by 14 ft. long by 16 ft. high and has a capacity of 15,000 gal., 5000-gal. of this (lower portion) being required for fire protection.

In order to keep the penthouse tank down in size, and for protection against city water failure, a concrete reservoir of 10,000 gal. capacity was installed under the ground floor of the boiler house. Water is pumped from this reservoir direct to the fixtures on the high level system or to the penthouse tank if it needs water. If for any reason the pumps are stopped the penthouse tank will feed the high level system, depending on requirements. A 10 in. connection to the penthouse tank acts both as a supply to the tank and as a supply from the tank to the cold water piping if the pumps are not running. An altitude valve is installed in this 10 in. connection near the tank, and when a certain level in the tank is reached the valve shuts off and the pumps discharge directly into the system. If the pressure below the valve is reduced the valve opens and the water flows from the tank.

The cold water system was designed for an approximate peak usage of 1000 gal. per min. There are three 500-gal. per min. pumps to handle the cold water. Two pumps are steam driven and one, which is a spare, is motor driven. The two steam-driven pumps are entirely automatic and the second one comes into use or stops depending on the demand. The motor-driven pump is manually operated and is only used when the steam pumps are out of commission. The cold water piping is laid out and valved so that the reservoir in the boiler house (and therefore all the buildings) can re-



Front view of the three main boilers showing the oil burners. At the extreme right is the oil burner control panel.

The metering and instrument board in the boiler room incorporates automatic combustion control.

ceive water from either the Pine or Cedar Avenue city main.

There is a City of Montreal plumbing by-law which forbids the installation of any plumbing fixtures which might provide a cross-connection between the city water distribution system and any plumbing system or make possible the back flow of sewage into the water supply. This would include any fixture where a rubber tube or hose is liable to be connected to a tap, bed pan cleaning jets with hose, or hand operated supply valves. The department in Montreal enforce this by-law strictly in order to avoid possible cases of infection, especially in hospitals, where back flow might occur after a cold-water line had been turned off and then put on the line again.

The department banned the use of vacuum breakers, except in special cases, as they found that quite often the breakers were taped up or removed. It was therefore necessary to run separate cold water lines from the tank in the penthouse to all laboratory sinks, etc. Allowance was given to use vacuum breakers for the bed pan cleansing jets as these are all foot-operated and close as soon as the foot is removed.

All three cold water supply pumps are located over the concrete reservoir in the boiler house All pumps are double suction centrifugal with horizontal split casings; each pump has a capacity of 500 U.S. gal. per min. against a 320 ft. head including 10 ft. suction lift. Two pumps are directly connected to 60 hp., 1750 r.p.m. steam turbines with constant speed and emergency trip governors. One pump is directly connected to a 60 hp., 3-phase, 60-cycle, 550-volt, 1750 r.p.m. motor. The electrically driven pump, which is used as a spare, can handle about one-half the peak load in an emergency and is manually operated.

Steam to each cold water pump turbine is controlled by means of a constant-pressure diaphragm-actuated governor. The two governors are air-operated through one pressure pilot which is connected to the penthouse tank by means of a 1-in. line. This pilot operates the pump governors by means of compressed air connected to the diaphragm of each governor. The pilot is actuated by the height of the water in the penthouse tank, regulating the compressed air to the pump governors, thus regulating the speed of the pump and the height of the water in the tank. There is another similar pilot connected to the 1-in. line from the penthouse tank which air-operates two mercury switch pressuretrols which in turn operate a high-level and a low-level alarm.

There are two float-operated switches located in the reservoir under the boiler room floor, one operating a high-level and one a low-level alarm. There is also a pressuretrol, connected to the air

line, that operates an alarm when the compressed air pressure is too low. Pilots, pressuretrols and compressed air reducing valve are located on a separate gauge board in the boiler room. The alarm lights and bell are also located on a separate gauge board.

Underground water mains and street connections are made of class 250 Delavaud pipe, bell and spigot.

Cold water piping inside the building of 1½ in. and under, and cold water piping in concealed spaces and shafts (all sizes), are made of standard brass iron pipe size with extra heavy brass iron pipe size and pattern fittings. Cold water piping inside the building over 1½ in. exposed is made of standard galvanized steel with standard galvanized malleable iron fittings.

Domestic Hot Water System

There are eight domestic hot water storage heaters located in "machinery" rooms, etc., in the various buildings that take care of the various domestic hot water systems. Some of these heaters furnish hot water to fixtures in the high level water system and some to the low level system. Each storage heater is capable of taking care of two-thirds of the load should the other tank be out of commission.

The hot water to dishwashers in each of the two large cafeterias has its temperature raised to 180° F. by means of steam operated boosters. Each ward kitchen has a dishwasher which uses hot water at the same temperature as for the other fixtures, which is between 140° to 160° F.; these dishwashers also have a steam connection. There are no dishwashers in the main kitchen, in which fixtures use water at the regular temperature of 140° to 160° F.

There is a complete hot water circulating system to ensure hot water from a fixture soon after a tap is opened. If a hot water branch line has more than three fixtures or if a fixture is more than fifteen feet from a riser, there is a branch circulating line connected to the circulating riser.

Each domestic hot water heating system has two circulating pumps, one of which is a spare and capable of taking care of the full load. All pumps are single-stage, single-suction horizontal centrifugal, directly connected to motors by means of flexible couplings; sleeve bearings are used.

All domestic hot water storage heaters are horizontal combined hot water service heaters and storage tanks. Two of the heaters take care of the laundry hot water and have coil capacity to raise the water from 40° F. to 180° F. All other heaters have coil capacity to raise the water from 40° F. to 160° F. The capacity of all heaters is based on 5 p.s.i. steam pressure. Interiors of all shells have two coats of Serviron paint.

All domestic hot water and circulating piping is made of standard brass iron pipe size with extra heavy brass iron pipe size and pattern fittings. In some cases in the larger sizes "Walseal" brass fittings were used instead of extra heavy screwed fittings.

Outside Sewers

There are a total of eight sewer connections to the city sewers. Two connections, for storm water, are made to the 2 ft. x 3 ft. brick sewer on Cedar Avenue and six connections for combined sewage and storm water are made to the 2 ft. x 3 ft. brick sewer on Pine Avenue.

Plumbing Fixtures

There are approximately 1,841 plumbing fixtures of various types. This includes laboratory sinks, but excludes kitchen or ward kitchen sinks. The plumbing fixtures consist of standard type fixtures such as lavatories and water closets for general use, special hospital type fixtures, and stainless steel sinks. The hospital type fixtures are made of vitreous china and have special blade handled supply fittings. Most other sinks are of stainless steel, and are either separate counter top sinks or are integral with a counter top or drainboard and are set over a wooden cabinet.

All lavatories in patients' rooms and toilets, consulting and examining rooms, and where used by doctors, and hospital type fixtures, have arm action blade handles. All lavatories have backs but do not have lift waste or plug and chain. Drinking fountains are self-contained and electrically operated.

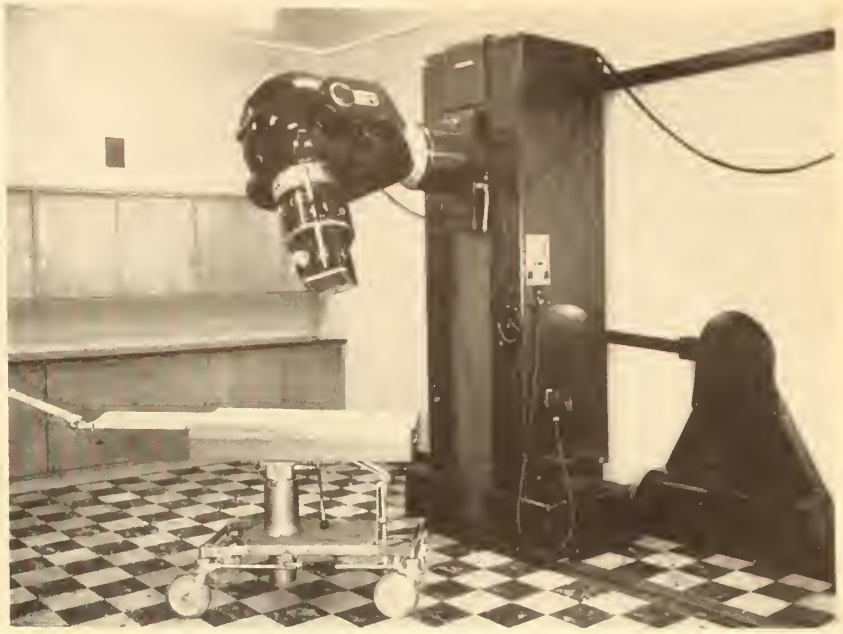
Stainless steel wash-up troughs are located in wash-up area between two operating rooms on the 8th floor and delivery room on 7th floor. These troughs are 7 ft. 6 in. long, and have three supply fittings so that three people can wash at the same time. Troughs are completely enclosed on front and exposed side to within 6 in. of the floor, by stainless steel panels. The front panel has an access door to trap and waste piping. There are also several other stainless steel wash-up troughs, 4 ft. long with two supply fittings, one located in cystoscopy department, and one between the two emergency operating rooms on 1st floor. There are two 31 x 23 in. vitreous china wash-up sinks located in dental operating room.

Water closets for use in public and general toilets have flush

Underwater treatment tank in the physical medicine department. The two electric turbine ejectors and aerators mounted on the tank produce an underwater thermal stream, at controlled water temperatures and pressures, that can be directed on to any part of the body.

valves located 38 in. above the floor for easy operation, but not by foot. All the water closets in patient's toilet rooms, and where they are near patient's rooms, are one-piece quiet-action tank combinations. Water closets in patient's toilets and where bedpans are used, are equipped with bedpan lugs and pedal-operated bedpan cleanser.

There are two specially-designed autopsy tables located in autopsy operating room. These are made of stainless steel and are complete with hot and cold water supplies, thermostatic mixing valves, removable basin at head, and hose and nozzle. One part of the stainless steel trough has a removable top (in two parts) made of chromium plated steel tubing. The other end of the trough has a removable perforated stainless steel top. The trough has a stainless steel removable sink with gooseneck water supply and standing waste and overflow. The main body of the trough is drained through a 2-in. whirlpool trap.



The cobalt therapy bomb is a major feature of the radiological department, which occupies most of the fifth floor. Special screening and ventilation are necessary for this equipment.

Underwater Treatment Tank

There is one tank and wading trough of Hubbard design located in the physical medicine department on the second floor. The shape of the tank is a modified figure "8" and permits the physical-therapist to reach the patient on either side without entering the tank. Two electric turbine ejectors and aerators are mounted on the tank and produce an underwater thermal stream which can be directed upon the affected parts of the body. The ejectors produce a double-action underwater massage at controlled water pressure and temperatures. One or both ejectors can be used on either side or at the foot end of the tank. Each ejector has a carriage with wheel which travels on the rim of the tank. An elevator is an integral part of the carriage and permits raising, lowering and rotating of underwater stream to any angle for direct application to affected parts.

A wading trough with adjustable hand rails and steps is incorporated and the patient is supported by a suspension wading harness. A cover is placed over the trough when the tank is used for full body immersion treatment. The tank is complete with thermostatic water mixing valve and thermometer assembly mounted in a steel cabinet, head rest, body hammock, water stretcher, canvas body sling, hoist and trolley suspended from an I-beam, and so on. All parts of the tank and trough are of electrically welded stainless steel. The tank is 8 ft. 10 in. long with a maximum width of 6 ft. 6 in.

There is one continuous flow bath located on 15th floor equipped with remote control equipment (thermostat mixing valves), recording thermometer, high and low water temperature alarm and canvas cradle and restraining sheet.

Laboratory Equipment

Vitreous china sinks were installed in most of the laboratory departments, but wherever a joint was undesirable, for contamination or other reasons, a stainless steel sink integral with the table top or the drain board was installed. When special size sinks were required for special cases, Alberene stone was used. All cup sinks are made of a lead alloy.

The type of top used was a question of its function. Arborite tops are used in general; Belstone for bio-chemistry. In pathology, as well as in washing rooms, stainless steel tops were installed.

Most of the fume hoods are of the sash type, completely built with ¾ in. Belstone and having a baffle plate at the back with two adjustable dampers, one for heavy fumes and other for light fumes. A special canopy hood of ¼ in. transite with a lead-coated angle-iron frame was installed over an entire wall in general pathology room.

The dental units in the dental clinic are highly functional. Each unit is designed for two students, each having an identical number of drawers, individually locked with an automatic locking device. The unit is equipped with a viewing box, gas and air cocks and a small stainless steel sink with drain board and splash back.

All drain or waste piping from benches or tops where sinks are located, to vertical soil stacks are made of acid proof piping and "Duriron" fittings. Laboratory sinks have lead alloy traps and waste fittings. Some of the Alberene sinks have "Duriron" traps and waste fittings.

There are two laboratory glassware washers, one located in scullery room in bacteriology department on third floor and one in bottle washing room in pharmacy department on 1st floor. There is space for a future similar washer in glass washing room in metabolism department on 7th floor. Flasks and bottles are washed in the pharmacy bottle washing room and test tubes, petri dishes, pipettes and flasks are washed in the scullery room. Each washer has a hot water, distilled water, steam, drain and electric connection; washing and rinsing is done at high pressure. Washers are equipped with automatic steam thermostatic controls, distilled water booster pump, manual and

automatic timing, pump motor, high pressure wash pump, and motor for oscillating the basket.

Vacuum Cleaning System

A stationary vacuum cleaning system is installed to take care of the patient's floors (7th and 9th to 19th) in Cedar Avenue building. A few outlets are also in the west corridor of the 8th floor Cedar Avenue building near the recovery rooms. Since a stationary vacuum system conveys all the dust to a central point it was felt that there was less chance of contamination than there would be with individual vacuum sweepers with dust bags.

There are about 102 inlet valves located in the corridors of the various floors connected by piping to a central unit, located in garbage room on 3rd floor (near boiler house). The unit consists of centrifugal exhauster and motor, one primary and one secondary dust separator. All piping is standard black iron with extra heavy cast iron long sweep turn fittings.

Fire Protection

The fire protection system consists mainly of a separate system of fire lines and stand pipes together with hose, hose racks, and valves in cabinets located in various parts of each floor. Each floor has a cabinet with an additional valve for city fire department use.

Part of the laundry room, showing some of the ironers and two of the large ventilating hoods.

There are no separate fire pumps, but if necessary, the three cold water pumps could be operated at the same time to feed the penthouse tank and provide water for fire-fighting. The cold water line from the pumps to the penthouse tank was sized to take care of the three pumps operating at one time.

Sprinklers are installed at top of elevator and dumbwaiter shafts with a standard wet pipe system.

Ventilation and Air Conditioning

When the term "air conditioning" is used it means summer cooling and year-round ventilating and humidity control. When the term "ventilation" is used it means all year round exhaust or supply of air, or both, and no summer cooling and the air supplied in the winter is heated and humidified.

General Description

There are a total of 15 supply and 28 exhaust fans in connection with the ventilating and air conditioning systems. The 15 supply fans have a total capacity of 206,855 cu. ft. of air per minute and the 28 exhaust fans have a total capacity of 227,965 c.f.m. There is a total of 434,820 cu. ft. of air supplied and exhausted.

Where there is a preponderance of exhausted air in certain areas, supply air is introduced in the corridors or other rooms in order to balance conditions and prevent draughts. Where hazardous gases are used such as in operating rooms, anaesthesia room, delivery, fracture, cystoscopic, and plaster rooms, and rooms where combustible gases are used, ventilation is in accordance with regulations recommended by the National Fire Protection Association.

All patients' toilets which are a part of each patient room have exhaust ventilation. This also helps to ventilate the rooms. In order to prevent cross-contamination, air is supplied to the corridors to keep them under a positive pressure as well as supplying make-up air. There is some danger of transferring virus diseases such as chicken pox, measles, and virus pneumonia, if air flow is encouraged from patients' rooms to a common corridor.

The return air from air-conditioned rooms, except from operating suite and rooms where hazardous gases are used, is partially recirculated. No air is recirculated from rooms where hazardous gases are used or from the ventilating system exhaust.

Ventilation

In general the types of rooms that are ventilated are those which do not have outside windows and are used by hospital personnel, patients, and others; all toilets with windows having three or more water closets; all rooms in which there are liable to be odours, such as laboratories, autopsy room, morgue, animal rooms, utility rooms, clean-up rooms, locker room; all spaces where moisture, steam and excess heat is generated such as cooking spaces, dish washing and serving areas, and laundry; all rooms where hazardous gases are used, as mentioned above; certain rooms (with windows) where a number of people congregate such as lecture rooms, public waiting rooms, and dining rooms.

The ventilating systems and the areas they take care of are: general supply and exhaust for Cedar Avenue building; for Pine Avenue and Centre buildings; supply and exhaust for amphitheatre; for main kitchen; for central sterilizing room; for laundry; for dining areas; for basement of Pine Avenue building; for emergency operating rooms and dental operating room; toilet exhaust systems for Cedar Avenue and for Centre and Pine Avenue buildings; exhaust systems for autopsy, animal, and cystoscopy rooms; supply for boiler room; and exhaust for diesel engine room. There are also exhaust systems for fume cabinets, vaults, and projection booth.

Each of the above supply systems are complete with fans and motors, heating coils, and high velocity washable all-metal filters. The general supply systems and the amphitheatre supply have air washers.

Most of the fans, except where

they are part of a utility set, are multi-blade centrifugal, either single or double width. Some of the exhaust fans are of the propeller type.

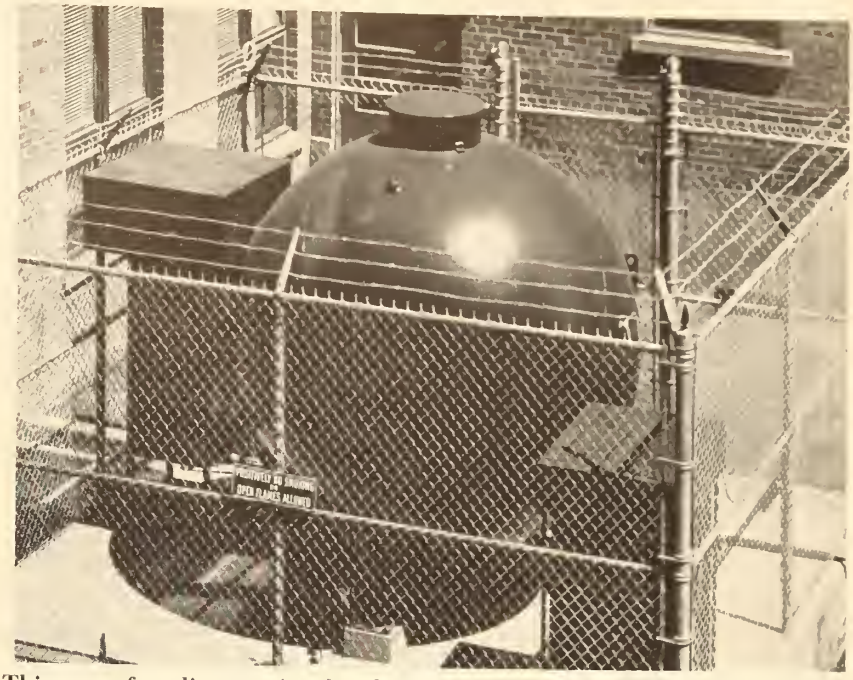
Air Conditioning

The air conditioning systems and the rooms and areas they take care of are: the eleven operating rooms, bed parking rooms, fracture rooms, small operating room, anaesthesia room and wash-up areas, all being a part of the operating suite on the 8th floor; two recovery rooms in 8th floor; the two delivery rooms, two labour rooms, preparation room, ten nursery and examination rooms, all in obstetrical department on 7th floor; one bedroom on each patient's floor of 9th to 16th floor and two bedrooms on 17th to 19th floors for allergy patients; board room and executive directors' room on 6th floor; and the whole of the photography department (10 rooms) on 4th floor, cooled mainly on account of its proximity to the boiler room. Four fluoroscopic rooms on 5th floor are cooled by means of individual air-conditioning units.

Each of the above systems, except that for the board and directors' room and fluoroscopic rooms, have their own air-conditioning system consisting of supply fan and motor, air washer, heating and cooling coils, filters, controls, exhaust fan and motor, and duct work. The board and directors' rooms are connected to the delivery room (obstetrical department) system. The system for operating suite has a separate supply fan, special capillary air washer and separate heating and cooling coils and high-velocity washable all metal filters. Each of the other systems has similar equipment, but they are installed as one unit.

Each of the four fluoroscopic rooms are cooled by means of fan-coil room air conditioner units located in each room. Cooling coils in the unit are connected to the chilled water system. These units are also used to heat the rooms in winter and are also connected to hot water heating system.

Separate ducts are run to each operating room, each delivery room, labour rooms, nurseries, board room and directors' room, from their supply fans. Each separate duct has a reheater installed, connected to a thermostat in each room, so that each room can control its own temperature.



This seven-foot diameter insulated tank is the source of the centralized oxygen supply system and has a liquid capacity equivalent to more than 100 standard oxygen cylinders. An automatic vaporizing and pressure regulating system is fitted. The tank is replenished from specially-designed tank-trucks.

A 180-ton refrigeration unit furnishes cold water for the cooling coils in the various air conditioning units. This unit consisting of compressor, condenser, water cooler, etc., is located in the mechanical room on the 5th floor of boiler house. The chilled water is pumped from the water cooler to the air conditioning cooling coils of the various systems in the various buildings, and returned, by means of a motor-driven single-stage end-suction centrifugal pump. There are two pumps, one being used as a spare, and they are located adjacent to the refrigeration unit.

A cooling tower to cool the condenser water so that it can be reused is located on the roof of the boiler house. A centrifugal pump lifts the water from the condenser to the cooling tower from which it is returned to the condenser. This pump is located beside the other two. The cooling tower has a capacity of 555 gal. per min. and has a 10 h.p. motor-driven fan. An expansion line is taken off the chilled water supply line and runs to an expansion tank located in the fan room on 11th floor of Pine Ave. building.

The refrigeration unit consists of a centrifugal multi-stage compressor with shell and tube type condenser and cooler, purge recovery unit, economizer, and automatic suction damper. The compressor is directly connected through gears to a 200 hp. squirrel-cage induction motor. The refrigerant used is F-11.

The air-conditioning system for the operating rooms is designed for an inside temperature of 70° to 75° F. with outside temperature at 90° F. and with a maximum relative humidity of 60 per cent and a minimum of 50 per cent. The recovery room system is designed for an inside temperature of 75° to 80° F. with a relative humidity of 40 to 60 per cent. The conditions for the recovery room system were assumed to be half way between the conditions in the operating rooms and in the wards so that there would not be too great a temperature difference when the patient is returned to his uncooled ward.

Humidification is used as a means of controlling static in anaesthetizing areas. To be effective the relative humidity should be at least 50 per cent.

The temperature of the air leaving the mixing chamber of each air-conditioning system is regulated by the relative position of a duct thermostat, which operates the modulating steam valves on the preheating and reheating coils during the heating season. During the cooling season, the instruments are automatically shifted to operate cold-water valves on the cooling coils. Also, during both seasons, several automatically-operated dampers are controlled to pass the air through or around the

heating and cooling coils, in order to secure immediate response to the demands of the controlling instruments.

Automatic humidity control for several of the systems is accomplished, during both heating and cooling, by a humidostat in the air washer discharge. The humidostats, fitted with an animal-horn element are especially effective in sensing small changes in relative humidity and operate valves which determine the moisture content of the air leaving the washer.

All piping in connection with chilled water system is standard brass with extra heavy brass, I.P.S. and pattern fittings.

Ventilation of Cobalt Bomb and Isotope Rooms

The cobalt bomb therapy room on the fifth floor is located partly under Cedar Avenue and has three sides and ceiling under ground. This room is ventilated by means of supply and exhausted air which are connected to the general supply and exhaust system. To prevent scattered radiation from entering the ducts, lead baffles are installed in the inlet and outlet. The viewing glass, which is set in the wall and allows the operator to see the patient from outside, is a 2 in. thick special "Penberthy" lead glass 24 x 24 in. which contains lead silicate and other materials and prevents the penetration of rays. This glass is a new development and is very expensive.

The isotope laboratory on the fifth floor contains a fume cabinet and two hot-boxes. The exhaust from the radioactive isotopes is taken care of by branch ducts from the fume cabinet and from the two hot-boxes joining together into one duct and running outside the building to an exhaust fan located on the penthouse roof of the building (23rd floor) and then discharging ten feet above the roof. All the ductwork is made of stainless steel. To prevent radioactive dust from being deposited in the duct an Absolute filter is installed in the discharge from the fume cabinet. This filter was specially designed for the United States Atomic Energy Commission. To assist the exhaust from the hot boxes, a commercial vacuum cleaner is made part of the hot boxes. This particular type of vacuum cleaner is the only one that meets the requirements of the hot-boxes.

The hot-boxes are used to store and work up the materials and the fume cabinet is used for the actual application of the isotopes.

Miscellaneous

All fans and motors, except where they are a part of a ventilating or air-conditioning unit are mounted on "vibration dampener" bases, under fan, motor and drive, with sliding base. All exhaust utility sets where vibration is liable to be transmitted have vibration dampers.

Supply air is generally distributed through various sizes of ceiling outlets of recess pattern, having integral volume control dampers for ease of balancing the air quantities to each location. Supply air is also distributed by wall mounted two-piece double-deflection grilles having opposed blade volume control dampers and with turning vanes installed in the ducts to equalize the air flow to the grille. Exhaust and return air is handled through wall-mounted two-piece grilles, having opposed blade volume control and a return core. All grilles have a separate frame from which the core can easily be removed for cleaning. All outlets and grilles were designed on a performance basis, including noise level, pressure drop, and air drop not to exceed 70 to 100 f.p.m. at occupancy level.

Supply units have air operated damper motors and are generally so arranged that, when fan is shut off, the fresh air damper is closed, and if air is to be recirculated the recirculating damper opens. The steam valves and damper motors on mixing dampers, open to the heating cycle if compressed air fails.

In general, acoustic insulation is installed inside ducts near supply and exhaust fans, where required to reduce decibel ratings. The inside of all runouts to grilles and registers and all elbows in connection with the operating rooms, delivery rooms and nurseries have a coat of sound-absorbing paint.

Oxygen and Nitrous Oxide Systems

The use of oxygen therapy has increased greatly. A central system of supply was installed due to the many advantages it has over the individual cylinder method in time-saving, convenience, oxygen economy, and dependability.

Oxygen Supply

Oxygen is delivered to the patients by means of a piping system fed from a central source located on the hospital grounds. The source is a specially designed insulated spherical tank 7 ft. in diameter which contains liquid oxygen. The unit is provided with vaporizing and pressure-regulating equipment which operates automatically. The liquid oxygen is vaporized and supplied to the pipelines at a predetermined pressure. The pressure carried is lower than that of any other type of oxygen system.

The liquid capacity of the spherical tank is equivalent to 100,000 cubic feet of gaseous oxygen, or more than 400 standard cylinders. Liquid oxygen is delivered to the unit in specially-designed mobile trucks. The storage unit includes a bank of emergency reserve cylinders containing gaseous oxygen, which will automatically supply the pipe line should there be a failure in the primary supply. There is no interruption of oxygen flow to the piping system when the unit is being refilled and there is no change in line pressure when the unit goes over automatically to emergency reserve supply.

When a patient is to receive oxygen, the nurse has merely to attach a flowmeter to the wall outlet, connect the administering apparatus, and turn a valve to start the flow of oxygen, which can be given a few minutes after it has been ordered.

All oxygen service outlets are Schraeder oxygen coupler check units with dust cap assembly and accommodate only Schraeder "safety-keyed" oxygen adapters.

Oxygen outlets are installed as follows: one in each emergency operating room, and one in each recovery and emergency examination room, all in emergency department on 1st floor; one in each nursery, one for each crib in septic nursery, one in each delivery room, one in each labour room and one in preparation room, all in obstetrical department on 7th floor; one outlet for each single bed patients' room and one outlet for each two beds in two and four bed patients' room including patients' rooms in obstetrical department; one for each bed in recovery rooms; two outlets for each operating room; one outlet for each anaesthesia room; one out-

let for small operating room and one for fracture room; one outlet for each cystoscopy room.

All sections of piping have special shut-off valves. All pipe is seamless hard-tempered copper tubing Type B for assembly with Walseal fittings. All piping, fittings, cleaning and testing follow a rigid specification.

Nitrous Oxide Supply System

Nitrons oxide is piped to all the operating rooms located on the seventh and eighth floors, from a central manifold. The manifold is designed so that the changeover from the primary supply to the reserve supply takes place automatically. The manifold consists of two high pressure manifold shut-off valves, two automatic pressure reducing regulators, two low pressure shut-off valves, and two pressure relief valves. A signal system is installed to indicate when there is a changeover from the primary to the reserve supply.

Each operating room is equipped with a shut-off valve located in the corridor outside the room so that any theatre can be closed down without affecting the supply to the balance of the hospital. Outlets are placed in an alcove with the oxygen and vacuum outlets.

Sterilizing Equipment

All the instrument and utensil sterilizers in utility and other rooms are pressure-steam types with the exception of the portable electric instrument sterilizers and two others (cystoscopy and eye clinic) which are of the boiling type.

There are only three bedpan washers and sterilizers, two located in fluoroscopic department and one in soiled utility room in connection with recovery room on 8th floor. On all the ward floors bedpans are emptied in the water closets in each ward and sterilized in the pressure sterilizer in soiled utility rooms. Utensils used on the floors are also sterilized in this pressure sterilizer. Most of the sterilization for dressings, is taken care of in the general sterilizing room which is located on the operating suite floor.

All water is sterilized in flasks in the central sterilizing room. The water for use in the operating rooms is kept in flask warming cabinets in sub-sterilizing rooms located between each two operating rooms. Distilled water is used so that a lime deposit will not be made in the flasks.

The central sterilizing room contains three 24 x 36 x 60 in. rectangular pressure sterilizers, one 20 x 60 in cylindrical pressure sterilizer and one 25 x 19 x 19 in. dry air sterilizer, all recessed in one enclosure. The room also contains two water stills. An adjacent glove room contains a glove conditioner and an automatic glove washer.

The formula room in the obstetrical department contains a milk formula pressure sterilizer and an electrically heated mobile bottle warmer.

The milk formula pressure sterilizer and the four pressure sterilizers in the central sterilizing room are each equipped with recording thermometer and automatic cycle control.

Each sub-sterilizing room on operating room floors, has a 16 x 24 in. emergency and hi-speed pressure instrument sterilizer of the cabinet type. These sterilizers are exposed and have a stainless steel housing. Each of these rooms is also equipped with a 30-gal. recessed mounted flask warmer, steam heated and thermostatically controlled for keeping sterilized water warm.

The instrument clean-up room on the operating suite floor contains two pressure instrument washer sterilizers. These units are arranged for washing and sterilizing instruments, primarily in bulk, although they can be used in an emergency as a high speed sterilizer. The complete cycle of washing, sterilizing and drying is controlled automatically by a timer with buzzer indicating completion of the cycle.

Besides the above mentioned sterilizer there are also sterilizers of various types located in laboratories, outpatient department, emergency department, pharmacy department, etc.

Steam is brought to all sterilizers at 60 p.s.i. and there reduced to the required pressure by an automatic regulator and reducing valve.

Miscellaneous Systems

Wound Drainage System

Vacuum outlets for wound drainage were generally installed wherever there was an oxygen outlet, with the exception of the nurseries. The outlets in patients' rooms are located 21 in. above the floor, to facilitate the attachment of the manometer type single suction bottle.

The central sterilizing room contains three rectangular pressure sterilizers and one cylindrical pressure sterilizer (right) and one dry air sterilizer (left), all recessed in one enclosure.

All vacuum outlets are connected by means of piping to a vacuum pump unit located in machinery room in Pine Avenue building.

Vacuum cocks are $\frac{1}{4}$ in. chromium plated brass with flat lever handle and are installed at an angle so that the spouts are parallel to the wall. All piping is seamless hard temper copper tubing Type "K" for assembly with solder connection.

The vacuum pump unit consists of two vacuum pumps and one horizontal receiver, fully automatic controls, and the necessary starters, solenoid valves, silencers, and gauges. Each pump is capable of maintaining a vacuum of 20 in. of mercury when evacuating 195 c.f.m. at 1150 r.p.m. and is directly connected to a 15 h.p. motor.

Vacuum System for Laboratories

This vacuum system consists of outlets in all the laboratories, etc., piped to a vacuum pump unit located in machinery room in Pine Avenue building. The piping is similar to that used for the vacuum wound drainage system. The vacuum pump unit consists of two vacuum pumps and one receiver with fully automatic controls, and gauges. Each pump is capable of maintaining a vacuum of 27 in. of mercury when evacuating 5 c.f.m. at 150 r.p.m. and directly connected to a 1½ h.p. motor.

Compressed Air System

The compressed air system takes care of all the requirements of the buildings such as laboratory work, air for pneumatic controls, laundry and boiler room. There are two compressors located in machinery room in Pine Avenue building and one in the boiler room. The three compressors are connected to the same pipinge so that any of the three can be used.

Two of the compressors, one located in the machinery room and one in boiler room, are each two-stage, single-acting, air-cooled, complete with a 7½ h.p., 1800 r.p.m. 550 v., 3-phase, 60-cycle standard squirrel-cage induction motor. Each compressor and motor is mounted on a standard horizontal 24 x 22 in. air receiver, the compressor being complete with intake filter and muffler, unloader, V-belt drive, automatic pressure switch for automatic start-stop control. Each compressor delivers 28 c.f.m. at 100 p.s.i.; the compressor located in machinery room of Pine Avenue building is similar to the above except that the motor horse power is 10 and the actual delivery at 100 p.s.i. is 39 c.f.m.

All compressed air piping is standard galvanized steel with standard galvanized malleable fittings. Air cocks are chromium plated brass single pedestal type with long spouts for ¼ in. hose connection.

Pneumatic Tube System

An air tube automatic switch system is installed for transporting medicines, specimens and documents from one location to another.

The carriers have adjustable rings that determine the destination and are moved in the tubes on a rapid stream of air. Two tubes pass each station, a despatch tube to take away carriers sent from the station and a receiving tube to bring carriers to the station. In the receiving tube ahead of each station is a switch to divert carriers out of line. Each station switch operates only for carriers that are set to be switched out through it. Rings on the carrier act as electrical contacts for the brushes in a selector, and are the means of closing an electrical circuit and actuating the switch for which they are set. A carrier set for any particular station will switch out only at that station. The system is powered by means of centrifugal exhausters.

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Electrical Work in the Hospital

There are few, if any, types of buildings in which there are more electrical services than in a modern hospital. Not only are there the usual light and power facilities but also numerous systems for signals, communication, conveying, and cleaning; vacuum systems, food preparation and transportation systems, refrigeration for preservation and for comfort as well as diagnostic and treatment equipment such as x-ray.

To supply all these requirements in the new Montreal General Hospital there is more than 60 miles of electric conduits with some 280 miles of wire. Light switches and receptacles number over 20,000. There are 14,000 electric light bulbs of all kinds.

All of this equipment must be designed for the utmost reliability as most services are, or may be, required continuously or at any hour of the day or night.

Main Transformer Station

Electric power is supplied by Hydro-Quebec at 12,000 volts, three-phase, 60-cycle via two underground cables. Each cable is fed from a separate source to minimize probability of both lines failing simultaneously. Each cable terminates in an oil circuit breaker with line and load side disconnecting switches. Each breaker is interlocked mechanically (keys) with its associated disconnecting switches to prevent disconnects being opened or closed unless the breaker is in the open position.

The breakers are electrically operated and interlocked both mechanically and electrically to prevent both breakers being closed together thus paralleling the two incoming lines.

Energy for operating the breakers is supplied from a 120 v. lead-acid battery which also takes care of a limited number of emergency lights. The battery is charged by a dry plate type charger with adjustable rate.

The circuit breakers are automatically operated to the extent that power failure on the operating line will cause the breakers to change over to the standby line. The change back is not automatic unless the standby line fails and the normal line is alive. This feature is to prevent unnecessary changeovers.

Provision is made to cut out the automatic changeover feature and put the breakers on normal manual control, and also to reverse the designation of normal and standby lines should need arise.

Potential transformers with high interrupting capacity fuses on each incoming line after line-side disconnects provide intelligence for change over relays and operate pilot lights on the switchboard showing whether each line is dead or alive.

In case the circuit breakers operate due to overload the changeover and the reclosure features become inoperative to prevent repeated closing on a fault.

Power company metering is after the common connection on the load side of the breakers.

Two only banks of transformers are fed from the 12,000 volt bus. One is a bank of three, single-phase, 666 kva., 12,000-575 volt units connected delta-delta to supply all light and power required. The second bank consists of two 150 kva., 12,000-115/230 volt, single-phase units connected in parallel on the primary from one phase only and the secondaries in series to provide output of 115/230 volt. (Each transformer is connected for 115 volt.) This bank serves x-ray equipment only.

The 575-volt bank being a three-phase delta-delta arrangement permits open delta operation in case of failure of one unit. Space is also provided to install in future a fourth 575 volt unit as a standby should it be considered advisable.

The 115/230 volt bank also permits one unit to be out of service and the remaining one can provide reduced capacity of same characteristics. It is worth noting that the 115/230 volt transformers have lower than normal regulation. This was achieved at a small loss in efficiency but was considered advisable in the interests of better x-ray operation. It is also worth noting that the one bank provides all x-ray requirements thus cutting down the number of transformers and kva. normally installed for x-ray operation.

A diesel-driven 575 volt generator is provided for emergency use but of a capacity less than full requirements.

While power failures are of infrequent and usually of short duration it was felt that a local source was essential to the extent of being able to maintain a minimum of services.

The 575 volt bank feeds into a free standing totally enclosed air circuit breaker type switchboard. From this board two buses carry the total light and power load horizontally through the hospital proper. One is marked "power" and the other "light". The designations are not completely accurate as the lighting is not limited to the lighting bus as will be later explained.

This view of the main entrance hall shows the type of lighting used. Large luminous panels incorporate standard 40-watt fluorescent lamps to give even illumination. The fixtures are arranged to harmonize with the architectural treatment. At extreme left is part of the doctors' in-and-out board.

Distribution System

In the design of the system considerable study was given to the most economical method of distribution. The physical extent of the system and also its capacity indicated that an intermediate voltage (2300 or 4000) would be required to keep regulation and losses within acceptable limits. The introduction, however, of an intermediate voltage would require an additional transformation with consequent losses and regulation and increased investment as well as requiring space of a different construction. Furthermore this space would, in some cases, be in locations which would be most inconvenient and which should be available for other uses. (The building is 21 stories high.) The study revealed that a distribution system using low reactance bus could provide the required regulation at a cost not greater than normal conduit and wire with intermediate transformation and with a lower operating cost.

From the 575 volt bus six transformer banks located throughout the hospital proper, two banks located in nurses' home and one in the internes' residence, step down from 575 volts 3-phase to 120/208 volt, 3-phase, 4-wire for lighting and other requirements at lower voltage. In the hospital proper the 120/208 volt banks feed vertical buses which are tapped at each floor.

The 575 volt and the 120/208 volt buses are tapped wherever a sizeable load occurs. As this bus is of the "interlaced" type it can only be tapped at joints and by using a fitting for that purpose. By careful design of the vertical bus, all connections are made in the tap boxes thus making it possible to inspect all joints at any time even though the bus is concealed throughout. Taps on the bus whether 575 volt or 120/208 volt are made via air circuit breakers.

Power panels are of the usual type, dead front, cartridge-fused type. Lighting panels are of the plug-fused type with cartridge fuses being used where the load exceeds the capacity of a plug-type fuse. The kitchen loads are fed from 120/208 volt panels similar to power panels. In the case of the main kitchen the panel is fed from a bank of 575-120/208 volt transformers serving that load only.

All standard receptacles are of the 3-wire grounding type which will accept both the standard 2 parallel blade cap or the new 3-wire grounding type.

Special receptacles are placed in corridors to handle specific loads such as floor machines or portable x-ray whose rating is greater than that of a standard receptacle. These corridor receptacles are also on the emergency circuits so that they will always be available for equipment whose uninterrupted operation is essential.

All local switching, except certain 4-way and for some D.C. circuits, are of the quiet type.

Returning to the designation of the two 575 volt buses "light" and "power" the "light" bus carries a major part of the transformers for lighting, kitchen equipment and other loads in the 120/208 v. category.

The "power" bus carries all 575 volt 3-phase motor load and also the 120/208 volt emergency lighting.

Most motors have no voltage release features, hence when power failure occurs most of the motor

load is automatically dropped until manually restarted. The motors which are classed essential such as operating room ventilation (not cooling) have maintained-contact control switches and hence do not require manual restarting after power failure.

With this arrangement emergency power may, after a power failure, be applied to the "power" bus only, which will restore emergency lighting and the essential power load. This enables the operator to restore minimum essential requirements of both light and power without delay and with complete control from the switchboard room to the extent that the generator will not be overloaded.

As generator capacity permits, further power loads and other lighting may later be picked up depending upon the need. This arrangement of feeders permits adequate control of the emergency load with a minimum of duplication.

The only loads which must be remotely controlled are the kitchen, laundry and elevators. The kitchen and laundry control is accomplished by electrically operated main breakers controlled from the main switchboard room. In order to take care of elevators which might be stalled between floors at the time of power failure and to provide for using any one of the elevators, remote controls are provided from each elevator control board to the main switchboard room. The controls consist of a d.c. relay at each elevator control board operated from the 120 v. control battery with a normally closed contact. To prevent the elevators from starting up on resumption of power (emergency) the relays are energized from the main switchboard thus opening the elevator control circuit. These relays may be de-energized individually to permit any elevator to operate. Upon resumption of normal supply the relays are all manually de-energized and elevators return to normal operating condition.

Emergency Electric Generator

The selection of size of emergency generating unit requires study of many factors. Certain minimum lighting requirements (such as operating suites which have no windows) are essential at all times. Depending upon time of day other lighting requirements are variable. It is not considered necessary to provide complete lighting on an emergency basis but enough light must be provided to permit essential duties to be performed in safety. Similarly certain power loads such as operating room ventilation is essential. Furthermore building heating may or may not be essential depending upon season and duration of failure. Certain safety devices such as vacuum pumps and other treatment devices are essential. To arrive at the minimum requirements the essential loads under worst conditions are totalled. Under more favourable conditions some of these essential services may not materialize hence some generator capacity will be available for other uses. The bus and switching arrangement permits some "desirable" but not "essential" services to be provided.

The emergency generator is a 380 k.w., 575 v., 3-phase, 60-cycle unit driven by a diesel engine. The engine generator and exciter, which are all direct connected, have a concrete base which is set in cork to absorb vibration. All connections, cables, cooling lines, fuel lines, etc., are brought from overhead via flexible connections so that no vibration will be transmitted.

Cooling requirements for the engine are met in two ways. In order to be completely independent of outside services the engine blocks and heads are radiator-cooled. This radiator is mounted on top of the boiler room (outdoors) some two stories above the engine and utilizes a permanent-type anti-freeze. A thermostatically controlled three-way valve bypasses the radiator until engine temperature comes up to normal. This valve then serves as a modulating valve to maintain uniform engine temperature. When the radiator temperature rises the motor driven radiator fan automatically starts and continues to run as long as the emergency generator operates or until coolant temperature in radiator drops to a predetermined value.

Lubricating oil is cooled by a separate radiator and motor-driven fan located in the engine room. The heat from this radiator and the heat directly liberated by the engine is removed from the engine room by a forced-ventilation system.

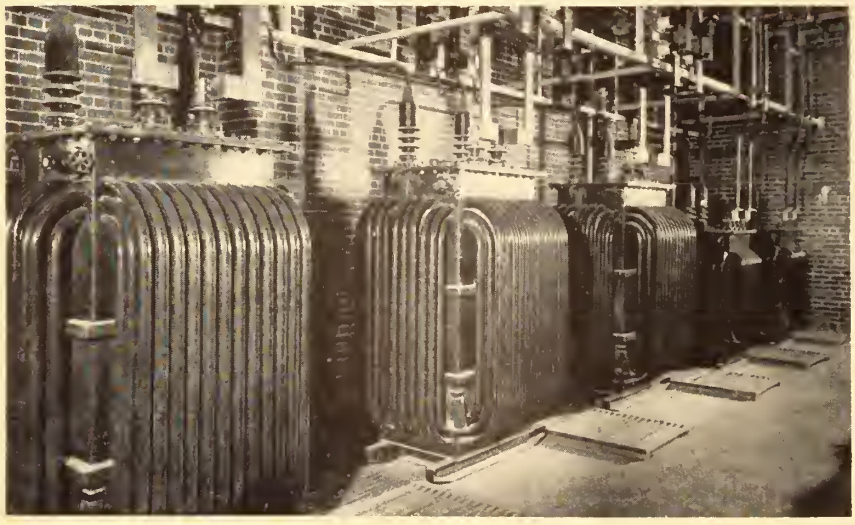
The engine is started by compressed air using one automatically-operated (pressure switch) electrically-driven compressor and one standby compressor driven by a small diesel engine. This arrangement makes even starting air independent of outside power.

Engine exhaust is piped into the main boiler plant chimney.

An automatic voltage regulator, voltmeter, frequency meter, ammeter, field discharge switch and field rheostat are mounted on one of the main 575 v. switchboard panels. This panel is located adjacent to the remote control switch panel for the elevators.

It is interesting to note that the elevators (one only at a time) constitute a very fluctuating generator load. When accelerating from standstill with full load the demand is in the order of 100 h.p.

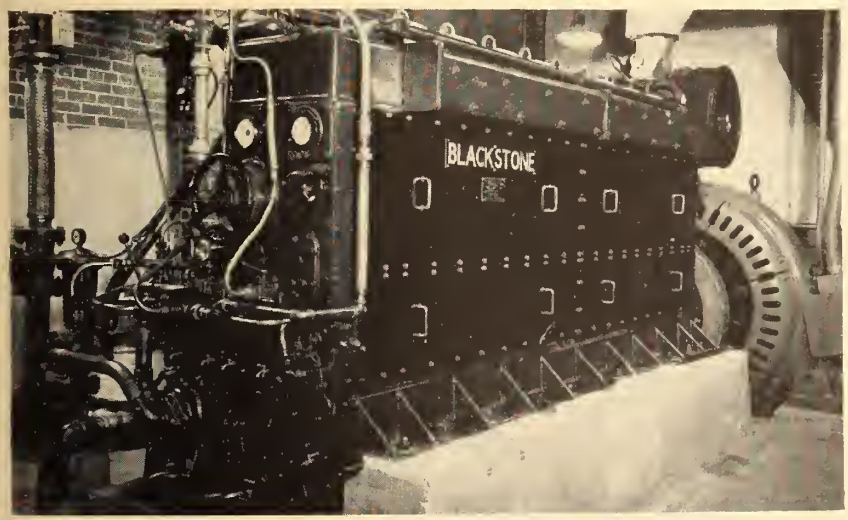
Part of the 12,000-volt transformer room. Main power is supplied by Hydro-Quebec at 12,000 volts, three-phase, 60-cycle via two underground cables.



This demand decreases as full speed is reached and then becomes a negative load (feeds back into the power system) during slowdown, as the braking is regenerative. The demands on the speed and voltage regulators are therefore quite severe.

Load is transferred to the generator via air circuit breakers. On each feeder which has emergency source available to it, two mechanically interlocked breakers are used; one breaker from the normal supply and the other from the emergency generator bus. As pointed out previously, both the time of day and season can affect the priority rating of emergency loads.

Automatic starting and changeover switches are not used. While



The diesel-driven 575-volt emergency generator can maintain minimum services in the event of main power failure.

such features are possible it was felt that they could not be justified, as only part of the possible load could be so controlled. Furthermore the station battery provides the absolutely essential light during the interval between power failure and emergency start up. The battery-operated lights are on automatic change over switch. This switch will automatically transfer from battery back to either normal or emergency a.c. as soon as either is available to keep battery drain to a minimum.

Transformer Stations—575-120/208 v.

The 575-120/208 v. transformer stations vary in k.v.a. rating but otherwise are standard in construction. A 575 v. breaker controls and protects the primary feeder (cable in conduit). A factory fabricated enclosed type of bus duct is used for secondary connection. This duct is fed into a 250 v. breaker, from which it goes directly to the riser. The air breakers are mounted in free-standing enclosed cubicle. All connections on secondary side are bus with the exception of the connection between the transformer terminals and the low voltage bus which are in cable. As these stations are located within the building, and often adjacent to quiet areas, particular care has been taken to secure quiet operation. The rooms are ventilated from the general system.

Lighting Fixtures

Both fluorescent and incandescent type fixtures have been used with fluorescent predominating. This extensive use of fluorescent was dictated by economy of operation particularly where hours of burning per day will be high.

Lamps are standardized at 40 w. — 48 in. size using two-lamp, rapid-start ballasts in practically all cases.

Numerous types of recessed fixtures are used most of which are standard items but in other cases special designs were made up to meet particular requirements.

All corridor fixtures are recessed, single, 40 w. fluorescent so made that on main floor corridors the light is continuous. In other corridors where lower levels of illumination are in order the same fixtures are used but in eight-foot sections only. This arrangement permits use of standard lamps and ballasts.

In main entrance and board room large luminous panels are used employing egg-crate type louvres or corrugated plastic, with standard 40 w. fluorescent lamps and accessories. These fixtures are arranged to harmonize with the architectural treatment.

Suspended fixtures are used in many areas where space did not permit concealing or where it was felt they would provide better working conditions; a direct-indirect type with proper shielding is used.

Night-lights are provided in all wards and in ward corridors. These are flush type recessed fixtures located about 18 in. above floor. They provide sufficient night illumination to move about but not of an amount or in location to be disturbing to sleep.

Operating room lighting fixtures are highly specialized units providing local intensities in the order of 1000 to 3000 foot candles. General illumination in operating rooms is from recessed type fluorescent.

Outside areas such as driveways and parking areas use ornamental street lighting standards, controlled by time switches with astronomic dials.

Outdoor signs indicating entrances, ambulance service, etc., are inside-lighted on standards similar to other outdoor lights.

The corridor fixtures, as previously mentioned, present an unusually even corridor illumination and have eliminated the spot effect characteristic of long spacing between fixtures and higher fixture output.

Operating Rooms—Special Conditions

Considerable research has been done concerning operating room safety as modern anaesthetic gases are explosive within certain concentrations. Two approaches have been made to the problem, one being to decrease the possibility of vapour concentrations and the other to eliminate the cause of ignition such as static discharge or accidental grounds.

To reduce concentration, ventilation is provided with a generally downward direction of flow. This direction assists the natural flow of the gases, which are heavier than air.

It should be noted that operating rooms have completely artificial conditions, there being no windows for light or ventilation. Air entering the operating room is cleaned, warmed or cooled depending upon the need, humidified

to keep down static, and discharged to outside after use so that no contamination of any kind be returned to the operating rooms or to any other area. As the point of gas escape is in the lower part of the room and using the down flow of air, it has been demonstrated that five feet above floor level is the upper limit of hazardous concentrations. Hence, all electrical equipment (switches, lamps, etc.) above the five-foot level is standard equipment; but all equipment below the five-foot level is classed as being in possibly hazardous area and hence is of the explosion-proof type. It is worth noting that an explosion-proof device is one in which explosion can occur but which will not permit flame, sparks or hot gases to escape that will ignite the surrounding air even though it too may be at a hazardous concentration. These explosion-proof devices are entirely different in construction to the vapour-proof type which are designed to keep vapour out. The vapour-tight fixture is not rated as safe in explosive atmospheres.

To reduce the hazard further the 110 v. system is isolated from ground. This is accomplished by using a two-winding one-to-one ratio transformer without a secondary ground. If a device (usually one using a receptacle as point of connection) did become "grounded" it could not acquire a potential to ground of sufficient wattage to ignite a combustible atmosphere. A second "ground," however, might complete the circuit, but warning lights are provided to show the first instance of the system being unbalanced to ground.

To accomplish this warning two resistances are permanently connected in series across the 110 v. lines with the centre point connected to ground through a sensitive relay. Balanced voltages to ground cause no current to flow in the relay coil. Unbalanced voltage to ground cause the relay to operate and show a red warning light. As a further check, when voltages to ground are balanced a green light shows. The warning lights are placed above the door and are placed beside similar lights which show that the air supply to the room is adequate. All lights are of the low voltage transformer-operated type for long life.

Floor construction in operating rooms also deserves comment. To prevent static build-up the floors are conductive but of high resistance. This condition permits static continually to drain off but the resistance is sufficiently high to prevent a current flow of sufficient wattage to cause ignition should conditions permit a charge to build up.

Certain fabrics, particularly synthetic, are capable of building up static and in order for the floor to perform its function it is necessary that all fabrics, clothing, shoes, sheets, etc., used in the hazardous area be of conductive material and have little if any susceptibility to generating static.

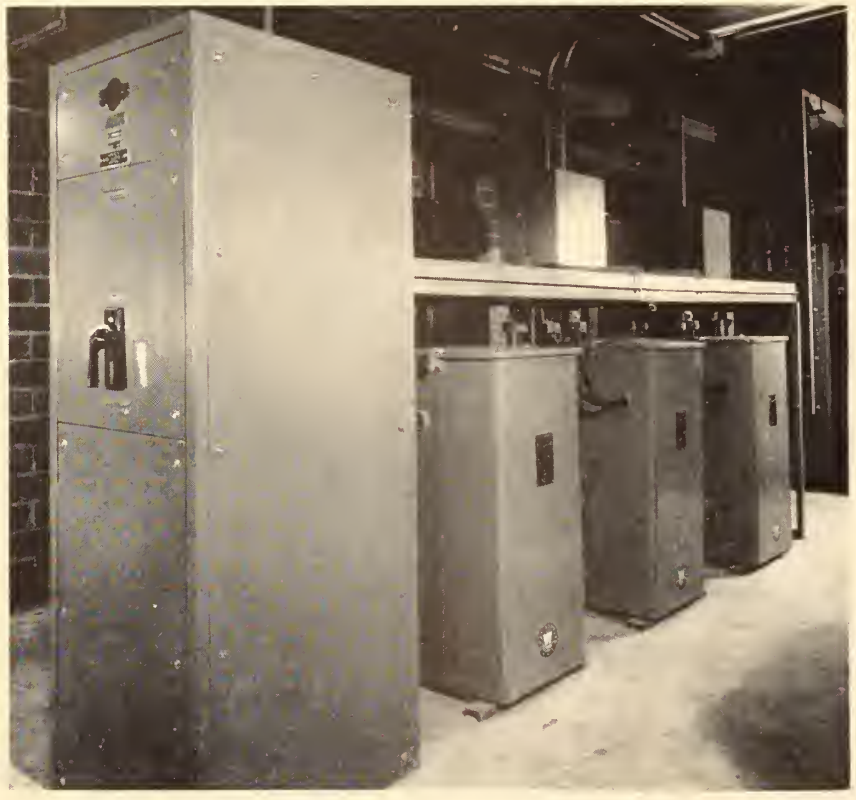
The vertical limit above which no hazard is considered to exist has been defined as five feet above floor. The horizontal limits, however, may extend some distance and hence the conductive flooring is extended outside the actual operating room into adjacent sterilizer room, corridor, and so on.

As there is always a sterilizing room adjacent to an operating room, these also come under the hazardous classification but the hazardous limits are not confined to the five foot level since ceiling exhaust is used for heat removal. The sterilizer rooms are therefore treated as hazardous even at ceiling level and all electrical equipment is explosion-proof.

The whole matter of hazards originating from the use of anaesthetic gases has been the subject of very extensive research, firstly in defining the extent of the hazard and secondly in providing means of coping with the hazard where it cannot be eliminated. Hospital equipment manufacturers have cooperated extensively in making their equipment conform to the requirements but the task is still not complete. Instruments such as cauterizers operate at a hazardous temperature, and may have to be used within the hazardous area. X-ray equipment, particularly of the portable type, may also come into the hazardous areas at times. Electric sterilizers are another item which in most cases cannot meet hazardous area requirements. The problem becomes most acute in areas where the use of an anaesthetic is only occasional.

These latter problems, however, can in most cases be eliminated by constant vigilance and proper administration for which there is no substitute.

A typical 575-120/208 volt transformer station, of which nine are installed in the hospital and adjoining residences.



Telephone Provision

In certain locations as between ward kitchens and main kitchens, between admitting office and records room where communication

is heavy along certain channels, private and separate communication systems are provided.

Doctors' paging, nurses' call, clinical paging, and others are also handled by separate systems as will be described later.

The balance of the communication requirements are handled by the Bell Telephone Company via a private dial exchange which permits intercommunication within the building and practically all outgoing calls to be made without use of operators. All incoming calls are handled via operators at the main board who direct the call to the proper destination.

Private wards have private phone service. Other wards are served by "telecarts" which are mobile pay stations taken from room to room at certain scheduled times. Ordinary pay stations are provided on most floors.

Telephones are provided in each room of internes' residence as they are subject to call at all hours.

In the nurses' home telephones are provided on all floors but not in individual rooms. The manner in which incoming calls to nurses' home are handled will be described later.

Radio System

A complete central radio receiving system is provided for use of all patients.

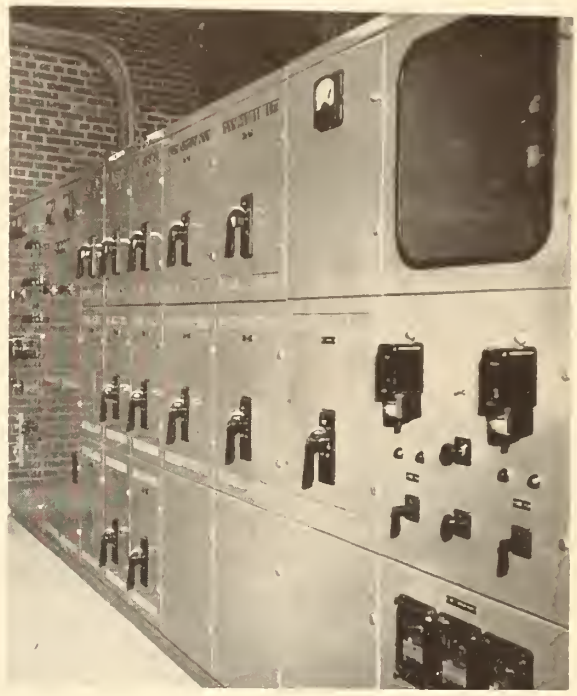
To provide a choice of programs and to prevent annoyances to other patients all speakers are of the pillow type.

The central receiver is a five-channel AM and FM receiver with outside antennae on roof. The receiver is of the commercial type, rack and cabinet mounted, installed in the penthouse. This receiver has tuners, amplifiers and monitoring equipment for all five channels. A time switch automatically turns the central receiver off and on according to the schedule prescribed by the administration.

From the central receiver all channels are wired to all beds and terminate in a flush, wall mounted selector switch with receptacle for speaker cord. The selector switch is operated by the patient by merely pulling the speaker cord. The switch has six positions corresponding to the five programs available and one off position.

The speakers are, as the name implies, placed under or on the pillow. They are circular in shape (about 3 in. diameter and ¾ in. thick) with rounded edges and are sturdily built. A ring is provided so that they may be hung on a hook provided on the selector switch plate when not in use.

To take care of special messages or events originating in the hospital a microphone is provided in the board room which can be connected to one of the channels thus making it possible to reach every patient via the radio system.



Main low-voltage switchboard showing 12 kv. control and metering panel, 575v. breaker panels, X-ray breaker panel, and (at far end) emergency generator panel.

Television Provision

Television provision is limited to instructional use only. At this time empty conduits are provided whereby either of two operating rooms may in the future be televised and transmitted via cable to the auditorium where a number of screens may be installed. While the actual equipment is not currently being installed a comment on the present stage of development is interesting. The television system will of necessity be coloured. Many problems are involved as the camera must be in a position to have unobstructed view and yet be under control of an operator for such factors as focus and area televised. It is undesirable to have floor-mounted cameras and operators in the operating room as they only add further equipment and personnel to an area already crowded. Consequently the current trend is to place the camera in the main lighting fixture and make it remotely controlled from an adjacent room where the camera operator is thus out of the sterile and congested area, has a view of the operation via a window between the rooms and also monitors his picture on a screen. In this way he not only observes the operation but also sees the picture as transmitted. From the above it can readily be seen that the equipment becomes very extensive if it is properly to perform its function.

Nurses' Call System

The nurses' call systems (there is a complete and separate system on each floor) are of the audible and visual signal plus voice-communication type in most cases.

At each bed in private wards and between each pair of beds in other wards is a "nurses' call" outlet. This outlet consists of a microphone speaker unit, a signal switch and two pilot lights, and a reset button with a pull cord to each bed.

To call a nurse the patient merely pulls the cord. Whether the cord is released or not the call is registered. The pulling of the cord lights a white pilot light at call outlet, lights a dome light over the door in the corridor of the ward where the call originated, sounds a chime in the ward kitchen, in the duty station and in the nurses' station lights up a number, corresponding to the room which originated the call, on a desk type annunciator. The nurse has merely to lift the hand-

set (similar to a telephone) and is then in voice communication with the patient. No manually operated switching is required for the two-way voice communication. At the same time the communication with the room is established the lighted number is extinguished, the corridor dome light and the white light at bedside are extinguished automatically. The white light at the bedside is, however, replaced by a green light the purpose of which will be later explained. Upon completion of the call and replacement of the handset the green light is extinguished.

When a number of calls are placed in short order each call is registered in same manner as above and there may hence be a number of calls to be answered. A selector device automatically transfers the set to the next number as soon as the previous call is completed.

A nurse in the corridor may answer a call by going directly to the patient and in such case the call is cancelled at the bedside by pressing the reset button.

While the voice communication feature enables the nurse to ascertain a patient's needs before going to the room the feature has another advantage. The annunciator at the nurses' station in addition to showing the room or rooms calling also has volume controls for both listening and talking circuits and switching keys whereby the automatic selector may be made to stop at any room whether or not a call has been made. By increasing the gain of the amplifier (increasing the sensitivity of the room microphone) it is possible for a nurse to audibly check every room for the slightest sound.

It is this checking feature which brought the green pilot light on the calling station into being. It is often times referred to as the "privacy" signal and its purpose is to indicate in the room that the room is being monitored. There are cases where confidential conversation may be involved and the green light then serves as an indication that the room is being monitored.

Calling facilities are also provided in bathrooms, toilets, etc., but in these cases the voice communication feature is omitted. In order to convey to the nurse that such a call originated where voice communication is not available the corridor dome light and the annunciator flash off and on indicating that the call must be answered at the ward and that it should receive priority over any other calls.

On certain floors, where two nurses' stations are normally in use, each operating independently, all nursing is handled from a single station during part of the night hours. To comply with this condition it is possible to transfer all calls from one station to another station so that the one operating station then has complete coverage. When the other station again comes into operation in the morning the systems revert to their normal scope.

Some modifications are made to the above systems in such departments as outpatients and psychiatry, but the modifications are deletions of certain features where they are not required.

One of the nurses' call stations on a patients' floor, equipped with audible and visual signal systems plus voice-communication.

Nurses' Home Call System

In the internes' residence each room has a telephone as internes may be on call at any time. In the nurses' residence such extensive provision of phones is not practical or necessary. Phone booths are provided on all floors for both incoming and outgoing calls. Incoming telephone calls are taken at the receptionist's desk and from this point all nurses' rooms can be signalled by a return call system.

The receptionist signals the room wanted by pressing two buttons, one being common to the floor and the second the room number. This pressing of the second button sounds a small chime and lights a signal lamp in the room. The corresponding number also light up on the receptionist's key board. To acknowledge the call the nurse presses a button in the room which extinguishes both the room pilot light and the receptionist pilot light thus indicating to the receptionist the call is acknowledged and the nurse will answer via one of the corridor phones. If the call is not acknowledged the pilot lights remain lighted indicating to the receptionist that no answer is forthcoming and hence a message should be left.

The system whereby two buttons must be pressed to complete a signal to a room does not have as complete flexibility as does the single button per room system. The equipment, however, only requires a fraction of the space of the other system and the wiring is correspondingly reduced without an undue loss of flexibility.

Fire Alarm System

A fire alarm system for a hospital has unusual requirements in that in case of fire the intelligence must be conveyed to all people concerned, but there is another and larger group, the patients, who are not in most cases in a position to help themselves and may suffer more from anxiety and strain under a general alarm than if they were completely unaware of the condition.

In a modern fire-proof building the probability of a major fire is extremely remote yet small fires may occur and it is mandatory that they be brought quickly under control with least possible disturbance (principally smoke) to other areas.

Many areas are under constant 24-hour occupancy and detection of fire is then very rapid. Other areas are only occupied a portion of the day and still others (e.g., storages and shops) may have only very intermittent occupancy. To take care of the constantly occupied area manual stations (boxes) are provided. To take care of other areas automatic stations are provided.

The nurses' home and the internes' residence are also tied into the common system.

The system operates from the central battery and is of the pre-signal type which came into being specifically for hospital use. It is of the closed-circuit self-supervised type. A break in any circuit automatically sets off a signal in the boiler room indicating that the system is out of order.

Operation

The operation of the system is as follows:

The "pulling" of any box manually or the operation of any automatic station sends out a coded signal which is repeated four times. The code consists of three digits such as 3-2-4. The first digit identifies the building concerned, i.e. nurses' home, internes' residence, Pine Avenue section or Cedar Avenue section of main hospital. The second two digits designate the floor. The signal then not only conveys the information of a fire but also locates the building and the floor on which the signal originated. All floors on the same level of all buildings have the same two digits as final part of the code.

The signal thus transmitted is sounded in certain restricted locations only, being those in which personnel have definite assigned duties to perform in cases of fire. This restricted signal is known as pre-signal.

If a signal originated in the hospital proper the internes' residence and nurses' home alarms are not sounded. If it originated in internes' residence only limited portion of the hospital would receive the signal although all of the internes' residence would be alarmed. Similarly a call originating in the nurses' home is limited in its outside extent.

The pre-signal, or first alarm, is thus limited in its scope to those who are immediately concerned. Others are unaware of the signal.

The doctors' in-and-out board in the telephone switchboard room has hinged side-panels for use by a single operator. Corresponding signal boards are situated at each of the two main entrances.

If, however, the situation is not of minor nature and additional help is required the system has a general alarm feature. Keys are provided to personnel directly concerned with fire fighting. These keys can be inserted into the box and the alarm again sounded. With the key in place additional alarms are sounded to call additional help. For example any general alarm will sound in the internes' residence and nurses' home thus bringing additional personnel into action.

The system is entirely local, no connection with the City of Montreal system being permitted.

A tape-recorder is provided in the telephone switchboard room which records all signals by punching holes in a moving tape. An automatic time and date stamp also operates to complete the record.

In each building, manual boxes are located in same position on each floor so that personnel are familiar with their location. They are of the break-glass type.

The automatic boxes are actuated by heat detectors which operate not only on maximum temperature but also on rate of rise principle. They are thus also sensitive to sudden rise in temperature although the temperature may still be below the maximum temperature setting. This feature permits much more rapid detection than fixed temperature only.

Most of the audible signals are chimes rather than gongs. The reason is that in confined areas the chime is adequate and the signal is not thus audible to other areas. This is particularly the case in nurses' stations where the signal is not audible to patients.

Although the codes are easily memorized due to their sequence and standardization framed codes are provided at stations as permanent listings, so that any code may easily be verified.

Doctors' In-and-Out System

With some 300 doctors, internes, etc., in the hospital at one time or another it is necessary to provide a system of showing whether each particular person is in the building or not. This is accomplished by a "board system" consisting of three boards each of which has all names listed alphabetically and beside each name a small toggle switch.

Upon entering the hospital, either at Pine Avenue or Cedar Avenue, the doctor operates the switch opposite his name. This causes his name to be illuminated at all three boards. Similarly on leaving the hospital he operates the switch opposite his name (at same board where he entered or at other entrance) and the illumination is extinguished.

The third board is located in the telephone switchboard room for information of telephone switchboard operators. On this board the switches opposite each name perform an entirely different function. If a call is received and left for a doctor who is not in, the operator turns the switch opposite the name. At this time no circuits are completed to light the name but

when the Pine Avenue (or Cedar Avenue) board has its switch operated by the incoming doctor his name not only illuminates but flashes indicating a call is awaiting him at the information board. The telephone system is then used to contact the information board, the flashing is eliminated and the illumination becomes continuous indicating only that the doctor is in the building.

The flashing feature can also be used when the paging system fails to locate a doctor who is in the building. The flashing name is obvious when he goes to the board to register out.

Doctors' Paging System

Closely associated with the doctors in-and-out board is the paging system used to locate doctors and internes who have no fixed point of contact or who are away from their normal location.

Three types of system are available for this purpose each with its own merits, advantages and limitations. The most commonly used system of flashing codes in corridors would not meet the requirements of this hospital due to large number of doctors and the complexity of numbers required.

A very recent development to serve this purpose is the miniature pocket type radio receiver for each doctor. Each receiver is tuned to a different frequency and by selecting the proper frequency and sending out a radio signal any receiver, and that one only, can be made to respond to the signal. The response consists of turning on a small buzzer in the receiver which notifies the wearer of the call. While the system has much to recommend itself experience has not yet demonstrated its reliability to the point where it could be recommended.

The third system, while not perfect, was finally adopted as best fulfilling the requirements. It is the audible paging system and its principal objection is that it may become annoying, particularly to patients. To keep this objection within limits the size and location of speakers have been carefully selected.

The system operates in conjunction with the doctors' in-and-out board so that only those people known to be in the building are paged. The flashing feature of the in-and-out board takes care of the messages for incoming doctors and serves as a second line of contact for doctors in the building who have not been reached via the paging system.

The P.A. system used for paging has a microphone on the information desk which is mounted in front of the in-and-out board at the telephone switchboard. Form sheets are used by the information and paging operators showing person called, time called, message and finally time message was delivered.

The amplifier for the system has, in view of the operator, a volume meter and volume control so that the operator can at all times adjust the volume to predetermined level according to time of day, and other conditions.

A Problem of Growth and Industrial Expansion

Water Pollution

by

A. E. Berry, M.E.I.C.

Director, Sanitary Engineering Division, Ontario Department of Health.

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Growth of population and industry, and a net reduction in water resources, are seen to be major factors in water-pollution problems in Canada. Action for future remedial work is essential, but must be properly co-ordinated in the face of public apathy and, even, opposition.

Water pollution has become a world-wide problem. Its recognition as such evokes the question as to what are the major factors responsible for it. Several are to be found. They are the associates or products of population growth and industrial expansion. They have been especially conspicuous on this continent in recent years. In that same period much has been accomplished in pollution abatement, but the problem is of such magnitude and so variable in its nature that its conquest is not immediately in sight. It will require the best efforts of engineers, administrative officials, and the general public.

It is well at the outset to have a clear conception of what constitutes pollution of water. The layman is inclined to have a different interpretation from that of the sanitary engineer or professional student of this problem. Thus, complaints are frequently voiced about conditions which are of little significance except probably that of appearance. On the other hand the person who must deal with stream sanitation is confronted with many conditions which alter the quality of the water. These are continually changing and they offer a challenge to his skill.

Pollution and contamination in technical terminology refer to those conditions in water which result from the introduction of pathogenic organisms, toxic materials, or any other substances which depreciate the natural quality of the water to such extent that its usefulness is impaired or it becomes offensive to the senses. This embraces both quantity and composition of pollutants.

Likewise it is related to the normal use being made of the water. In the modern conception water is expected to serve many purposes, the highest of which is drinking and general culinary use. Others include industrial requirements, recreation, agriculture, dilution of sanitary wastes, power, and navigation. In each of these the degree of pollution which can be tolerated before the water becomes unfit will vary greatly.

Whereas the origin of pollution may be manifold, chief concern is associated with municipal sewage and industrial wastes. These result from the concentration of population in urban centres and from the waste waters of modern manufacturing processes. Both have changed greatly in Canada in recent years.

Although domestic sewage is reasonably uniform in its composition, the problem of dealing with it becomes one of concentration both in respect to population and in the mixture in the receiving stream. Industrial wastes, on the contrary are not only widely variable but they are constantly changing. They produce a broad range of effects on the receiving stream.

In general it may be said that pollution of water has taken place when the stream receives any substance which materially interferes with the normal uses for that water. It is well to note that there must be substantial interference. Practically all surface waters in inhabited areas carry some pollution, but this causes no insurmountable problem. If this were prohibited urban communities and industries could no longer exist.

Stream standards for sanitation are not easy to define in rigid terms to suit all conditions. General standards have been prepared by a number of administrative agencies. In some cases these are designated as objectives rather than precise standards. This is what has been done by the International Joint Commission for boundary waters quality control and by the Pollution Control Board in Ontario for all streams in the Province.

In some jurisdictions the streams have been graded according to best usage of the water therein. This recognizes a higher degree of pollution in some places than in others.

Today's problem in water pollution is difficult to measure. It is related to many factors, some of which are changing rapidly. The degree of treatment of the waste will be governed by the size of the stream and the uses to which it is applied.

The extent of the problem is most frequently expressed as the number of treatment works needed and the estimated cost of these. This expression recognizes only the present population and conditions as they now exist. It should include the expansion during the period required for this program to be completed as well as the continuing problem of urban growth and industrial expansion.

In the United States, figures on the water pollution problem indicate the need for about 4,200 new municipal sewage treatment works, as well as 2,300 replacements or enlargements. They also record the need for nearly 2,800 industrial waste treatment plants and nearly 700 replacements or enlargements. These are large programs of high capital cost.

In Canada no comparable figures are available for all provinces, but in Ontario it is estimated that new sewage treatment works and trunk sewers will cost $61 millions, while alterations to existing plants

will cost $34 m. If to this is added an estimated cost of $18 m. for treatment works in those municipalities likely to install sewers shortly it brings the total for trunk lines and treatment to $113,000,000. This is exclusive of the cost of separate industrial waste treatment works.

On the boundary waters between Ontario and the States of Michigan and New York the cost of pollution remedial works has been estimated by the International Joint Commission to be between $125 and $150 millions. This is for both sides of the border and includes municipal and industrial waste waters.

These figures reveal a large program of necessary works, much of which is concentrated in the areas densely populated and containing many industrial plants. The problem will continue as these favored areas grow.

Causative Factors

An analysis of the extent of today's problem invites some explanation as to the reason for this. Why have these wastes been allowed to enter water courses without first receiving adequate treatment? It is desirable to understand these factors in order to appreciate the present difficulties in remedial measures. Some of the factors at work in the past are as potent today as ever.

In the early days when communities were being settled they built for the most part along major water courses. Dilution of the sewage was generally adequate to meet the needs. Complex industrial wastes did not exist.

This situation changed as municipalities grew and developments expanded inland. Dilution no longer was sufficient to avoid offensive conditions or to prevent disease. At the same time the knowledge of waste water treatment had not developed greatly, and only simple methods such as septic tanks and sewage farming were in vogue.

The major factor, however, that works against pollution control both in the early days and still continuing has been the lack of public support for the expenditures necessary to install and operate sewage works.

If sewers are available to carry the sewage from the premises, the householder is little concerned about the pollution of a stream with which he has little contact. The ratepayer is asked to finance many municipal projects which are more tangible to him in their effects on his mode of life. Thus he is inclined to put off and to delay financing these outfall sewers and sewage treatment plants.

That is the major obstacle. The science of sewage treatment has advanced to a high point. Industrial waste treatment strives to keep up with the many changes in these wastes although the problem there is a more difficult one. Technical progress has been very gratifying.

Methods of Treatment

Some observations on the present status of treatment processes are pertinent to the pollution problem. Are these methods adequate to meet the needs or are further developments essential to success?

The objectives in treatment must be adequate purification to protect the water course and economy in construction and operation. Advances have been made in both directions.

Sewage treatment still utilizes basic principles which were recognized many years ago. The progress is most apparent in the modification of these measures to secure greater efficiency and economy. Thus, the removal of solids by sedimentation continues to occupy a prominent place in present-day practice. Biological processes remain the chief weapon against substances requiring oxidation to bring stability in the effluent. Chlorination completes the programme where disinfection is desirable.

All of these measures in some form were used many years ago. Marked progress has been made through mechanization of the plants. Here, the contribution of engineering skill has attained important results.

The degree and kind of treatment for sewage are problems of local environment, and it is necessary to adopt those measures which will be adequate, but at the same time incur no unnecessary financial burden on the ratepayers.

Primary treatment based on sedimentation to remove about 60 per cent suspended solids and 35 per cent biochemical oxygen demand is still the major process in this country. It can be successful only where there is adequate dilution and the receiving water is not used for domestic purposes or swimming.

Secondary treatment by biological methods is confined in Canada almost entirely to trickling filters and the activated sludge process. These can be expected to remove 85 to 95 per cent of the suspended solids and B.O.D. The effluent can be discharged to small water courses or in unfavourable localities. Disinfection reduces the bacterial content of the effluent and tends to stabilize the liquid further until natural purification can carry the load.

Statistics on Canadian sewage works reveal the following information. The total number of municipal treatment plants is 520, of which 309 are primary treatment. There are 92 activated sludge plants and 63 trickling filter plants. Sewered municipalities in Canada total 845 to serve 55 per cent of the entire population. This figure may be compared with nearly 1,600 municipal water works systems serving 65 per cent of the population.

Thus it may be seen statistically that there is still a major problem to build sewers and treatment works for our growing communities.

Industrial Wastes

Industrial wastes offer a completely different situation. These waste waters do not follow the same uniform composition as domestic sewage, but they vary as would be expected with each type of industry.

Their effects on the receiving stream are numerous. Organic wastes from industry have a deoxygenating effect on the stream. These can be treated in much the same way as sewage. Oil wastes present two main problems, one of the oil itself and the other the phenols which produce offensive tastes and odours in water. Chemical wastes are frequently toxic, and they may have pronounced effects on the water and on fish life.

There is no single measure for dealing with these many kinds of wastes, and new problems arise as new industrial processes continue to come to the fore.

An administrative problem confronting municipalities as well as industries involves a decision as to whether industrial wastes

should be accepted into the public sewers or be treated separately at each plant.

A large portion of the industrial wastes in Canada reaches the municipal sewers. In large industries, where major volumes of waste are involved, separate treatment at the expense of the industry is the usual practice.

There is an advantage in having a joint treatment plant for sewage and other wastes providing the volume of industrial waste is not too great in proportion to the sewage, or if no abnormal treatment of the waste is involved.

Pollution Abatement Agencies

It can thus be seen that in spite of much progress there is still a great problem of dealing with municipal sewage and industrial wastes. Technological advances in sewage treatment have made steady progress. There are more pressing problems now in industrial wastes, and it is evident that research and study will be desirable if the best and most speedy results are to be secured.

A number of agencies, governmental and others, are at work in pollution abatement. They include such government departments as Health; Lands and Forests (Fish and Wild Life); Agriculture; Planning and Development; Mines; Municipal Affairs, and others. Each has some specific relationship with this problem. Municipal governments including councils and boards of health have been active participants in the program.

The International Joint Commission between Canada and the United States has been involved for a number of years in the investigation and control of pollution in the boundary waters. Much has been accomplished by this agency.

In Ontario a Pollution Control Board has operated since 1952. Its members comprise representatives from those Departments of Government involved most directly with pollution. In this way there is concerted action against all forms of pollution irrespective of the effect it will have on the stream.

Similar bodies function in a number of States, and this is a recognition of the importance of the problem and the need for joint action to control it.

Any solution to the problem of water pollution in this country is related to a number of factors, some of which are difficult to control but others of which should be recognized if success is to be attained. Some of these are discussed below.

Some Problems in Pollution Control

(1) *Public Attitude.* — Among these factors one of the most important is the public attitude toward the necessity for treatment of wastes. The ratepayer has not been convinced that these projects should be placed on the same priority basis as such other measures as water works, schools, hospitals, paving, and like municipal works he can see often and can appreciate. Educational campaigns are needed to convince him that stream pollution justifies action and expenditure on his part. Important work has been done by a number of voluntary agencies, and there is now an indication that continued emphasis on the problem will bring results.

(2) *Cost.* — The cost of trunk sewers and treatment works is substantial. These have risen greatly in the post-war period, but they are no different from most other projects. Increasing attention will be needed to reduce the cost of treatment plants to a minimum.

(3) *Legislation.*—Comprehensive legislation to deal with pollution is important but not all-significant. There is a feeling on the part of some that all which is required is prohibitory legislation rigidly enforced. Unfortunately the problem is much more complex. The reason for delay on the part of municipalities is not generally one of inadequate legislation.

(4) *Methods of Financing.* — These are often as important as the total cost of the project. All too frequently such works are just one more item to be paid out of general taxation on the basis of assessment. Few people find satisfaction in paying taxes. If, however, the cost of the treatment works is paid as a service charge in the form of a sewer rental or sewage rate it is much more acceptable. The trend to this method of financing is pronounced all over this continent. The charge can be added to the water bill and be collected a number of times a year.

The actual cost of sewage treatment is not so great as many people believe. Present costs in Ontario financed over a period of 20 years at current rates of interest amount to about 25 to 35 cents per week per family. This also includes the cost of operation. If it were possible, as it is in the United States, to issue tax-free revenue bonds the cost would be reduced that much more.

(5) *Research.*—Active research and investigation into treatment processes, particularly for industrial wastes can be productive of real advantages. To do this, research facilities are needed and again more expenditures must follow. This can be done mostly by Governments and by industry.

(6) *Increased Treatment.*—The need for higher degrees of treatment is apparent when it is realized that our population is increasing, that our inland streams are decreasing in volume, and the problem is thus more complicated. There is a trend in most places today to provide higher degrees of treatment and thereby to ensure greater protection for the future.

(7) *Population Growth.* — The rapid growth in Canada is continuing, and with concentration of this in urban centres it may be expected that this problem is not one for solution today alone. It will require constant supervision.

(8) *Water Resources.* — The water resources in parts of Canada are shrinking. It is thus all the more important to preserve these as much as possible by keeping them free from excessive pollution.

(9) *Joint Administration.*—Sewage treatment should be considered on an area basis rather than being limited to municipal boundaries. Where feasible, attempts should be made to have two or more municipalities combine the sewage flows into one plant, jointly owned and administered or operated under some mutually satisfactory plan.

Conclusions

Some of the problems, and some of the related factors in water pollution have been outlined. The whole situation is a complex one involving large expenditures. There is need for support from all public-spirited groups in an effort to bring home to ratepayers a true picture of what is involved in the maintenance of our waterways in a clean condition. Municipalities and industry must co-operate in meeting this challenge. If the effort can be made successful the results will fully justify all the cost and energy put into it.

The Engineer and Industrial Management

by

C. R. Armstrong,

Assistant Vice-President, Employee Relations, The Bell Telephone Company of Canada, Limited, Montreal, Que.

When asked to take on this assignment, it seemed like a good idea. There are few, if any, subjects of greater importance to the future of our industrial life. It has many ramifications and points of view. I hoped that the preparation would at least help to clear my own thinking.

As I got further into considering the various factors and looking into some of what others have had to say, I began to grow more uncomfortable. I found myself in the middle of controversy, some of it heated. Some of the thinking seemed to reveal strong bias, a decided element of self-interest. There were some concepts of a traditional flavour supporting conservative conclusions. There was, of course, as always, resistance to change. On the other hand, there was pressure for a forward look into an imagined future. We have not arrived at agreement.

It seemed to me the best hope for working through the many ramifications would be to go back to fundamentals. The past could be looked at for lessons from experience, not for flag-waving traditions. The possible effect of proposed measures on individual lives could be considered coupled with a viewpoint which would include the total economy or the total society. The breadth of view could go beyond possible special privileges or prerogatives for a favoured class, no matter how worthy that class may have proved itself to be. In looking into the future, wild flights of fancy could be discounted and reasonable efforts made to keep our feet on the ground.

This paper has, then, taken on a trend not anticipated at the outset. A list of suggestions for consideration on separate phases seemed to be unrelated to a coherent whole and largely meaningless. It seemed to me, as I gave it further thought, necessary to begin at the beginning. This opened up such questions as objectives and purposes, economic and social values, possible strains between groups where objectives seemed to be opposed, and the whole question of contributions to the future social welfare.

If, at times, the discussion grows somewhat abstract, even philosophical or moral, my apology is simply that I couldn't help it. There is no intent to be positive or conclusive. My highest ambition, at this stage, is to be stimulating even where that may be provocative.

The subject itself introduces relationships. The Engineer and Industrial Management. With our sensitivity to group consciousness, the subject, as stated, implies possible areas of conflict. Where the subject has been raised, it has almost invariably been considered from the standpoint of the responsibility of one group to the other. Only too rarely has it seemed to stimulate thought of mutual and complementary service. It has certainly suggested division. Perhaps all this could be looked at dispassionately with profit.

Industrial Management

Since the beginning of the century the economy has passed through a gradual and largely unnoticed revolution of the greatest significance. Control of production has passed from the ownership group to a new element in our society, professional management. Formerly the owners controlled all the activities of, and directly bossed, the enterprise. Today, owners are those who chose to invest their savings in risk capital with hope of high returns in preference to debt capital with its greater security and lower general return. Their association with the enterprise usually ends with receipt of the stock certificate. Occasionally they sign proxy forms for voting, as requested.

All controls, planning, directing and bossing have been handed over to management. In many instances, by force of knowledge and numbers, management takes a dominant place on the board of directors. Objectives, purposes and policy are set by management.

The predominant cause has been the gradual growth of large industrial entities to a dominant place in the productive phases of the economy. In addition, because of the size of the enterprises they control, industrial management has achieved an influential place in finance.

Even newspapers have recognized the change. One no longer sees headings about disputes between labour and capital. Bargaining is a process involving unions and management.

What are some implications from this for the present discussion? One-half of our discussion is about industrial management. This is a relatively new group in our scheme of things who achieve their place not by inherited position, not by personal wealth, not through political influence, but by selection and appointment, presumably on the basis of proven merit and worthiness to assume large responsibility. To them has passed, through a gradual revolution, almost full power over the productive and service phases of the economy.

There is no intent to disparage the influence of banking and finance on our economy. It has its place, perhaps largely manipulative, in determining the state of our prosperity and its soundness. But to industrial management has passed the control over what and how much shall be available for our standard of living. They, along with the trade unions, determine the distribution of the wealth which arises through the production of goods and services. That is, the wealth that is left after taxes. They are acquiring more and more control over the trend and speed of applied scientific progress. Some of the largest research laboratories are now an integrated part of industrial operations. National defence is perhaps as much dependent upon management

The present-day concepts and practice of industrial management, the position of the engineer in industry, and his relationship with management are presented by the author so as to promote thought on the subjects involved. The point is made that the practice of human relations in industry is something that applies to all employees at all levels.

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application of industrial know-how as upon military skill and organization.

The only visible attack, so far, upon this growing power of industrial management comes from the socialists, and their more or less distant relations, the communists. They have introduced some of the elements of the old-fashioned battle for power. Theirs is, in essence, a suggestion that the growing power of appointed management be transferred by law to professional politicians.

One of the peculiarities of this revolution involving the transference of much influence and power, is lack of evidence that management people, as a class, ever sought it. Be that as it may, realism requires that we recognize the facts and their significances.

With growing power goes increasing responsibility.

The old-time owner-boss manipulated his enterprise within the pressures of a highly-competitive economy to draw off the highest possible profit for himself, his family and his few associates. His objectives were clear, simple and immediate.

The professional management of a large enterprise must also make a profit. This is a basic principle of business in any form of economy. Without earned profits, the investing public will lose confidence and refuse to supply the funds necessary for replacement, growth and progress.

It is, however, more than doubtful that the sole objective can be to drain off the highest possible immediate profit to distribute among the hordes of anonymous stockholders. In comparison with the shop of the old-time owner, a modern industrial enterprise looks like an empire. It must be directed to be held together and its future assured. This can be done only through inspiring confidence; confidence of the investor, confidence of the purchasing public, and sufficient confidence of the working force to retain them and attract others.

In setting policy and in controlling the practices and procedures to implement policy, the industrial manager can never lose sight of this three-fold set of responsibilities. He is more than a money-maker, he is a responsible official of an industrial empire that must serve now and be structured to survive and serve in the future. If he serves a useful purpose as recognized by the investor, the public and a large segment of the working force, I think we can agree his power is being used in a large way for the common good. Possibly the severest test on his judgment is in striking a proper balance between these three.

One more factor arising out of the growth of individual enterprises and the ascendancy of professional management warrants mention for the purposes of this discussion. For convenience, management is often referred to in the singular. We have fallen into this in this discussion.

This practice could lead to an erroneous impression. The management hierarchy requires a head, usually designated president. He has full responsibility for all operations from the formation of broad policy to the simplest function. His method, however, is by delegation. He splits his responsibilities into segments, usually by function, and delegates to others each a share. They, in turn, delegate, and the process is continued all the way to include all those whose place in the organization calls for the exercise of management judgment.

This type of integrated structure does not allow for the effective use of the two or multi-party system. Objectives and purposes are set on a company basis and each recipient of management-delegated authority is called upon to play his part toward the accomplishment of those objective. If he fails to work to this purpose, he has no right in honesty to be there. The principle of industrial organization is built around the concept of the well-knit team all pulling together for the common weal.

This unity of purpose must apply to all management. Perhaps it would be healthier if it could apply to all industrial personnel. However, that objective is beyond hope of achievement in the forseeable future. Unions have drawn a sharp line between management and labour. The only sensible position is to accept this as inevitable and make the best of the situation. The dividing line has had many definitions. One that may serve our purpose here is: anyone whose duties require planning, directing or controlling any of the firm's activities toward the main objective or a subordinate objective within the whole, occupies a management position, he is on the team; anyone whose duty it is to perform a specified function under direction and control can properly belong to labour.

Position of the Engineer

A moot question is this. As the engineer moves into industry, where does he fit? Does he belong to management, to labour or do he and his associates constitute a third and distinct group? Are the objectives different from those of management?

To avoid the possibility of misunderstanding, I will confess here to a personal bias. Prompted by a sincere desire for the effectiveness of industrial organization, I am opposed to the introduction of a third group. Distinct groups within the whole inevitably lead to conflict. Preoccupation with prestige, prerogatives and special privileges draw off energy that would otherwise be directed toward the accomplishment of the main industrial purpose. Artificial restrictions on assigned duties, a natural consequence, puts up an artificial barrier to the sensible carrying through of necessary functions. It can, if not controlled by high purpose, lead to something similar to feather-bedding, one of the most vicious practices and a deterrent to industrial progress. We have all seen examples of how splinter groups can put a practical stop to accomplishment.

The engineer comes to industry with unique equipment. He has acquired a scientific knowledge and training in methods of applying this to practical problems. He brings the result of four years of strict mental discipline in analysis and interpretation, particularly in the field of physical things. His degree, as the symbol of a hard job at least passably done, is the basis for self-confidence and cour-

age to tackle problems for a solution. He has acquired greater powers of insight than would have been the case had the time been spent in a routine production occupation.

It is beyond the scope of this discussion to enter the controversy about the adequacy or suitability of university engineering courses as presently constituted. I would just like to quote one paragraph from the report of a survey made among some leading employers of graduate engineering personnel made under the auspices of The American Society for Engineering Education.

> "These representatives of industry were unwilling to sacrifice courses in engineering science to provide time for the study of technology or administration at the pre-baccalaureate level since they believe that these can be obtained under company sponsorship whenever needed."

Experienced management in this instance were unwilling to sacrifice any of the scientifically oriented curricula in the time available for the training and development of the engineer. Among the industries represented, less than 25 per cent of the engineering personnel were employed in the highly-technical fields of research, development and design. The scientific engineering training prepares the individual for a variety of phases of industrial operations.

At the beginning the engineer is assigned to specific duties under direction and control. He doesn't yet even know the objectives of the business. He has, however, not been engaged to operate on that plane. He soon passes on to phases of planning calling for the application of judgment beyond that of skill. On the basis of his judgement money will be spent. He is operating from then on in the area of planning and directing affairs toward the accomplishment of the main industrial objective. He is contributing, with increasing scope, to a balanced management direction of the business. By logic, status and a commonsense understanding of the purpose he serves, he belongs with management. In our company, all those performing engineering functions are classed as management.

Professional Status

This brings us, somewhat by the back-door entrance, to that highly controversial subject of professional status for engineers within industry. There are both pros and cons to the argument, otherwise there would be no problem calling for judgment decision. As far as we have gone so far is to try to establish that engineers are properly classed as management and that the industrial process would suffer through the establishment of a group within the main group. Is that sacrifice justified in the interests of the engineers themselves?

Lawyers, doctors and clergy have had professional status protected by law for many years. Perhaps we could omit the clergy from this discussion. For doctors and lawyers this has served two purposes. It has saved for them the exclusive right to function in their well-defined fields, and gain the rewards for these services. It has also protected the public from unprepared practitioners who would, but for this protection, collect financial rewards for alleged services they are incompetent to perform. Allowing such people to practice would be dangerous to the public.

For consulting engineers, those offering a specialized service to an unknowledgeable public, there seems to be well-founded reasons for similar protection by law, where it does not now effectively exist. Such protection would be intended for both the professional engineer and the public. But this is not the problem before us here.

There are areas where sound management would be to engage consulting engineering services from outside. The most ready example might be architectural design. But most graduates of engineering faculties enter industry to contribute to design and operational planning on the main function of the industry. They have in a way become the problem children.

Normally each industry finds it essential to retain most of its research and all of its design and planning within its own direct control. It, therefore, requires the exclusive services of the engineer. It is ready and able to judge for itself the quality and suitability of the engineered product. The protective phase for the purchaser does not enter. In matter of fact, the whole future of the industry is wrapped around the progressiveness and skill of its research, design and planning. They stand at the heart of the management direction of the enterprise. It must, obviously, remain an integral part of the whole scheme of management direction and control.

The application of strict engineering professionalism within an industry would make it necessary to set up rigid definitions of the content of engineering functions. Others would be barred from these activities, not on the basis of lack of competence, but because of inability to acquire professional status. A natural, and I think eventual necessary correlate, would be a mutual exclusiveness. The professional would be barred from, and would decline duties outside, his prescribed sphere. He would be somebody working inside but set apart to work on given assignments relating solely to research, design and technical planning. That would be the professional consultant working from within.

We have already argued that this would be highly artificial and would throw a monkey-wrench into the smoothness of industrial operations. In the end it would be a deterrent to progress.

Collectivism and Individualism

It has been argued that having this separated well-defined group would increase the independence of the professional in gaining economic rewards for the types of services rendered. That seems to have been the chief appeal. Where this has and is being tried, it has taken on the form of group pressure for group economic standing. It could not do anything else. I would like to try to make the point that this is not professionalism at all, but collectivism. It takes a form hardly distinguishable from trade union bargaining.

That brings us to what seems to me to be an untenable logical inconsistency. The professional status, outside the legal regulations, is one of extreme individualism. Once the doctor or lawyer or consulting engineer establishes his legal competence to practise, his economic position is regulated by public acceptance. It comes to him after recognition of his personal skill and reliability within the profession. He is free to accept or reject requests for his services. The public is equally free to accept or reject him. It does, with the resultant widest possible spread between rewards to individuals.

Economic rewards are directly related to recognition of merit.

Collectivism or bargaining has always worked in the opposite direction. Economic return, the rate of pay and fringe benefits, is set by the group for the whole group. No provision is made for unusual returns, for unusual contributions or recognition. It is economic security for the mediocre for which the outstanding are called upon to pay the price. This has been accepted by labour. I will leave it for you to judge who would stand to gain most from a collective bargaining position for management engineers. The point is, do not let us get professionalism mixed up in our thinking with union bargaining. No clear pattern can emerge from such a confusion of historical background and objectives and purposes.

The situation into which we seemed to be drifting a few years ago and which has not quite dissipated seems to me to be wholly incongruous. We were to have engineering people on the one hand making management decisions, calling for balanced judgment and on the other uniting to face other management across the bargaining table to compel management decisions solely in their favour. How could any degree of sincerity or honesty of purpose prevail in the face of such contradictions? It is also incongruous to picture independent, educated professional people maintaining the solidarity necessary to make the practice effective in even its narrowest implications. Recent experience tends to show units built up on such principles and with such purposes will fall apart in practice.

Economic Position

Suppose, then, we assume you have come along with me thus far. That is something experience gives me plenty of cause to doubt. We have eliminated both collective bargaining and restrictive professionalism from the engineering situation within industry. Where does the graduate engineer or his recognized equivalent fit into the industrial picture.

First, and of least importance, his initial salary will be at least equal to that of the first level of management. That has been confirmed by recent experience recruiting graduates on the campus. This level has been acquired through the laws of supply and demand, still not too bad a method of establishing equity between rewards and worth.

Economic sense requires that he be assigned to industrial functions that will speedily be equivalent to those of the first level of management. On the average his four years of training have gained for him an economic position somewhat better than he would have gained through equivalent time spent on an earning occupation. He is better equipped by knowledge and by the mental discipline to which he has been subjected. He is, then, a better man starting somewhat higher up the ladder. He has gained in position and potential through the qualifications he has acquired.

Special Attention

If for no other reason than he is expensive, he will be given special attention. Usually he is processed through an induction program and in his early years passed through several types of experience. All the time he is being watched and reported on. This will automatically continue as long as he demonstrates ability and shows some zest in application. If neither of these is exhibited interest will probably wane. I submit that if he were out in the cold professional world public apathy would also be effectively apparent.

From now on many things will influence the course. If he shows keen interest in and adaptability for engineering research he may be chosen for development work in that highly technical phase. With the rapid growth of industrial laboratories and as automation proves its economic values more clearly, more will find application for their natural bent in this and related fields. I think we have here an unresolved economic problem.

So far as I know, no acceptable formula has been worked out to relate the value of the management researcher to some equivalent in the control management group. I have a feeling this may have influenced some of the restlessness that has been apparent.

Obviously the president of a concern will be chosen from among those who have been controlling and directing rather than researching. Because of his eminence, he is the highest paid. The depth of the hierarchy, each level having a differential above the one below, pushes the top levels up. It is a little hard to conceive of a similar hierarchy with similar results in the research and technical fields. With the high degree of specialization coming, it is doubtful that the laws of supply and demand will bring a satisfactory answer.

There are many evidences of honest attempts to find a solution. Recently one very large industry announced it was working on a plan whereby the technical expert could be paid more than his organizational director or boss. Where his special qualifications were such that a loss would be incurred through advancing him to a higher position of broader application for which he might qualify, special provision would be made for adequate pay compensation. Perhaps something along this line of appraisal will eventually solve the problem.

To reiterate my former position, I would suggest an equitable solution for finding a basis for individual rewards in special cases will most likely evolve through calm, earnest, honest, sincere management deliberations. I would not like to hand this problem over, for collective pressure or unilateral professional decisions, on the relative worth of defined types of specialized activities of a high order.

In the meantime, my suggestion to the researcher is to research. The situation is not at all hopelessly bad, and the high job interest and satisfaction more than compensate for any other real or imagined deficiencies.

Operational Engineering

Others in large numbers will start and continue in operational engineering. In the public utility field this comprises the bulk of the engineering effort. Because of the numbers and the breadth of application, there is usually quite a hierarchy up to the chief engineer. The normal processes of selection and promotion will provide opportunity for status and pay recognition and increasingly interesting occupation for those who, by experience, effort and ability, justify such advancement. For the others there will be engineering assignments of varying degrees of interest and breadth and possibly relatively slow pay progress. I maintain that these same people in a purely professional atmosphere would be working for the success-

ful consultant, for not too much, or be struggling to exist.

Any form of operational engineering has a close relationship with other phases of management operations. The experience gained can be translated to usefulness in many other fields. Most industries have a strong technical element. The experienced engineer, then, has a background of inestimable value for making the appraisals from which management decisions evolve. If he has the flexibility to adjust to other requirements, he is a strong candidate for management positions of almost every kind. In our Company, we have engineers in the Engineering Departments, as district heads in others, as department heads, as general managers, as vice-presidents, and, at the present time, one as president. In fact, some of us who are not engineers by training are beginning to wonder.

Our experience has been paralleled in many industries. Men of breadth and adaptability, trained in engineering, have been chosen over and over again for straight management duties, often at a relatively high organizational level. There are no limitations on where the engineer can go in industry. All the evidence supports the value of this trend. My only hope is that engineers, themselves, will not put artificial barriers in the way.

Engineers as Management

At the beginning I spent considerable time talking about the influence and responsibilities of industrial management in the present and coming era.

My thesis is, there is no tenable division between industrial engineering and industrial management. The two are inextricably mixed. The role of the engineer in industry is to adopt the management viewpoint and assume, with others, the leadership in giving direction, through the activities of the industry with which he becomes associated, to industrial progress. From among qualified engineers many will be chosen for positions of great authority and responsibility in management. From such positions their independent judgments will, in large measure, determine the course of the economy and the state of well-being of the whole of society.

One important phase of the subject remains. How can the qualified engineer in industry prepare himself for a larger share of these responsibilities? This problem is not limited to engineers, but opens up the whole question of management development. This is much too broad and important for coverage in a few concluding paragraphs.

However, I would like to add one or two points.

No engineer nor anyone else will ever be developed for management responsibilities by sitting still and expecting someone else to do it for him. I will admit an impatience with those who come to me and ask what I am doing for their development. When I ask what they are doing, they look aghast. The assumption is that some vague "they", I suppose higher management, should do this for them. I say it cannot be done. Development means self-development, not the waving of a magic wand to translate the ambitious indolent into executive material.

Now that that has been said, we can agree there is an excellent opportunity for an effective co-operative effort between decision-making management in the area and those with special qualifications including a willingness to work extra hard and long. They should be exposed to good and inspiring leadership. This will serve as an example. They should be given an opportunity to participate in discussions on matter of policy. They, on their part, can keep their eyes and ears open and learn much beyond the limited details of their own jobs. They can adopt the attitude of the enquiring mind and learn from what they see how the whole thing fits into a dynamic pattern with a common objective. They can mature on the job no matter what that may be.

Then there are formal courses available on the two phases to which engineering experience seems to contribute the least: the science of management and the techniques of leading people. Most of these are good. Anyone with eagerness to learn will be better for having attended. They pack a lot of experience into a relatively short time.

Then, if it is a co-operative program, there remains the problem of the selection of those to attend. If the courses selected are long and expensive, this creates some difficulties. Are you prepared to face the almost inevitable morale reaction to the jet-propelled theory of personnel development? Are you sure enough of your selection methods to be assured you can choose from among your younger management group those with the greatest potential for future high responsibilities? Are you sure of the effect upon those chosen and that it will be all good, or will the selection itself tend to turn the individual's head with less than fortunate results?

Many experiments are being tried. The results are not yet clear. If you have a tendency to answer these questions in the negative, you may wish to look hard at an in-plant type of program. In our company, where the need is keenly recognized, we have tended to be rather conservative in providing, at company expense, special opportunities of this kind for specially selected people. Our trend has been more along the lines of stepping up our internal training opportunities and making them available to all. Perhaps everyone will benefit in degree and those with outstanding potential will emerge under this stimulation coupled with their job experience and their own applied interest. The whole level of management may thereby be raised and those with ability and initiative will profit most and automatically emerge as those destined for greater management responsibility. We may find it inadequate.

Summary

I would like to conclude with this brief summary. The management revolution has increased management authority and responsibility over the all-important production phases of the economy. Our present and future prosperity depends in large measure on the soundness of their applied wisdom. Engineers in industry are incorporated into this management group and will be called upon to provide a considerable share of the future top leadership. Preparation for positions of leadership is largely an individual responsibility but may effectively be coupled with well-thought-out plans for exposing all worthy candidates to various types of experiences from which they can profit if they will.

This does not attempt to bring answers to all the viewpoints and all the problems. I hope it may have, in part, met the original object of providing something for the stimulation of thought and discussion. √

Electrical Equipment in Large Transport Aircraft

by

Clayton Glenn,

Engineering Department,
Trans-Canada Air Lines,
Montreal, Que.

A paper presented at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

Today's large transport aircraft incorporates an electrical power system that may be likened to the powerhouse for a large industrial plant. The author discusses generating systems and associated equipment, engine starting, ground electrical supply problems, and de-icing, and deals briefly with the subjects of instrumentation and electronics.

Aircraft electrical systems have been with us since the day, over fifty years ago, when the Wright Brothers made their first powered flight at Kittyhawk. At that time, engine ignition constituted the only requirements for electrical energy in an airplane but, as time went on, night flying made it necessary to install instrument and navigation lighting systems. Later, as airplanes developed into passenger transports and bombers, the electrical systems became more complex, and generating systems increased in size, until today the electrical power systems of our modern transports resemble the powerhouse for a large industrial plant.

It is not intended to describe, in detail, the electrical equipment used in current transport aircraft, as this has been covered thoroughly in recent technical literature. I would rather discuss some of the equipment which we shall use and problems which we will face, on future aircraft, using current aircraft electrical equipment occasionally for comparison.

When reference is made to current transport aircraft, think of one which weighs about 65 tons, cruises at 300 m.p.h., has about 5500-gallon fuel-capacity, carries about 60 passengers from Montreal to London in 11 hours, and costs about $1,750,000. The gross weight of future turbojet transports, will be in the order of 125 tons; they will cruise at about 550 m.p.h., have a fuel capacity over 15,000 gallons, carry 100 passengers from Montreal to London in about 6½ hours, and cost about $4,500,000. Two airplanes of this class, each flying on a daily flight schedule would have the same passenger carrying capacity as the *Queen Mary*, based on her present accommodations.

Generating System

When it was first found necessary to install a generating system in an airplane, it was logical to take advantage of the development work which had already been carried out in the automotive field. Hence, we find that early aircraft used a lead-acid storage battery with a d.c. generator, regulated by a vibrating contact type of control. This system grew until the present day 28 volt d.c. system was reached with elaborate feeder fault protection and carbon pile regulators.

The growth of the generating system capacity over the years has been amazing. The curve on Fig. 1 shows the increase in capacity of the past 16 years and how it is expected to grow in the near future. Each point represents the introduction of a new airplane type into service. Those shown for 1958 and 1960 represent the turbojet airplanes which we are currently investigating for the North Atlantic service. From the curve it can be seen that the power available from the generating system in our Super Constellation introduced in 1954, is 45 times greater than that of the Lockheed 14 introduced in 1939. This represents a growth of about 30 per cent per year.

Theoretical calculations show that, even for present day transport aircraft, higher voltage d.c. or a.c. systems would be more economical from the point of view of weight than the present 28 volt d.c. systems. Depending on the outlook of the calculator, higher voltage systems appear to be from 25 to 50 per cent the weight of the low voltage d.c. system. In the United States, the military has recognized the advantages to be gained from the use of higher voltages and the latest bombers and transports have been designed accordingly. The airlines have been a little more cautious and have actually been reluctant to accept higher voltage systems, since these would require a complete change in operating technique, test equipment, and so on. However, they are beginning to realize that the 28 volt d.c. system has been pushed about as far as it can go, and appear willing to accept the radical changes which are inevitable.

It will be virtually impossible to convert the whole aircraft industry at one time to a particular voltage and frequency, so on the next generation of transports we will find quite a mixture—28 volts d.c. will be with us to a degree for

some time as it has been the most predominant in the past, and the industry has a considerable investment in tooling to produce and maintain equipment for operation on this voltage. We expect, however, eventually to see it disappear; 400-cycle 110-volt three-phase has been standardized as the power for gyro instruments and other equipment requiring fixed frequency, so this voltage and frequency will appear on future transports and is likely to remain for many years.

Whether to go to a basic power system of high voltage a.c. (208 v.), with either fixed or variable frequency or high voltage d.c. (110-120 v.), has been the dilemma of the aircraft manufacturers. Each has its advantages and disadvantages. The fixed frequency a.c. requires constant speed drives with sufficiently close speed tolerances to permit the output of two or more machines to be paralleled. Variable frequency a.c. cannot be paralleled and, hence, complicated load switching is required to provide adequate reserve power for all the loads. High voltage d.c. has the problems of commutation at high altitudes and the ever present danger of flashover. Whatever the basic system, it stands to be far more complex than any we now use.

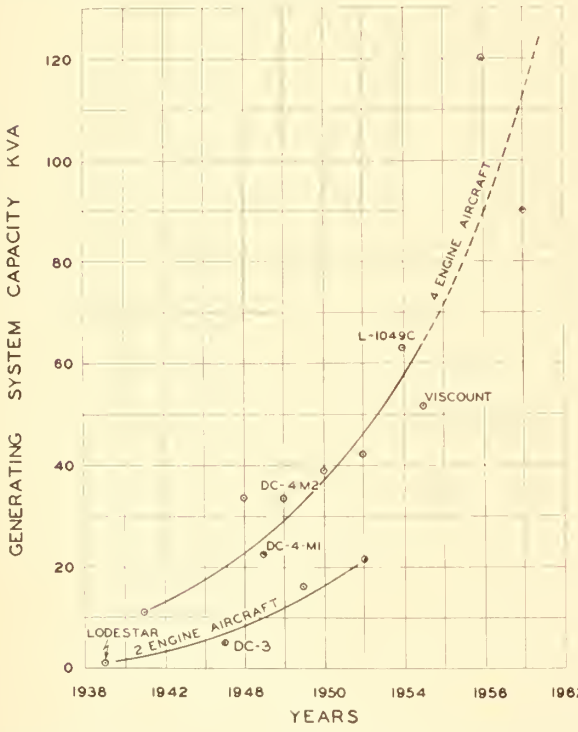


Fig. 1. Growth of electrical generating systems in transport aircraft since 1939, projected to 1961 for four-engine aircraft.

Figure 2 shows how, on present day aircraft, the electrical power is generated and utilized. The output of four (or six) shunt field generators is paralleled and distributed from a main bus, as required. Where fixed-frequency single and three phase power is required, the transformation from d.c. is made through a heavy, noisy, inefficient inverter. Do not be misled by the few lines representing wires in this diagram. In actual fact, our present-day transports have over 200 different circuits and utilize about 100,000 feet of wire ranging in size from 2/0 to No. 20 gauge.

Figure 3 shows the approach taken by one airplane manufacturer who is a proponent of the 110 volt d.c. system. With this system, the output of the 110-volt d.c. generators is paralleled and feeds the main distribution bus. The 110 volts is used directly for starting, lighting, motor loads, heating, de-icing, etc. To obtain 28 volts d.c., a rotary converter stabilized by a battery is used. The 400 cycle three phase loads are supplied by an inverter driven from the 110-volt d.c. bus. This system has these advantages:

1. In principle, it is similar to the present day 28-volt and from the airline's point of view would be simple to introduce into service.

2. The engine starting system operates off the 110-volt bus, which has a suitable storage battery connected to it. This would make the starting independent of an external starting source in an emergency.

3. Since series field d.c. motors have high starting torques, no problem along this line would be encountered.

4. High voltage d.c. is readily available for use in electronic equipment.

5. Circuit protection is straight forward and little new development would be required.

Disadvantages would be:

1. 110 volts d.c. is extremely lethal and maintenance personnel would have to exercise extreme caution.

2. There has been very little experience in the design of high-voltage d.c. utilization equipment and field of selection for suitable components would be limited.

3. At high altitude there is more danger of a sustained arc after flashover than with a.c. systems.

4. Commutation at high altitude is difficult.

5. Rotating transformation equipment is necessary to obtain 28 volts d.c. and 400-cycle 110-volt three-phase a.c.

6. There may be brush trouble at high altitudes with d.c. motors and generators.

Figure 4 shows a variable frequency system proposed by one manufacturer. The 110-volt 3-phase and 208-volt three-phase output is rectified to produce 110-volt and 28-volt d.c. The 400-cycle 3-phase 110-volt power is obtained from an inverter driven from the 110-volt d.c. bus. The 208-volt variable frequency is available for de-icing and heating loads and for motors which are not frequency critical. The variable frequency sources cannot be paralleled and, in the event of alternator failure, the loads must be switched to some other source. This system has the following advantages:

1. The engine starting system operates off the 110-volt bus and, as with the 110-volt d.c. basic system, can make engine starting independent of any external supply in an emergency.

2. No constant speed drive equipment is required for the alternators.

3. High starting torque d.c. motors can be used.

4. High voltage d.c. is readily available for use in electronic equipment.

5. There would be no generator commutation problems, although there may be brush trouble at high altitude with the d.c. motors.

Disadvantages would be:

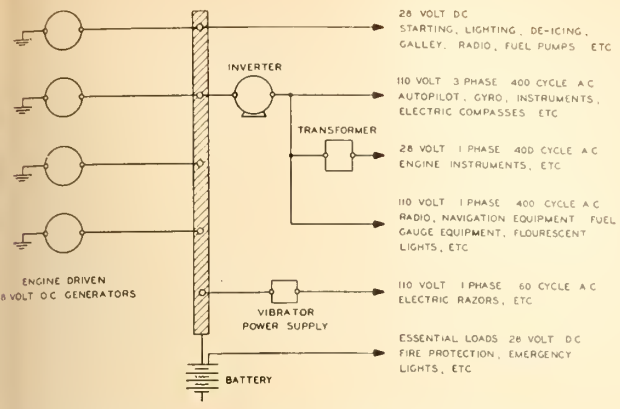


Fig. 2. Current electrical power system for transport aircraft - 28 volt d.c.

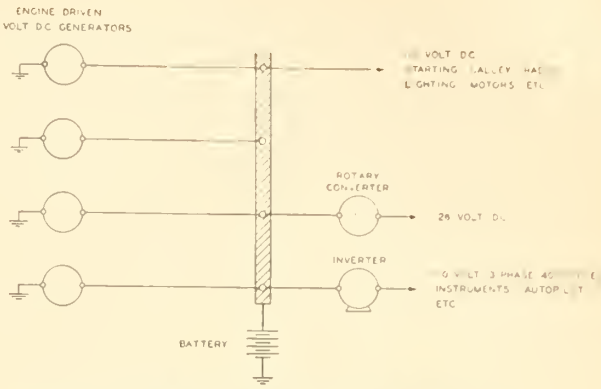


Fig. 3. Proposed electrical power system for transport aircraft - 110 volt d.c.

1. Since the variable frequency source cannot be paralleled, elaborate switching devices would be required to cope with the failure of one of the alternators. This would require careful monitoring of the system, necessitating the services of a flight engineer.

2. Rotating transformation equipment is necessary to obtain 400-cycle 110-volt 3-phase power.

3. The 110-volt d.c. system is extremely lethal.

4. Little experience has been gained to date in the manufacture of 110-volt d.c. utilization equipment and the field of selection would be limited.

5. 110-volt and 28-volt d.c. ground power is required.

Figure 5 shows a fixed frequency system operating at 208 volts 400 cycles 3-phase. Between the alternators and the engine is a constant speed drive which permits all of the alternators to be run at the same speed and in phase. To obtain 28 volts d.c. the three phase is rectified. Provision is made for splitting the main a.c. bus in the event of the inability of the constant speed drive of any engine to maintain the corresponding alternator in phase with the others. Advantages of this system are:

1. No rotating transformation equipment is necessary, (eg. inverter or rotary converters).

2. No complex switching of a.c. loads is necessary when a single alternator fails, since the alternator will automatically drop off the line. Disadvantages are:

1. A fairly complex constant speed drive is necessary for each alternator. The cost of operation of this equipment is very high.

2. Three-phase motors have lower starting torque than series d.c. motors, hence the design of the utilizing equipment is more critical.

3. The airplane is entirely dependent on an external power source while on the ground with engines stopped, with the exception of certain emergency loads which can be driven from the battery.

4. Circuit protection for the paralleled operation is extremely complicated and the system appears to be very difficult to "trouble-shoot".

5. A flight engineer is necessary to monitor the system.

In theory, the fixed frequency a.c. systems with the alternators driven by a constant speed drive, seem to be superior to the other two but in actual practice the circuits will probably be extremely complex and we can visualize a lot of maintenance being required to keep the system serviceable. We would rather not purchase another airplane which requires a flight engineer, and it is felt that both the fixed and variable frequency systems are sufficiently complex to require one.

In the past, aircraft electrical engineers and technicians have been able to get by without knowing more than Ohm's law and a few other simple formulae. When a.c. systems are introduced, particularly the fixed frequency system, it will be necessary for them to go back to school and brush up on symmetrical components, circulating currents, etc. Whereas, our average mechanic has a fair knowledge of the airplane's electrics on our current 28-volt d.c. systems, this would not be the case if a.c. were adopted. Perhaps this would be a good thing, as there would probably be less "finger" trouble.

As we see it, the 110-volt d.c. system offers more to an airline than the a.c. systems; however, none of the American airplane manufacturers are considering its use. In spite of its superiority, it will probably not become the number one system in the aircraft industry. It appears to have the backing of only one British airplane manufacturer and it is unlikely that sufficient 110-volt d.c. utilization equipment will be produced by the various electrical accessory manufacturers to give a wide enough selection of equipment. Any airline using an airplane which has a "bastard" system finds itself alone in overcoming the inevitable service difficulties and cannot share techniques and procedures with the other operators.

Although basic electrical systems are investigated when we select a new airplane, it is not probable that the superiority of one system over another will dictate the type of airplane which we will buy. In spite of how we feel towards the complex a.c. systems we will probably find ourselves saddled with one within the next five years.

Generator Cooling

In order to obtain a high output from an aircraft generator with a minimum expenditure of weight and space, blast cooling is used. On current aircraft, a forward facing scoop picks up ambient air and cools the machine, the discharge air being dumped in some area of low total pressure. By locating the scoop in a high pressure area back of the propeller, a certain amount of cooling is available for operation on the ground.

With low-speed, low-altitude propeller transports, generator cooling has not been too much of a problem, but with a high-speed,

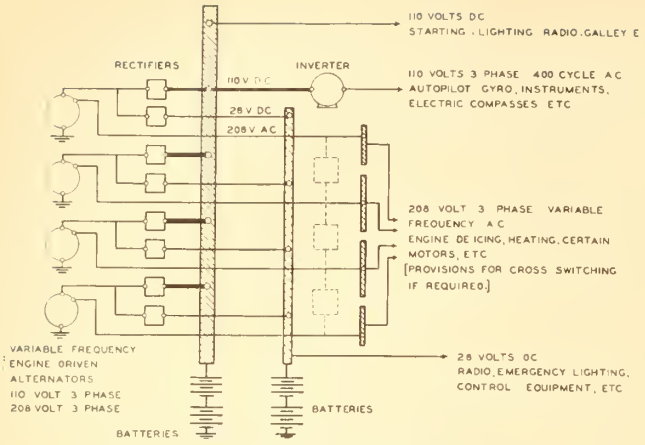


Fig. 4. Proposed electrical power system for transport aircraft - 208 volt variable frequency a.c.

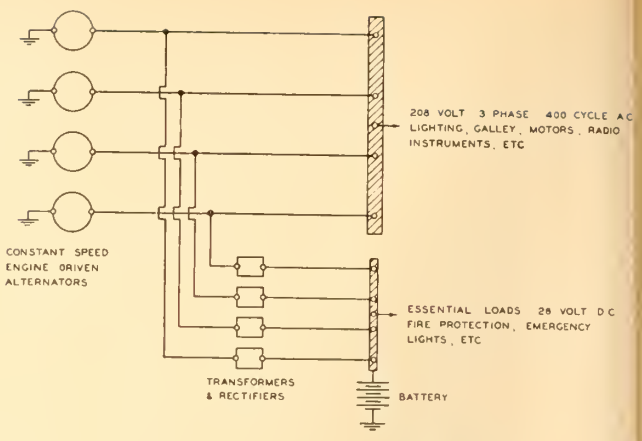


Fig. 5. Proposed electrical power system for transport aircraft - 208 volt fixed frequency a.c.

high-altitude turbojet airplane, everything is working against efficient cooling. Even ground cooling presents a problem, since there is no propeller slipstream to provide cooling air.

In bringing air to rest from any velocity, there is an increase in temperature. Actually, the temperature rise goes up as the square of the speed. For low speed airplanes, this increase is not significant and can usually be neglected. However, at high speeds, it becomes an important factor in cooling system designs. For example, at 600 m.p.h., the rise is about 65° F, and at 1,000 m.p.h. 180° F. Trying to cool a generator with hot air can become a real problem.

Normally, generators are rated with an average winding temperature of 180° C, with the hot spots going about 50° higher. We have been told that an increase of 10° C in temperature above this value halves the insulation life. With the cooling air temperature roughly 65° F higher than ambient in proposed transports, it is obvious that either the standard generators must be derated if used on these airplanes, or new generators be developed with better insulating material.

Fortunately, recent design changes in generator insulating materials have allowed an increase in wire temperature sufficient to cope with the speeds being considered for turbojet transports. For extremely high speed fighters, manufacturers are talking in terms of environment free generators, using liquid or vapour cooling.

Another factor working against efficient cooling is the decrease in air density with altitude. More cubic feet of air are required to do a given cooling job at altitude than at sea level, assuming the same air temperature. This problem can be overcome with complicated cooling equipment but usually the effect is taken into account in the rating of the machine.

One turbojet manufacturer plans to overcome the problem of blast cooling on the ground by using the engine intake as an aspirator, to suck air through the generator. Another bleeds air from the engine compressor but here, as at high speeds, the cooling air is hot.

Engine Starting

The problems encountered in starting gas turbine power plants are quite different from those encountered with reciprocating engines. Our current reciprocating engines require 50 r.p.m. or less cranking speed to start them, the starter requiring a high starting torque to overcome the breakaway friction, cylinder compression, etc. The major starting problems which we have encountered are those associated with low temperatures, where oil viscosity is high and where high cylinder and bearing friction prevents the engine from accelerating to a high enough cranking speed to permit the engine to sustain itself.

With the gas turbine, an entirely different combination of conditions exist. There is seldom any appreciable amount of breakaway force required due to the lack of cylinder friction and even with the turbo-propeller engine, which has a high mass of reduction gearing and propeller to rotate, this factor is not too significant. On the other hand some 1000 r.p.m. is required before the engine is self-sustaining and up to this speed, the power required to rotate and accelerate the engine is considerable, due to the high compressor load.

Figure 6 shows roughly the problem involved. Curve A is the horse power required to rotate all the engine components, the majority of the load being required by the compressor, which absorbs power directly as the cube of the speed. Curve B is the power produced by the turbine which is not significant until the engine "lights up". The difference between these two curves, C, represents the power which must be added by the starter to maintain that particular engine speed. Actually, the starter must produce power as shown on curve D, in order to accelerate the engine to the minimum self-sustaining speed. The greater the difference between curves C & D, the more rapidly the engine will accelerate.

At the minimum self-sustaining speed, the power being produced by the turbine equals that absorbed by the rest of the engine and no further work input is required by the starter. In actual practice, the starter continues to supply power beyond this point in order to assist in the acceleration.

Above the minimum self-sustaining speed, useful horsepower would be available to drive a propeller, in the case of the turbo-propeller engine. In the case of the turbojet, the power delivered by the turbine above the minimum self-sustaining speed, would be equal to the power absorbed by the rest of the engine, for steady state conditions. Excess power would result in acceleration.

When turbine engines were still relatively small and when the military starting time requirements were not so critical as they are today, it was found that electric starting was quite satisfactory. To

lay, however, the following conditions have moved electric starting out of the military picture and replaced it by air turbine and cartridge starting:

(1) Reduction of starting time requirements from approximately 20 seconds to 3 seconds has increased the starter power requirements by five or six times.

(2) Higher power engines with higher compression ratios have increased the starter work requirements.

(3) The higher compression ratio engines have meant higher compressor temperatures, hence a trend to steel rotating parts instead of aluminum. This has increased the moment of inertia and resulted in higher starter power requirements.

(4) To make matters worse, it was found that the minimum self sustaining speed of the higher compression ratio engines was higher than the lower compression ratio engines, requiring starter

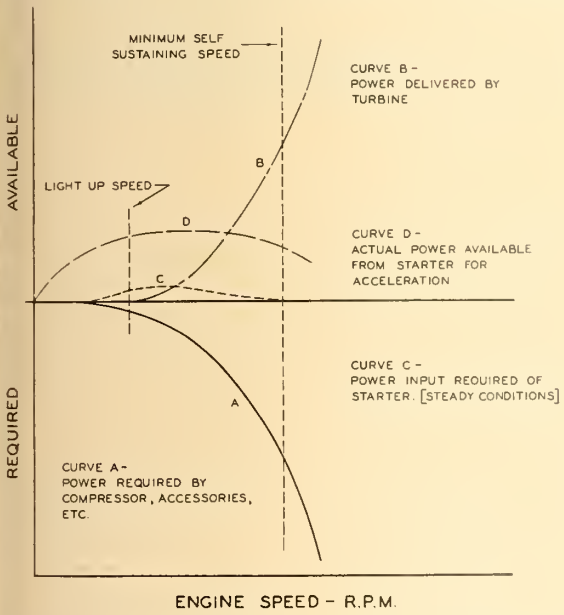


Fig. 6. Diagram illustrating the starter power requirements for turbine engines.

power to be applied for a larger percentage of the time.

Even though electric starting has practically been discarded by the military for fighter application, there is still hope for its survival in the transport field. In the first place, starting time is not nearly so critical. The most important factor, however, is the recent introduction of the twin spool engine which requires only the high pressure section or hot gas generator, to be started. This high pressure section has a relatively low moment of inertia and a low self sustaining speed resulting from the relatively high compressor efficiencies at low speeds. It is felt that all these factors coupled together will put electric starting back in the running.

Ground Electrical Supply

During ground loading and servicing, with the engines stopped, some source of electrical power is required to operate the multitude of electrical services. On light airplanes, as in the automotive field, the internal storage battery can be used, as the standard types usually have sufficient capacity to handle starting and other requirements. However, in current large transport aircraft the number of storage batteries to supply the total load would be prohibitive so this method is not normally used. Provision must, therefore, be made to connect some external source of electrical supply to the airplane.

Various forms of external power supplies have been used, ranging from battery carts to high-powered motor generator and rectifier units. The growth of capacity of these ground power units has followed closely the curve of the aircraft generating growth, shown on Figure 1. Ground power units of 1500 amp. 28 volts d.c. are now common for transport aircraft and if any turbine powered transports are planned, with 28-volt d.c. starters, larger capacities may be necessary.

As mentioned in the section on engine starting the requirements for gas turbine starting are much more severe than for a reciprocating engine. Whereas the short time starting requirements of reciprocating engines can usually be handled by the inherent overload capacity of the ground power units, the gas turbine requires a high load for a longer period of time. This results in the ground power units for a turbine transport having a higher continuous rating than those for the equivalent reciprocating engine powered transport, providing of course both use electric starters.

Normally, our reciprocating engines draw from 100 to 250 amp. during starting, with the initial transient about double these values. The Dart turbo-propeller engine used on our Viscount has an initial transient of 1400 amp. with the running current never dropping below 600. The starting load for four engines, on top of the other loads drawn by the airplane, results in an extremely heavy ground electrical power requirement.

With the radical changes being made in the basic electrical systems of the proposed turbo-powered transports will come an equivalent change in ground power units. In the case of the manufacturer who plans on using a 110-volt d.c. system, no ground power problem should be encountered other than the fact that 110 volts d.c. is extremely lethal and connecting and disconnecting the power may be hazardous. The system using the 208 volts fixed-frequency system should be straightforward although it is unlikely that the external supply will be allowed to operate in parallel with the airplane's alternators once the engines are started. The manufacturer who proposes the variable frequency system is really making it hard for the airline operator. Both 110 volts d.c. and 28 volts d.c. must be supplied from external sources. Even at this, it is impossible to operate any of the loads connected to the variable frequency bus bars. An airplane of this type would certainly complicate ground handling procedures.

The answer to the whole ground power problem is to make the airplane self-sufficient. Small auxiliary gas turbine drives are being produced for the military to provide ground power as well as ground air conditioning. Unfortunately, these units are heavy, noisy, costly and have too high a fuel consumption to be considered economical for commercial transports. However, there is a considerable amount of development work going

on, and we are looking to the day when they will become a practical proposition.

Electrothermal De-Icing

Pneumatic, liquid, hot air and electrothermal methods have been employed in the past for wing de-icing with the electrothermal probably being the least popular. As a result of research work conducted by our National Research Council in Ottawa, electrothermal de-icing is becoming more and more widely used and our future turbine transports will certainly use this method to some degree.

We are all aware of the importance of keeping an airplane free of ice. Not only does ice increase the weight but it may impair the aerodynamic characteristics of the wing or cause a severe loss of engine power. With a high speed jet transport, the penalty may be more severe than for a slower reciprocating engine powered airplane. Even light accumulations of ice on the wing can shift forward the transition point from laminar to turbulent flow, thus appreciably increasing the drag and decreasing the range of the airplane. A de-icing system for wing and tail surfaces of a high speed transport, therefore, must either remove all the ice, or prevent it from forming.

In order to prevent ice from forming, sufficient heat must be available to vaporize all the water, since the runback of any free water on to the unheated portions of the wing could cause ice build-up in critical areas. To date, this quantity of heat can only be produced economically from fuel burning heaters, engine compressor bleed, or from the engine exhaust. To generate it electrically would be prohibitive from the point of view of weight.

Electrical means can, however, be used to remove ice. The leading edges of the wings and tail are covered with a thin rubber boot, in which electrical resistance elements have been imbedded. Certain strips of the boot are supplied with sufficient electrical power to convert the ice in that area into water and to vaporize the water. These are called parting strips. The rest of the boot is supplied with considerably less electrical power, in fact just enough to break the bond between the boot and the ice. First the power is turned off and ice is allowed to accumulate. Then the power is turned on, the ice breaks loose and is carried away by the airstream, leaving no free moisture to turn back and refreeze. The idea of the parting strips is to provide a means for the airstream to get under the ice and lift it off.

By automatically cycling the electric power at different rates, various degrees of ice accumulation can be removed. On airplanes already equipped with high powered alternating current electrical systems, this method of de-icing could be employed with a weight penalty comparable to the other methods.

A popular method of de-icing aircraft windshields is with electrically conducting glass, and it is expected that this principle will continue to be used in future transports. Conducting metallic oxides are fused to ordinary plate glass in such a thin layer that the light transmitting characteristics are not impaired. Silver electrodes are sprayed along two edges of the glass and a relatively high voltage is applied, resulting in a dissipation of about 600 watts per square foot. A typical electrically heated window is shown in Figure 7.

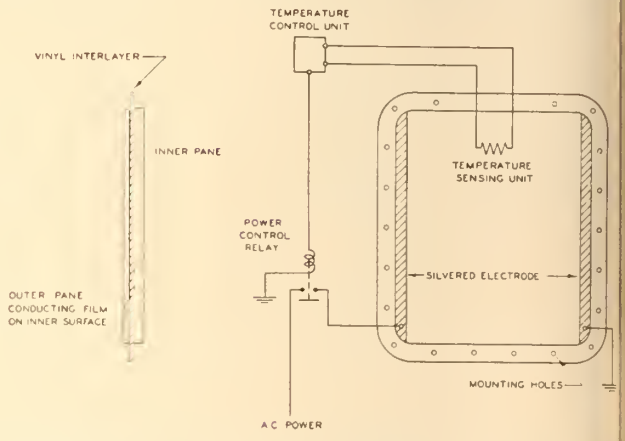


Fig. 7. Layout for a typical electrically heated windshield.

Actually, the main reason for heating windshields is for the retention of the bird strike-proofing qualities at low temperatures. The vinyl interlayer used in current aircraft windshield designs has maximum impact resistance between the temperatures of about 70° F and 130° F. Below this range the vinyl tends to become brittle and above it, plastic. It is extremely important that the maximum impact resistance be maintained, since even a small bird at high aircraft speeds, could do extensive damage to a windshield and critically injure a crew member.

By locating the conducting surface of the outer pane of glass in the window assembly in contact with the vinyl, it is possible to supply heat to the vinyl. With the sensing element of a temperature control system imbedded in the vinyl, it is possible to maintain it at the desired temperature for maximum strength.

Only a small percentage of the heat generated by the conducting glass is used for heating the vinyl. Most of it is conducted outwards and becomes a very efficient means of keeping the windshield free of ice.

Where windshield panels are not rectangular, it is virtually impossible to maintain constant current densities over the whole area hence there are hot and cold spots with the associated stress concentrations. This can be partially overcome by not applying the conducting coating to all areas of the panel but this method is not too satisfactory.

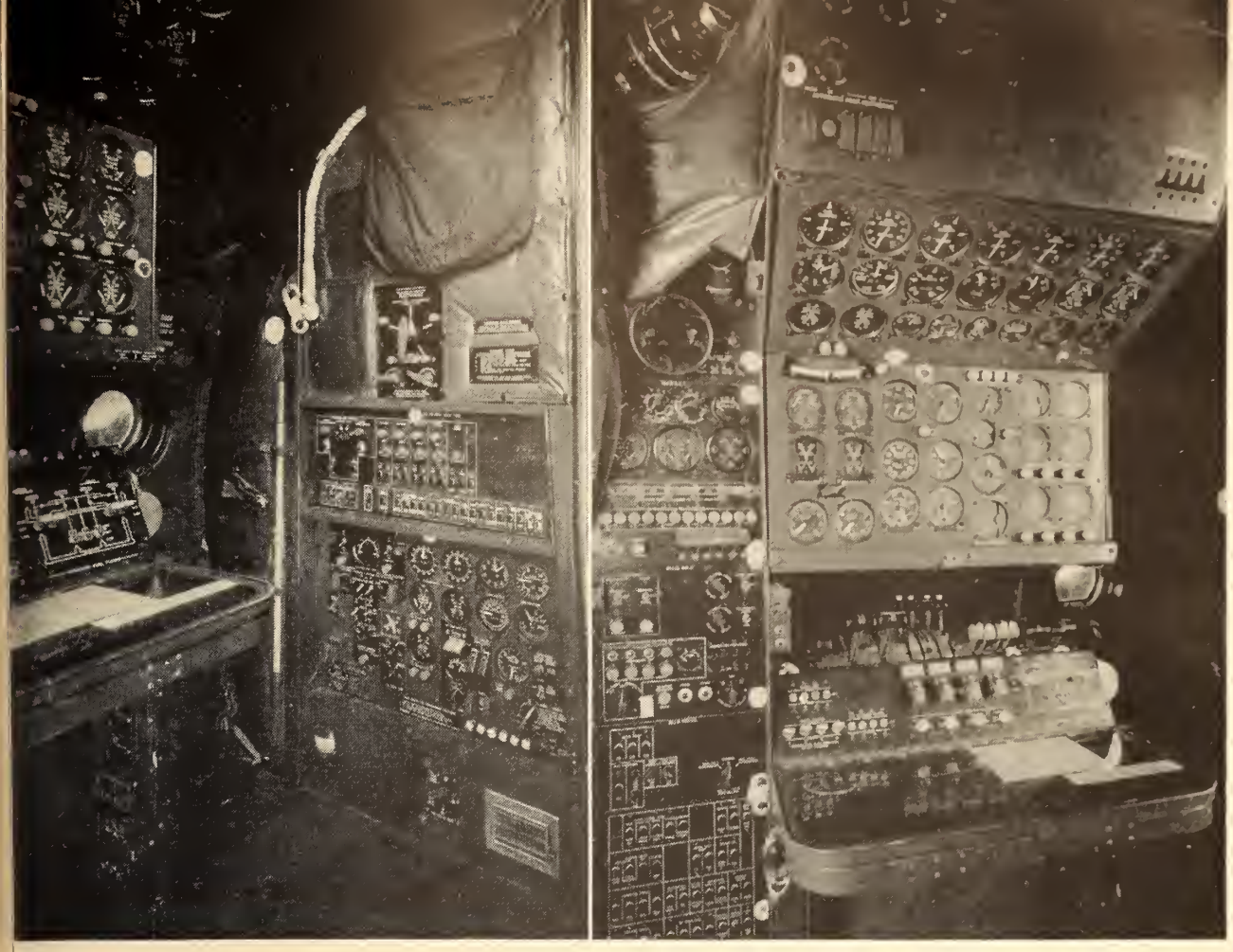
Other applications of electrothermal de-icing are engine air intakes, scoops, pitot heads, antenna masts, and so on.

Instrumentation

The majority of the instruments in aircraft today are electrically operated and, as such, should be mentioned here. However, the scope of aircraft instrumentation is so broad that I will merely try to touch a few of the high spots.

In the past few years, as aircraft have become more complicated, a need has arisen for more instrumentation. As a result, we now have aircraft such as the Super Constellations which have 148 instruments in the flight compartment, to say nothing of the 46 other assorted controls, switches and warning lights. The point has been reached where an airplane with any additional items would be beyond the capabilities of the normal flight crew, and there is a dire need for simplification.

The introduction of the gas turbine is a step in the right direction



Figs. 8 and 9. Flight engineer's station in Super Constellation, illustrating complexity of instrumentation in modern large aircraft.

rom the point of view of reducing omplexity, the Viscount being a ood example. In this airplane the umber of instrument presenta- ons is only 85, or about 57 per nt of that required in the Super onstellation. It is not expected hat future turbojet transports will e anywhere near as simple as the iscount but certainly they will ot be as complex in the flight mpartment as the Super Con- ellation. The photographs in Fig- es 8 and 9 illustrate the flight gineer's station in our Super onstellation. Nothing further ed be said.

A much higher degree of ac- racy will be necessary in the strumentation for turbojet trans- rts than that now acceptable in ciprocating engine powered air- aft, since the airplanes must be wn closer to the optimum limits. y deviation from these limits ll have a much more adverse ef- ct on the performance and econ- my of operation than is the case r piston powered aircraft. For ample, one per cent accuracy in e electric fuel quantity measur- g gauges is considered quite ac- ptable for our current aircraft. a turbojet transport of the class e are considering, this error could ean an error of 1000 to 1200 pounds, on the fuel required for a trans-Atlantic crossing. The error could be in either direction, that is, it could mean either taking off with too little fuel, or taking off at a weight higher than authorized.

Another good example of the effect of error in instrumentation is that associated with engine speed. These electrical instruments now require no great degree of accuracy, since a small percentage change in engine speed for a reciprocating engine does not produce too marked a power change. On one particular turbo-propeller engine we are investigating, a one per cent error in engine speed at take-off would mean a 7 per cent error in engine power. On our small Dart turboprop used on the Viscount, a one per cent change in r.p.m. means more than 4 per cent change in power.

With the turbojet such other indications as airspeed, outside air temperature, turbine inlet temperature (flame temperature) and angle of attack, all important parameters in cruise control, will be required to be read with a high degree of accuracy.

Electronic Systems

The field of electronics in large transport aircraft is so involved that no attempt will be made at this time to describe any part of it in detail. Instead, I would like to list some of the electronic systems which will probably be present in turbine transports in operation five or six years from now.

An automatic pilot will be an absolute necessity, not only to hold the airplane in level flight, but to aid in cruise control. Signals such as airspeed and angle of attack will be fed into the automatic pilot in order to guarantee that near optimum cruising conditions are maintained. Rather than have individual gyros for the various instrument and automatic functions, master gyros located near the airplane's centre of gravity will supply attitude information to any system requiring it.

Automatic approach coupling will be used to aid in landing, under low visibility conditions. With this system, information from the various radio aids, and magnetic heading is integrated and fed into the automatic pilot, so that the airplane can automatically be held on the approach path.

Integrated flight instrumentation will be installed, giving a pic-

torial representation of the location of the various radio aids with respect to the airplane and computed flight direction information for manual flying and manoeuvring.

Collision radar if far enough advanced at the time will probably be installed.

Weather radar, now more or less perfected, will be necessary in order to assist the pilot in keeping clear of turbulent air masses, hail, etc.

The Visual Omni Range (VOR) system currently used for short range continental navigation will probably be superseded by the Tactical Air Navigation (TACAN) system. This new system has been designed for use by both the civil and military but very little information regarding its operation is available for release.

An Air Traffic Control Transponder will probably be used for aircraft identification purposes. This equipment operates automatically from ground radar stations and supplies information to the Air Traffic Control.

If available, airborne teletype will be carried to give weather information over the ocean. The teletype will be controlled by high powered low frequency coastal stations.

A selective calling system will probably be installed whereby Air Traffic Control can give visual information to the pilot. Rather than listening to a continuous stream of radio messages and trying to sort out those intended for his flight, the pilot will be able to see the written message in front of him on a low definition picture tube.

The future transports will also carry the usual low and high frequency communication transmitters and receivers, automatic radio direction finders, Loran and absolute altimeters.

In spite of the seemingly complex communication and navigation electronic gear which will have to be carried, no radio operator will be required.

Over and above the communication and navigation equipment listed above, will be a veritable assortment of electronic devices associated with engine controls, deicing controls, air conditioning controls, etc.

In general, electronic units will be miniaturized compared to existing units and magnetic amplifiers and transistors will replace most of the vacuum tubes.

The main factors which an engineer must rationalize in designing an aircraft electrical system are weight, space, power requirements and cost. All these affect the overall economics of the airplane and it is his job to bring forth the best compromise. On current aircraft, with electrical systems which "just grew" like Topsy, there appears to be little evidence of any of these factors having been taken into consideration. With the electrical systems of the new turbine powered transports being developed from basic fundamentals, there is now an opportunity for the electrical engineer to prove his worth and come forth with an economically sound proposition.

Economic Aspects

Weight is an important factor in any airplane, as it directly affects the payload which can be carried. The electrical system, which is usually one of the heaviest systems, excluding the propulsion system must, therefore, be closely analyzed from the weight point of view. In the turbojet airplane of the class which we are considering for use on the North Atlantic, the weight of the electrical generating system, including distribution and control equipment, would be in the order of 1200 pounds. If we stay on the conservative side and assume that the weight of the equipment utilizing electrical power is the same as the generating system, then we can assume that the total weight chargeable to the electrical system is 2400 pounds. Actually, the utilizing equipment would be considerably heavier than the generating system, since the wired load is usually considerably greater than the available supply and the weight per kilowatt of utilization equipment is greater than that for generating equipment.

Assuming a generating efficiency of 80 per cent, and an electrical load factor of 70 per cent, it is estimated that for a 550 m.p.h. pure jet transport, the fuel consumed in generating electrical power would be in the order of 1000 pounds. This gives a total weight chargeable to the electrical system, for a trans-Atlantic crossing, of 3400 pounds.

If it were found necessary to increase the electrical utilization by, say 10 per cent, then theoretically the weight penalty involved would be 340 pounds. At a 70 per cent passenger load factor, this would amount to the loss of revenue from one passenger for every crossing. For one return flight per day across the Atlantic, the yearly loss of revenue would be about $250,000. Theoretically this 10 per cent increase in electrical utilization could also affect the performance and economics as follows:

1. The increased power drain from the engine due to the additional electrical load could reduce the speed of the airplane, lower the optimum cruising altitude, reduce the air miles per pound of fuel thus reducing the range.

2. For the same range requirements, the additional fuel required could mean larger fuel tanks, hence larger wings. This would mean greater drag and lower speed.

3. The drag resulting from cooling the additional generating equipment could lower the speed of the airplane.

4. The amount of fuel consumed over a given distance would be greater, increasing the total fuel cost.

5. The reduction in speed would reduce the amount of work which the airplane could do in a year thus lowering the revenue.

6. The capital cost of the airplane would increase due to the additional utilization and generating equipment installed. This in turn would reflect into the maintenance and spares costs of the using airline. Each item considered individually may not be too significant but, when considered as a whole, the economics of the operation could be affected considerably. Actually, this applies not only to the electrical system but to all the systems in the airplane and it illustrates the need for keeping the systems simple and light.

In conclusion, I would like to plead with the airplane manufacturers to think more of the airline operator when they are designing the new aircraft electrical systems. Naturally, none of us are in favour of anything which is going to make our lives difficult, and the electrical system designs now on the drafting boards stand to do just that. On the other hand, if complexity of design makes our airplanes safer then we are all out for complexity, in spite of the fact that we may require all our electrical mechanics to get their Ph.D.'s to keep the system operating.

New Developments in Canadian Mining Fields

by

H. R. Rice,

Dept. of Mining Engineering, University of Toronto.

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As recently as at the end of the 1939-45 war, it was a matter of grave concern to those engaged in Canada's mineral industries that as much as 56 per cent of production was coming from mining areas which had been discovered before 1910, 84 per cent from discoveries made prior to 1920, and 95 per cent from areas known prior to 1930. While this pattern has not altered a great deal insofar as our current production of metals, solid fuels and industrial minerals is concerned, reason for lament has been completely dispelled by the success which has attended the large-scale exploration programmes which have been conducted over a relatively few recent years.

Measured by the amounts of money spent by established mining companies, exploration companies, and governmental agencies, and by the less tangible indications produced by contemplation of the degrees to which newly-developed scientific techniques and correlations of older knowledge have been applied, this wave of mineral exploration is certainly unprecedented in Canada, if not in the world. It has secured to our Dominion the ability to produce minerals in an expanding diversity and on a growing scale; its continuing vigour ensures the projection of growth well into the future.

At the present we are seeing the fruition of several large mining ventures, important both in their individual magnitudes and in the new geographic, technical, and economic frontiers that are being breached as a result of the initiatives of their entrepreneurs. Still others are in the making, some of which have dates of initial production definitely in view, and others which are engaged in necessary research in order to secure an economic result from deposits of ores placed in sight during the relatively recent interval of growth.

Measures of Growth

At the turn of the century, the real economic investment in mining properties, mining real estate, mining plant, and in milling and metallurgical works, amounted to $103 million. The rate of growth in this investment was consistent with the growth of Canada's economy throughout the first half of the century, and by 1943 this investment amounted to $1,040 million on these accounts. Between 1943 and 1954 the total investment, still on these accounts, has increased to a level which may be placed conservatively at $2,000 million. Of this one-fold increase, some $518 million was accounted for during the four brief years 1951-54. The increase on construction and equipment in 1954 alone was $162 million, a rate which will undoubtedly remain stable, or even increase, during the next few years.

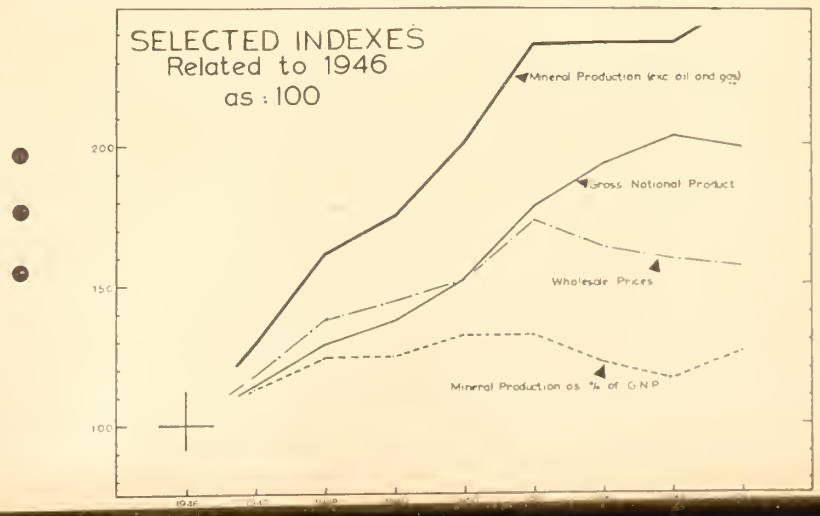
In view of the relatively large amounts of publicity given to the spectacular growth of the petroleum industry since the discovery of the Leduc Field of Alberta in 1947, it will come as a surprise to many that annual increases in the productive facilities for metals, industrial minerals, and solid fuels have, since 1950, been greater than those for oil and gas, measured by the available annual statistics on new investment.

The increases in new capital investment in the mining and metallurgical industries proper are given in Table I.

Such is one measure of the status and dynamic character of the industry, and, together with a consideration of the growing diversification of its technology and required services, it bears ample indication of the impact made upon its growth by service industries directed by technologists other than those peculiar to the mineral industries themselves.

The growth of production has been no less spectacular during very recent years; and it has in general kept pace with investment since the turn of the century. Beginning with a modest $64 millions in 1901, the trend-rate of increase has been exponential, doubling itself at intervals of approximately twelve years, until in 1954 the total value of minerals produced in Canada amounted to $1,454.2 million. Of this, petroleum and natural gas together accounted for $258.8 million, leaving $1,195.4 million as the dollar-value of those minerals with which we are here particularly concerned, and which number some 52 items of statistical account.

Since 1946 the dollar-value of metal and of mineral production has increased by 151 per cent ($1,195.4 million: $475.7 million), whereas the gross national product has but doubled ($23,985 million: $12,008 million); the relative trend-increase of mineral production has exceeded that of the gross national product by 26 per cent over the same interval. A considerable proportion of the increase in dollar-value of production over the interval has of course been due to higher prices paid for many of our metals and minerals; even so, physical volume has approximately doubled, and calculations made from available



indexes indicate that prices received by producers of metals and minerals lag about 12 per cent behind general wholesale prices as a trend. Although in physical volume several items of account are being produced at rates somewhat below their war-time peaks, with two exceptions all sections of the industry are operating at satisfactory and profitable levels and face prospects consistent with the amount of new investment being poured into productive facilities.

The two exceptions are gold and coal. The gold-mining industry is suffering a squeeze between a fixed price for its product and rising unit production costs, a squeeze which is partly alleviated by the effects of good engineering on productivity, and by the provisions of the Emergency Gold Mines Assistance Act. The problems of our coal industry are divided roughly into two parts: that of the west where, although ultimate solutions are somewhere inherent in the sheer physical presence of abundant reserves, the present is beset with severe competition from oil and gas in meeting the regional requirements for energy; and in the Maritimes, where the problems are concerned principally with the raising of productivity in order to meet another kind of competition.

Such then are statistical measures of the recent productive history and of the prospects for the foreseeable future of the Canadian mining and metallurgical industries. It is important to note however that two large and important sections are not included in the productive statistics — those concerned with the production of aluminum and uranium. In the case of aluminum, the only factors of production originating in Canada are land, hydro-electric power, capital, and labour; no Canadian ores have a part. Statistics of uranium production are sedulously withheld from circulation by the Atomic Energy Control Board; some of the new investment does however include capital now being put to work in potential uranium production by private companies.

Considerable amounts of the new capital are being utilized to improve and to increase productive facilities in the mines and plants of long-established producers; other portions are represented in new enterprises which have recently been brought to production and which have still to make their full impact; still other portions are being laid out on facilities which are not expected to bear fruit for a few years to come. Hence, we may safely say that we are now in a state of considerable growth that is assured a continuation by results that may confidently be expected from expenditures on exploration and prospecting that continue in the order of $20 millions per year. Production to a total annual value of $2,000 millions may well be reached within the next very few years, considering that in times of general economic health the annual dollar-value of metals, industrial minerals, and solid fuels has been of the order of 60 per cent of total real capital investment in the terms which have been indicated.

Diversification

Perhaps less tangible as a measure, but still of significant importance, is the growing diversity of metals and industrial minerals that contributes to the economic health of all provinces of the Dominion. During the late war, metallic magnesium and calcium, tungsten, mercury — and uranium — were added to the account; more recently titanium dioxide, perlite, indium, and elemental sulphur; and Canada will in the reasonably near future embark upon production of such hitherto-obscure metals as columbium, tantalum, and lithium. Metallic ores and industrial minerals that have by habit been considered specific to one part of the country, have been found and are being produced in areas far afield, one illustration being asbestos in Ontario and British Columbia, and another, nickel in Manitoba. Older areas have come to life with ore-bodies containing metals hitherto unknown as occurring locally—such as the copper, lead, and zinc of the Bathurst area of New Brunswick; still other old areas have acquired a new lease by having their known ores again rendered economic by industrial demand—such as the cobalt of northern Ontario.

Still another form of diversification is to be found in cases of mature mining operations, whose managements have applied themselves through diligent and expensive research to the winning of new products from materials formerly classed as metallurgical wastes—for example, fertilizers at Trail and Kimberley, British Columbia; ore-grade iron oxide and sulphur-dioxide at International Nickel's Copper Cliff plant; and ore-grade iron oxide, elemental sulphur, and sulphur-dioxide from Noranda's ores.

These suggest technological frontiers that have been crossed in past and recent years; other frontiers of a related nature have still to be crossed in the fields of ore-dressing, extractive metallurgy, and chemical engineering, before the best possible economies may be obtained from ore-bodies of relatively recent discovery. Any reasonable calculation of risk lends assurance however to an expectation of ultimate solutions of technical problems now facing the industry, and of those that always seem to emerge in turn from solved problems and answered prayers in any line of human endeavour.

Atmosphere of Encouragement

Many factors are combined in the creation of an atmosphere which lends encouragement to the technical and financial risks involved, particularly those which are essentially geological and are operative in the early stages of exploration. Along the trail of events and circumstance that begins with undiscovered mineral and culminates in economic exploitation, the Canadian industry is availing itself of technical device and organization, including the services made available as a result of accomplishment in other branches of engineering, to an extent not hitherto attained. Decisions to make outlays on expensive procedures require that the risks be calculable as reasonably as possible, and that encouragement of a somewhat direct nature be received.

Taking a large part in both aspects are the governmental agencies on both Dominion and Provincial scales, who have built up a seasoned and erudite experience in such matters that is serving the Canadian mineral economy to an extent which is undoubtedly unique in the world today. In full appreciation of the risks involved in the exploitation of fund resources, they render direct fiscal encouragement, expressed prin-

cipally through various forms of tax and excise relief. Through their geological surveys and other services they assist delineation of favourable prospecting areas.

Spectacularly related to this class of service are the aeromagnetic surveys which have been instrumental in converging upon important mineral deposits of the past few years. Although not all on government account, one prominent aerial survey company alone flew some 120,000 miles during the single year 1953 on mineral exploration work. Another specific and unique application of the use of aircraft has been made in detailed geological mapping, using helicopters, of large areas of the Northwest Territories as the Geological Survey of Canada has sought to accelerate their programme of delineating ground which may be potentially favourable to prospecting.

Research councils and foundations carry out investigations in many areas of knowledge that lie between pure science and technology; and, for the solving of detailed technical problems faced in almost any aspect of exploitation, a variety of excellent governmental services are available.

Aircraft of many sizes and kinds are used extensively in combatting Canada's principal single economic problem—that of distances over difficult terrain. In size, they range between the large multi-motored craft used for transporting heavy equipment for the construction of the Quebec North Shore and Labrador Railway between Sept-Iles and Burnt Creek, and the smaller types which have over the years made such a large contribution to Canadian aviation. In certain special and localized problems, the helicopter is rapidly becoming familiar, as for exploration and development work in mountainous areas, or where the objective may be rendered inaccessible for brief intervals between climatic seasons.

In summary, and giving point to diversification, is the success which has attended upon exploration in four of Canada's five principal geological provinces which are: the Cordilleran, Precambrian Shield, the Interior Plains, the Appalachian, and the Innuition, the last-named embracing the islands of the Arctic archipelago. It is of particular significance to note that, although the two first-named have been the main source of our metals and minerals in past years, in recent years the Appalachian and Interior Plains areas justified the attention that has been directed to them and we know now that their large deposits of metallic ores and industrial minerals will exert a great influence on the economies of the political provinces concerned.

Table 1.—New Capital Investment in Canadian Mining and Quarrying Excluding Petroleum and Natural Gas (D.B.S.)

Year	Construction	Machinery and Equipment	Total
	Millions of dollars		
1947	21.8	43.3	65.1
1948	27.5	44.9	72.4
1949	29.3	36.4	65.7
1950	25.3	33.9	59.2
1951	50.5	42.1	92.6
1952	65.9	54.4	120.3
1953	80.1	62.5	142.6
1954*	95.8	66.2	162.0
Totals (1947 - 1954)	396.2	383.7	779.9

*—Subject to revision.

It now remains to describe some of the more important individual developments in the Canadian mineral industries.

Significant Specific Developments

In its history, the Cordilleran region which embraces most of the Province of British Columbia, Yukon Territory, and the foothills portion of Alberta, has produced important quantities of both placer and lode gold, lead, zinc, copper, coal, and several valuable metals and materials that are by-products of its base-metal deposits; in special circumstances it has been a source of mercury, and tungsten, and iron-ore, the latter two of which are still being produced in quantity. Asbestos has lately been added to the inventory, and there is evidence that within a few years the status of British Columbia as an important producer of copper will be enhanced.

British Columbia

In July of last year Cassiar Asbestos Corporation placed in operation a 500-ton milling unit at a property situated in the McDame Lake area of northern British Columbia, 86 miles by road from Watson Lake on the Alaska Highway. Two unusual features attend the large deposit concerned in this operation, namely, in that weathering over the years has released sufficient asbestos fibre in a "talus" deposit overlying the slopes of the hills to render much of it marketable with a minimum of beneficiation, and in that the 3-K and 4-K fibre available both in the talus and *in situ* are so low in iron, the principal contaminant of asbestos, as to render it of premium grade for many special uses. Thus, despite the remoteness of the operation, some 265 miles from Whitehorse, Yukon Territory, the economies are assured over the life expectancy indicated by the seven million tons of fibre-bearing rock blocked out, and by other showings in the near vicinity that have still to be developed.

Ranking among the world's largest producers of base-metals, The Consolidated Mining & Smelting Company of Canada, with its substantial output of chemical fertilizers is also one of the leaders in the chemical industries of North America. Predicated upon its own great Sullivan Mine, and its privately-developed hydro-electric plants on the Kootenay and Columbia Rivers in southeastern British Columbia, the Company's highly-integrated facilities provide a market for ores and concentrates of zinc and lead of a considerable part of Canada. Many industrial minerals, including phosphate rocks, find their ways to the metallurgical plants at Trail, and to the chemical plants at Warfields and Kimberley, where are produced each day some 1,000 tons of refined metal, principally lead and zinc but with important quantities of silver, cadmium, gold, and bismuth, and 1,800 tons of chemical fertilizers.

"Cominco" has recently seen the culmination of a five-year interval of investment in plant improvement and expansion of services costing more than $90 million. This includes revisions, expansions and additions to both mining and metallurgical plants, the construction of the fertilizer plant at Kimberley, and the development of

power at Waneta on the Pend d'Oreille River, where at a cost of $37 million provision has been made for the generation of 105,000 hp. from each of four units. The hydro-electric development has included the construction of an 86-mile transmission line from the Kootenay River plants to Kimberley; a unique feature of this project is the two-mile span across Kootenay Lake—the largest span in the world at the time of its completion in 1953.

In 1953 a large low-grade copper body was discovered some 25 miles northwest of Stewart, B.C., at the head of Portland Canal by Granduc Mines. Financed by Granby Consolidated and Newmont, development work is being carried out both from surface and from underground, and present indications are that a large plant will be warranted. Owing to the high altitude of mountain passes in the vicinity, the operation is being served largely by helicopter, and in the meantime a great deal of knowledge and experience is being gained regarding over-land snow transportation in the area.

Canadian Exploration Company, whose property is situated near Salmo in southeastern British Columbia, produces the bulk of Canada's two-million pound/year tungsten output from its Emerald mill, purchased from the Dominion Government in 1952.

Partly inspired by the success with which the Aluminum Company of Canada has developed the water resources of the Tahtsa-Nechako watershed for use in their new aluminum smelter at Kitimat, the Ventures-Frobisher interests are considering plans for a tremendous investment to establish electro-metallurgical plants in the Atlin area, utilizing water on either side of the British Columbia-Yukon border for the generation of electrical energy. While mainly intended for the smelting and refining of metals from imported ores, as is the aluminum smelter at Kitimat, the establishment would have a favourable effect on mining development in northern British Columbia and in the Yukon, where distances and transportation difficulties are significant cost-making factors. The project also envisages the production of pig-iron, and this could involve the economic exploitation of iron-ores in the Quatsino and Zeballos areas on Vancouver Island, at Ecstall River in the Kitimat area, and at Zymoetz River near Terrace. If these plans reach fruition, they would entail one of the very largest single concentrated investments made at any one time by private enterprise in Canada, the figure contemplated being in the order of $2,000 million.

Yukon

Post-war improvement in metal prices encouraged the revival of silver-lead-zinc deposits in the vicinity of Mayo, some 180 miles south of the Arctic Circle. United Keno Hill Mines, aided by the improvements in highway facilities and other methods of transport, and by electrical power development of the Mayo River, has enjoyed a considerable success in its exploitation of high-grade silver-lead-zinc ore.

That success, together with aggressive development of power and transport facilities by the Dominion Government, has brought much attention to the Yukon as one of the potentially great mineral frontiers of Canada. In very recent years, new discoveries of lead-zinc in the Pelley River region, of nickel-copper in the Kluane Lake area, and of copper in the southwest portion of the Territory, have attracted the attention of some of Canada's most important mining and exploration companies, including Prospectors Airways, Hudson Bay Mining and Smelting, Noranda Mines, Ventures-Frobisher, and Conwest Exploration, as well as Newmont, and American Smelting and Refining, the latter two being of the United States.

Northwest Territories

Near the south shore of Great Slave Lake and some 500 miles north of Edmonton, Pine Point Mines are conducting a major investigation of a mineralized zone some 36 miles long by 3 miles wide. The original discovery of lead-zinc was made in 1898, but interest did not become alive until 1948, when Consolidated Mining & Smelting of Canada and Ventures took out a 500-square-mile prospecting concession to cover the large area known to be favourable, and diamond-drilling began. Three to four million dollars have been spent on testing this ground by diamond-drilling and prospect shafts, and ore-bodies have been found along the structure to an aggregate of several million tons. Efforts are directed toward establishing sufficient ore reserve of suitable tonnage and grade to justify the construction of a 430-mile railway from Grimshaw, Alberta.

Since 1938, when gold was first produced at the "Con" Mine of The Consolidated Mining & Smelting Company of Canada near the present town of Yellowknife, the Northwest Territories has received a great deal of attention from exploration companies and prospectors. Prior to that time, petroleum and natural gas at Fort Norman on the MacKenzie River, and radium at Great Bear Lake, had accounted for the mineral production of the Territories; all of these continue in full vigour.

The Giant Yellowknife mine began producing gold in 1948, and now ranks fourth among Canada's straight-gold producers; its milling rate is now 800 tons of ore per day and its ore grade is 0.8 ounce per ton. Although smaller, the Consolidated Discovery Yellowknife mine is situated some 60 miles north of Yellowknife and enjoys the distinction of being Canada's most northerly lode-gold operation, as well as that of having the highest grade, 1.26 per ton.

At Rankin Inlet, on the west coast of Hudson's Bay and some 300 miles north of Fort Churchill, North Rankin Nickel Mines presents a case in point of the spirit of venture that characterizes Canadian mining. Discovered in 1928, after long years of idleness it was revived in 1951 when surface work and diamond-drilling indicated the presence of nearly a half-million tons of good-grade nickel ore, which contains copper and platinum metals as well. In the summer of 1953, a cargo of 1,500 tons of freight, including a complete shaft-sinking plant and its supplies, as well as building and miscellaneous equipment, was landed by a chartered steamer which had voyaged 2,800 miles from Montreal, with a brief stop at Sorel for the loading of 50 tons of dynamite.

Saskatchewan

Since 1948, when uranium was discovered near Beaverlodge Lake by prospectors working for Eldorado Mining & Refining, a Crown Company, the results have been most spectacular. The wave of exploration, which followed the admittance of private companies to the right to prospect for radioactive materials, has increased our

knowledge to include a favourable belt extending from the Alberta boundary for a distance of eighty miles along the north shore of Lake Athabaska.

The Crown-owned Eldorado company has four principal properties in the area, and in April, 1954 brought into production their carbonate-leaching plant for the treatment of both their own ores and similar ores from other nearby mines. This extraction plant, which is a monument to Canadian technical enterprise, at present has a capacity of 800 tons of ore per day and is designed for expansion to an ultimate of 2,000 tons. Rix Athabasca Uranium Mines last year became the second company to produce ore, and this is shipped by truck to Eldorado; they have been followed in the list by Nesbitt-Uranium Mines.

In September of this year Gunnar Mines expects to begin production of uranium ores from its open-pit mine at a rate of 1,250 tons per day. This company, at an investment totalling $17 million, has in construction an acid-leach plant, for the extraction of uranium oxide that will utilize elemental sulphur at a rate of 14,000 tons a year and obtained from the petroleum industry of Alberta for the preparation of the necessary sulphuric acid.

Potash is contained at various places in Saskatchewan's widespread, deep salt bed, and at Unity Western Potash is now engaged in sinking a 3,200-foot shaft to exploit a deposit estimated to contain 16 million tons of KCl. Considerable physical difficulty has attended the sinking, owing to beds of quick-sand and other wet unconsolidated material that have been encountered. The Potash Company of America is preparing to sink a shaft, costing some $3.5 million, on its property 15 miles east of Saskatoon; the operation will be of considerable technical interest in that the ground is being prepared by freezing before starting the sinking operation, using an 800-ton refrigeration plant.

Manitoba

Late in 1953 Sherritt Gordon Mines started up a 2,000-ton concentrator on their nickel-copper property at Lynn Lake in north-central Manitoba. This operation is integrated with the Company's own metallurgical works placed in operation during 1954 near Edmonton, Alberta, the whole involving an investment of more than $40 million. Several interesting features attend the enterprise, which will have a capacity of 17 million pounds of nickel a year and about half that quantity of copper.

The company formerly operated a copper-zinc-gold-silver mine and concentrator at Sherridon and, as its ores were to become exhausted in 1951, attention was turned to the Lynn Lake property, 165 miles farther to the North, which had been discovered in 1941, primarily through geophysical methods. Having a considerable equity in plant and townsite, an economic decision was taken with the result that the entire plant and townsite were transported over winter roads in 1951-52; thus, rather than leave Sherridon to become a "ghost town", the "patient" was taken along and put to work.

From metallurgical tests conducted on Lynn Lake ores beginning in 1946, a method of treatment was evolved that promised to give both operating economies and better extraction than in a conventional smelting plant, and this culminated in the construction of the refinery at Edmonton where the concentrates are subjected to a pressurized ammonia leach, deriving both ammonia and process heat from the natural gas of Alberta. The whole programme of research, and its attendant result, is a remarkable Canadian achievement, and its success may well pave the way for the development of hydrometallurgical processes for other Canadian base-metal ores and concentrates.

The International Nickel Company of Canada have been prospecting for nickel in Manitoba, and a great deal of geophysical survey work and geological deduction has converged on a large low-grade deposit in the Mystery Lake area. During the past winter, a plant has been transported to the site, and a 2½-year programme of shaft-sinking to a depth of 1,300 feet and attendant underground exploration is now being embarked upon.

Ontario is enjoying a full measure in the general expansion of the mineral industries, and in 1954 50,000 mining claims were staked, an all-time record. This activity, combined with plant expansions, heavy investment in properties discovered in recent years and now under development, and research on metallurgical processes for new metals, ensures the Province's position as the producer of about one-third of the Dominion's total dollar-value of minerals.

Ontario

Although tending to become overshadowed in the public imagination by the spectacular developments in the uranium mines in the Blind River and Bancroft areas, expansion and technical innovation in the nickel-copper industry near Sudbury continue at a phenomenal rate. The increase to the present daily ore tonnage of 58,000 tons being mined at the five mines of International Nickel Company of Canada represents the culmination of more than $150 millions spent on mine and plant expansion and conversions since the last war, a rate of investment that shows no sign of let-up. Technical innovation in the Company's operations is the fruit of much research, including "flash" smelting of concentrates in oxygen-enriched atmospheres, and the addition of metallic cobalt to the thirteen metals and other elements recovered from their ores. At present, much attention is attracted to the Company's latest project, a $16-million plant now under construction near Copper Cliff for recovery of nickel from low-grade pyrrhotitic concentrates; important by-products of this plant will be sulphur, and about one million tons of premium-grade iron oxide per year, eminently suitable for blast-furnace feed as it will contain 65 per cent iron and less than two per cent silica.

Falconbridge Nickel Mines, the Province's other nickel-producing company, is engaged in a proportionate expansion of productive facilities, and by 1960 is planning to produce the metal at an annual rate of 55 million pounds, with about half that quantity of copper. The full expansion is expected to cost in the order of $55 million in new mines now under development, and in additions to concentrating and smelting capacities.

The already-great possibilities for uranium production in Ontario present a picture which may be suddenly enlarged, almost overnight. In September of this year, Pronto Uranium Mines, with a firm arrangement with Eldorado for the marketing of some $55 million-worth of uranium-oxide precipitate, will begin production at their 1000-ton mill in the Blind River area. Algom Uranium Mines,

controlled by Preston East Dome Gold Mines, with two principal properties in the Blind River area as well as participating interest in several others, is now engaged in underground development work at both their Quirke Lake and Nordic Lake properties, which together appear as one of the world's largest sources of the metal. A few weeks ago, the Company's treasury was enhanced by the proceeds of a $40-million bond and debenture issue substantially taken up by a group headed by one of Great Britain's largest and most conservative mining companies, Rio Tinto Limited.

Present iron-ore enterprise has no resemblance to what was virtually a step-child of the Province's mineral economy a relatively few years ago, and by 1960 it is likely that shipments from the three fields, Steep Rock Lake, Michipicoten, and Marmora, will have reached an annual rate of 12 million tons. Steep Rock Iron Mines, which in the early years of the late war made engineering history in their drainage, un-watering and dredging of a large portion of Steep Rock Lake, have begun work on a second ore-body, and plan to raise their ultimate shipping capacity from this year's 2 million, to 5.5 million tons of ore per year. Further, Steep Rock have leased still another ore-body to Caland Ore Company, Canadian subsidiary of Inland Steel Company, and that company is to spend an estimated $50 million in pumping and dredging some 160 million yards of silt from the lake bed in order to prepare the ore-body for production. This project, like Steep Rock's original, is in the same order of magnitude as the aggregate dredging work done in the construction of the Panama Canal. Production at the rate of 3 million annual tons is expected to begin in 1960.

The Province's pioneer iron-ore company on the modern scale is Algoma Ore Properties, who are now mining entirely by underground methods at their property in Michipicoten, and now have a capacity of 1.5 million annual tons of high-grade sinter. At present, the company is engaged in a development programme which will prepare for mining an estimated 50 million tons of ore situated below the present mining horizons.

In Eastern Ontario, Marmoraton Mines, a subsidiary of Bethlehem Steel Corporation, a few weeks ago started the production of blast-furnace-feed at their property near Marmora. It enjoys the distinction of having the first ore-body in Canada, if not in the world, whose presence was first indicated exclusively by aeromagnetic survey and the discovery was made as recently as in 1949. Lying beneath a 100-foot thickness of limestone capping, involving the removal of some 20 million tons of this material before production could begin, is a body of disseminated magnetite containing about 18 million tons of 35 per cent ore. The ore is mined in an open pit, and is beneficiated in a near-by concentrator to produce a pelletized ore-grade material which is shipped through Picton to Buffalo, N.Y. Rated output is 500,000 tons of furnace-feed a year from the operation which represents an investment in the order of $15 million.

Two years ago a major discovery of zinc-copper-silver was made near Manitouwadge Lake, 65 miles southwest of Geraldton, and sufficient ore has been proven by Geco Mines to warrant production at the rate of 3,300 tons per day from a 15 million-ton ore reserve. Mine development and plant construction are now going on, under the financial sponsorship of Mining Corporation of Canada and Noranda Mines. The significance of this mine and its surrounding area is also emphasized that planning and construction of railway, highway, and power facilities to the area are proceeding apace.

Another interesting venture of Noranda Mines in Ontario is the plant placed in operation late last year near Niagara Falls, wherein pyrite concentrates from their present property at Noranda, Quebec, are treated at 350 tons a day. The principal products are: a high-grade iron-oxide suited for use in the steel industry, elemental sulphur, and sulphur-dioxide gas for use in the manufacture of sulphuric acid. The gross saving of sulphur imports to Canada are expected to be almost 54,000 annual tons, and some 75,000 annual tons of high-grade iron-oxide will be made available to Canadian steel mills from the plant, which required an investment in excess of $4 million.

The industrial minerals are also receiving their fair share of attention in Ontario, and among enterprises worthy of attention are Canada's first asbestos producer lying outside the Province of Quebec, near Matheson, where Canadian Johns-Manville makes an output worth about $4 million each year. Of considerable technical interest as well as an important enterprise is the mine and plant under construction near Windsor by the Canadian Rock Salt Company. There, in order to sink a shaft successfully to a depth of 1,100 feet through wet unconsolidated strata, the ground had to be prepared by freezing, utilizing a 200-ton refrigeration unit; production of rock salt on a substantial scale is expected to begin some time this year. Nepheline syenite, of vital importance in the ceramic industry, and with many other uses, is produced at Lakefield, near Peterborough, by American Nepheline, a subsidiary of Ventures, whence 1954 shipments amounted to 120,000 tons.

Quebec

The Province of Quebec continues to grow at a rapid rate, and nowhere is this more evident than in the stature and diversification of its mineral industries. Of the recent developments, the most spectacular is the opening of the Labrador peninsula which is shared with the Province of Newfoundland. Shipments of iron-ore from bodies lying astride the boundary between the two Provinces began in mid-summer of last year by the Iron Ore Company of Canada, and by the end of the year two million tons had reached the St. Lawrence River port of Sept Iles whence the first transshipment was made on 31st July. Shipments are expected to amount to five million tons this year, and the objective of 10 million annual tons will undoubtedly be reached within two years hence. As is well known, this enterprise involved an investment of more than $200 million, including exploration, preparation for mining, the provision of trans-shipping facilities at Sept Iles, construction of a hydro-electric plant, and the construction of the 360-mile Quebec North Shore and Labrador Railway which is served by the most up-to-date communication system on any railway anywhere.

Last month, the large, low-grade copper mine of Gaspé Copper was brought into production and within a short time will reach its milling rate of 6,500 tons per day, the largest initial designed rate of any concentrator in Canada thus far.

Noranda Mines, whose subsidiary it is, provided nearly $40 million for exploration, development, and the provision of townsite, concentrator and smelting facilities which will produce 125 tons of copper anodes daily. Ore reserves are currently estimated at 67 millions of tons, containing 1.3 per cent copper. At present utilizing electrical energy developed by diesel engines, to be augmented by waste-heat boilers, the plant will shortly be supplied by the North Shore developments of Hydro-Quebec at Manicougouan and Bersimis; energy will be delivered to the Gaspé through a line which includes a four-conductor submarine line reaching some 32 miles across the St. Lawrence near Matane, the longest of its kind in the world.

The asbestos of the Province centred at Asbestos and Thetford Mines, continues to produce about 70 per cent of the world's mineral fibre, and is maintaining that position by constant endeavours toward plant efficiency and expansion. A few months ago, Asbestos Corporation completed construction on its new 5,000-ton mill at Normandin costing $14 million; last summer, Johnson's Company brought to production their new 4,000-ton mill at Megantic, involving an investment of $8 million; at an unspecified amount of investment but which must be very substantial, Canadian Johns-Manville have begun operation in a new mill designed to handle upwards of 15,000 tons of fibre-bearing rock. Three companies at Thetford, Asbestos Corporation, Bell Asbestos Company, and Johnson's Company are together spending nearly $6 million on a re-location of surface installations, including the Quebec Central Railway, in order to release additional fibre-bearing rock for mining. Other new projects in the area include those of Quebec Asbestos Corporation, United Asbestos Corporation, and Flintkote Company, all of whom have plans for productive services at an aggregate cost of more than $30 millions.

Quebec Iron and Titanium Corporation are mining by open-pit methods on what is held to be the world's largest ilmenite deposit near Havre St. Pierre on the north shore of the Gulf of St. Lawrence. The ore-body is estimated to contain 112 million tons of material grading 32 per cent titanium dioxide, and 36 per cent iron. The Company operates an electric-furnace plant at Sorel, Quebec, with a total rated capacity of 1,500 tons a day, for the production of 250,000 annual tons of titanium-dioxide slag and 175,000 tons of high-grade pig-iron. This mining-and-metallurgical enterprise required an investment in the order of $15 million.

The district of Chibougamau has at last justified the faith of a few who for many years have held belief in its potentialities, and development of the area has followed rapidly on the construction of a 150-mile all-weather highway from St. Felicien. One producer, Opemiska Copper Mines has now completed a year of successful production at a daily rate of 400 tons of ore, and another copper-gold mine, that of Campbell Chibougamau Mines has recently turned over its 1750-ton mill. A third mine, that of Chibougamau Explorers is now engaged in the construction of a 750-ton plant.

The Eastern Townships of Quebec, long of historical interest in base-metals production at Eustis, Victoria, Capelton, and other centres, have shown a strong revival since the end of the war. Beginning in 1948 with Ascot Metals at Moulton Hill, near Sherbrooke, this company and its associates are exploiting important copper-zinc ore deposits at Suffield, near Lennoxville; and are currently investigating a large, low-grade nickel occurrence. Quebec Copper Corporation have been rewarded in their investigation of the old Huntingdon, Ives, and Boulton Mines, situated some 70 miles southeast of Montreal, and now have their 750-ton mill in profitable production.

Large prospective mining enterprises afoot in the Province include lithium from La Corne Township, an area which is already the source of the only molybdenum produced in the British Commonwealth. Near Oka, about 30 miles to the west of Montreal, a newly-found area shows considerable promise, and plans are already afoot for the production of molybdenum concentrates from the mining of some 2,000 tons of ore a day.

New Brunswick

With virtually no history in the production of metals or metallic ores, New Brunswick now has sufficient reserves of base-metals to support a large industry for many years to come, and the emergence of its importance has come about almost entirely as a result of geophysical work, both from the air and on the ground. Many of Canada's mining and exploration companies are represented in the Bathurst-Newcastle area, which is now known to contain large reserves of lead, zinc, copper and pyrite. The largest to date is that of Brunswick Mining and Smelting Corporation, controlling two large properties at and near Austin Brook, 16 miles to the south of Bathurst, where present plans envisage a concentrator with a capacity which may reach 10,000 tons daily, together with smelting facilities. The original Austin Brook and the Anacon-Leadridge property together are estimated to contain 60 to 100 million tons of ore to a depth of 1,000 feet, containing 5.3 per cent zinc and 1.7 per cent lead in addition to copper and pyrite. The metallurgical possibilities are now being tested in a pilot plant, and mine development at both major properties is now proceeding on a programme which may require several years to unfold to its full productive possibilities, involving a real investment which may approach $100 million.

During the past year, the American Metal Company made an important discovery near Little River, about 30 miles equidistant from Bathurst and Newcastle. From preliminary drilling results it was estimated that, to a depth of but 300 feet, the body contained four million tons, of which three million grades 4.5 per cent lead, 10.5 per cent zinc, 0.50 per cent copper, and 4 ounces silver per ton.

Within this small area, therefore, and within a span of four years, there have been placed in sight reserves which in total economic output can well be comparable with those at Kimberley, B.C.

Nova Scotia

Hitherto noted mainly for coal, and the production of such industrial minerals as gypsum, barite, and rock salt, the success of New Brunswick has prompted large-scale base-metals exploration in Nova Scotia. The Province at present produces 85 per cent of the Canadian output of gypsum, with about three million annual tons; 98 per cent of the barium, at about 250,000 tons; and, hitherto, all of the rock salt, at 130,000 tons.

(*Continued on page 1206*)

Showing the conservation of neutrons is a basic problem in reactor design, the author enumerates the various fissionable fuels available for producing economical power. Pointing out that the choice of the type of reactor is the first decision, he lists the various types of reactors, giving their respective advantages and shortcomings. Methods of feeding the fuel into the reactor are discussed, as well as some of the problems involved in assuring safe operation.

Problems in Producing

Power From Nuclear Fission

by

F. W. Gilbert,

Atomic Energy of Canada Ltd., Chalk River, Ont.

A paper presented before the Toronto Branch of The Engineering Institute of Canada, March 1954.

One of the popular ways to introduce the subject of power from nuclear fission is to discuss world resources of fuels. It is sufficient at this time to say that this is a real problem in the world as a whole, and in Ontario in particular. The problem, of course, is how to produce economical power from nuclear fission. Let us take a look at some of the possible ways of doing so.

It is not necessary to know the complex nature of chemical bonds to burn coal. Neither is it necessary to know the complex nature of the atomic nucleus to use fission. The simple facts are these. Natural uranium consists of two materials —U^{235} and U^{238}. Of these U^{235} is a natural fuel and U^{238} is a potential fuel. These are known as fissionable and fertile materials respectively. When U^{235} is bombarded with neutrons it gives off energy, fission products and neutrons. These neutrons can be used to carry on the process and produce a chain reaction.

But there is a limited number of free neutrons. If it were otherwise all the uranium 235 would have been destroyed millions of years ago. This gives the inkling that neutrons must be conserved. In fact this is the whole basis of the chain reacting pile, and one of the major problems in nuclear reactor design. The free neutron balance sheet shows this.

Hypothetical Free Neutron Balance Sheet for 100 fissions

From fission of U^{235}	250
Producing fission	100
Captured by fuel without fission	18
Captured in fission products structure, coolant, moderator	62
Escape	20
Surplus	50
TOTAL	250

The above balance sheet is strictly hypothetical, and is for a U^{235} reactor. It can be seen that the surplus of neutrons would react with other atoms of U^{235}. This would be over that required for a simple chain reaction. The power would increase very rapidly and the reactor would destroy itself.

Several things can be done to correct this. First the pile can be decreased in size until 70 neutrons escape. This is known as the critical size of the reactor. Or other neutron absorbers could be built into the reactor. But both these methods waste valuable neutrons. They can, of course, be used for producing useful isotopes such as Cobalt 60.

But at the moment our interest is in getting the most power for the least money. Therefore, the material that is inserted is one of the so-called fertile substances. The common fertile substances are U^{238} and thorium. Both these under neutron radiation produce other fissionable materials. Hence this is a method for increasing the natural fuel supply.

Natural uranium contains only 0.7 per cent of U^{235}. The remainder is U^{238}. For every neutron captured by U^{238}, one atom of plutonium is formed. This is a new fuel. In the balance sheet it can be seen that by putting in U^{238} to reduce the surplus of neutrons to zero, it will be possible to form 50 atoms of plutonium to replace the "burned" U^{235}.

By a simple geometric progression it can be shown that this will double the fuel available. If the reactor can be designed to give a surplus of 90 neutrons, then the fuel reserve will be 10 times that found in natural uranium, and so on. Regeneration or breeding is taking place. If the surplus neutrons exceed 100, then the world fuel supply can be increased.

Hence the conservation of neutrons is of major importance in the design of power reactors. Like any other fuel, the available supply of uranium 235 depends to some degree on what you can afford to pay for it. In the examples given the burn-up of natural uranium extends from 0.7 to 7 per cent. The spread is one of the reasons for the wide variation in estimates given of uranium ore reserves, and also for the wide variation in estimated power costs. To each the question —what is the breeding efficiency? —must be applied.

The conservation of neutrons is the basic engineering problem of power reactor design. Most of the others pivot around this. For example, the energy generated must be at a high enough temperature to be useful. In a heavy water reactor this means a pressure vessel with the fuel on the inside. This fuel has to be changed periodically to remove the neutron-absorbing fission products. The equipment to do this must be such that it does not increase the parasitic absorption.

In the uranium 235 reactor just described there is both U^{235} and U^{238}. If the reactor is properly designed these two can be combined to form the same rods or slugs. The natural uranium reactor is, of course, just the opposite; the isotopes have not been separated. Here is one of the variables in design—every combination from pure U^{235} to a mixture of U^{235} and U^{238} having more than the natural abundance of U^{238}. From this infinite variety the engineer must select the one best suited for his use.

Assume that he has selected a natural uranium rod reactor, surrounded by a blanket of thorium to catch the escaping neutrons. Also assume that heavy water is to be used as the moderator. The

next problem is to obtain useful heat. The way to do this is to make the reactor a pressure vessel. The high temperature heavy water can then be circulated through a boiler which generates light-water steam to run a turbine. No doubt this would work. But how do you change the fuel? Remember that it is inside a pressure vessel and it is highly radioactive. Unless expensive standby equipment is to be provided, it must be changed under power.

Slurry Reactor

One answer that has considerable merit is the slurry reactor. This is essentially a homogeneous reactor containing a slurry of uranium in heavy water. The slurry is pumped through the boiler to remove the energy. Some of the slurry is continuously removed and new slurry added to maintain equilibrium conditions.

The fuel changing problem is solved, but the slurry reactor has problems of its own. Not the least of these is the problem of circulating such a highly radio-active fluid. However, in the slurry reactor it should be possible to reduce the number of neutrons captured in the fission products, and improve the breeding efficiency.

Fast Reactor

Finally, in the list of possible types of power reactors is the fast fission reactor. This type of reactor can best be described as a controlled atomic bomb. The fissions are promoted directly by the high energy neutrons. Materials generally do not capture high energy neutrons. Hence the neutron economy is exceptionally good regardless of what materials are used in the reacting core.

The fast reactor has two major problems. The first is control. Although it is possible to have minor explosions with thermal reactors, a fast reactor out of control could become an atomic bomb. The second is the heat transfer problem. A fast reactor is necessarily a small reactor. It is so small that the power that could be removed by heat conduction would greatly limit the output.

Before a power reactor is built, the first problem is the selection of the type of reactor. In the thermal or slow neutron range there are available all combinations of U^{235} and U^{238}. These can be used in combination with all types of moderators. The pure fissionable material reactor is the easiest to build but most wasteful.

The reactors with natural uranium in rods or slugs have the advantage that most experience has been with this type. The slurry reactor simplifies the problem of fuel changing and processing. Against these is the fast reactor, which has such a terrific neutron economy and is the most likely to produce not only power, but a surplus of fuel.

Safe Operation of Reactors

Having chosen the type of reactor, the next problem facing the engineer is to keep it operating safely. The problems of safe reactor operations are somewhat unique. In the hypothetical reactor illustrated by the balance sheet, the power would double every 0.003 of a second. Or in one second the power output would be multiplied by a figure having some 90 digits in it.

Such a figure is ridiculous as many other effects would occur before the one second had passed. But the pile would destroy itself. Fortunately it is neither necessary nor desirable to design the reactor with these characteristics.

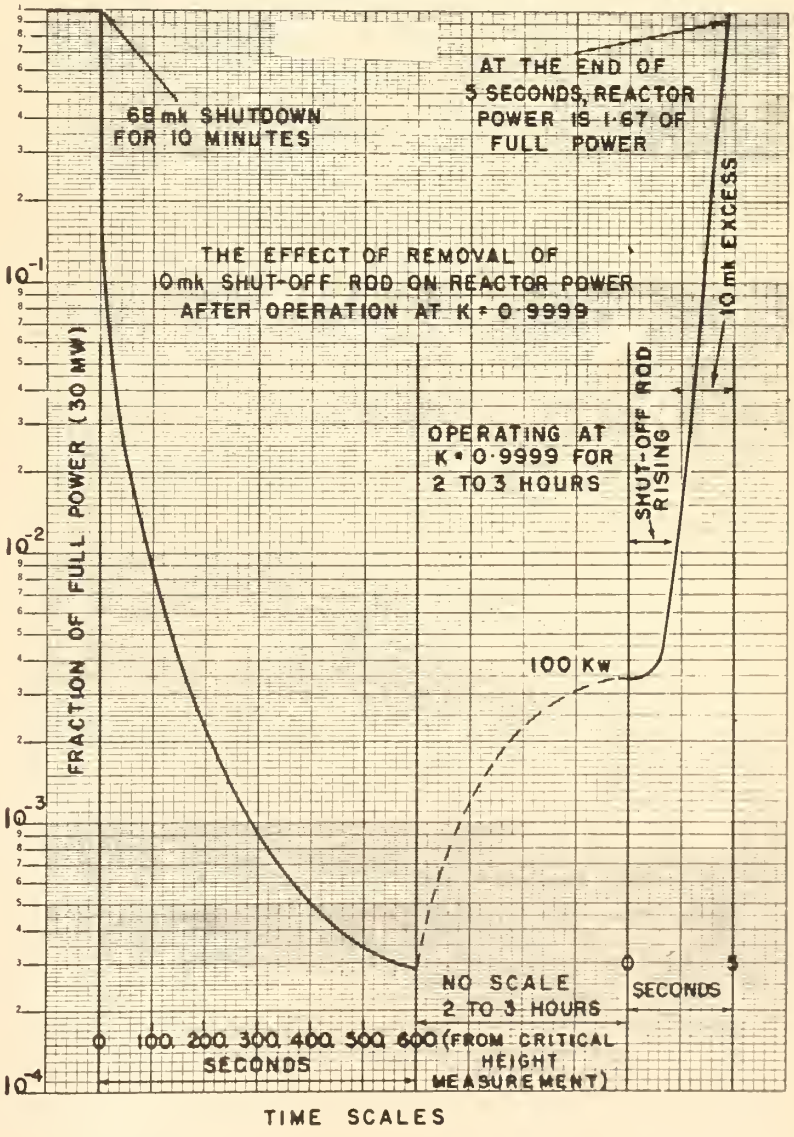
The control problem can best be illustrated by starting with a definition of K_{eff}, the multiplication factor. This is given by

$$K_{eff} = \frac{a - c}{b}$$

where a is the number of neutrons added to the system by fission,
b is the number of neutrons removed from the system by absorption or fission capture,
c is the number of neutrons that leak out of the reactor.

If $K_{eff} = 1$ the reactor is at equilibrium for any power;

Fig. 1. Effect of changes in K_{eff} as it refers to NRX reactor.



$K_{eff} > 1$ the power is increasing;

$K_{eff} < 1$ the power is decreasing.

In Fig. 1 the effect of changes in K_{eff} is shown as it refers to the NRX reactor. This curve illustrates the speed at which control must be exercised. In a thermal reactor, control is usually obtained by moving in or out a neutron absorber. In the short time available it is necessary to actuate a power-indicating device which in turn sends a signal to a drive unit. The drive unit has to insert enough absorber before the power output is high enough to cause damage. The safety circuits must be sensitive, quick, and reliable. In addition, all instruments must "fail safe." That is, the safety circuit must interpret a false signal as a dangerous one and cause the reactor to shut down. For continuous operation as required for power production, one other specification is required, namely that the safety circuit must have practically no failures. This problem has been solved for experimental and production reactors so that good operating efficiencies are obtained. But it is required that the efficiency be extended for power production.

Other problems are those of chemical and metallurgical processing of the fuel. Any fissionable material lost in processing has the same significance as lost neutrons in the pile. Another problem is that of safety. Apparently few complaints are heard regarding the danger to health and property from "smog," yet the public reacts quickly to the threat from radioactive dusts. The second attitude is at it should be. But it does increase the costs.

The problem of power from nuclear fission is strictly one of economy. Any of the problems of power production can be solved if costs are ignored. But costs cannot be ignored if competitive power is to be put on the market. √

NEW DEVELOPMENTS IN THE CANADIAN MINING FIELDS

by H. R. Rice

(*Continued from page 1203*)

The only base-metal mine in operation is that of Mindamar Metals, Richmond County, Cape Breton, where 600 tons of copper-lead-zinc ore are treated daily.

The operations of the Dominion Coal Company are at present undergoing a heavy mechanization programme in the expectation that the resulting productivity will restore the Province's competitive position in the coal trade. The most prominent device in this programme is a continuous mining machine, known as the "Dosco Miner" which obviates the intermittent cycle of drilling, blasting, and loading. Electrically-powered, and hydraulically-controlled, one of these machines is able to cut and load 500 tons from a longwall face in each eight-hour shift; the company now has more than twenty of the units in operation.

Newfoundland

The Province of Newfoundland has come into a full measure of attention in the wave of exploration and development, and mineral production has recently shown a sharp increase. The larger proportion of the initial production of the Iron Ore Company of Canada has been derived from the Ruth Lake deposit, which lies on the Labrador side of the Quebec-Newfoundland boundary, and accounts for much of the statistical increase.

The Dominion Wabana Ore Company, supplies of iron-ore to the Dosco steel mills at Sydney as well as an important exporter to Europe, is engaged in a programme of complete mechanization at their 50-year old mine on Bell Island, designed to increase both production and productivity to an extent hitherto unrealized. In recent years there has been placed in operation at this mine a system of conveyor belts for hoisting mined ore from the workings which now extend some three miles out at sea, through a vertical distance of 1,730 feet, constituting the highest-lift sloping conveyor in the world. Consistent with this is the complete mechanization of underground breaking, loading, and hauling operations, which will contribute a great deal to the ability to produce ore at an annual rate of nearly three million tons. A large heavy-media separation plant is now being envisaged, toward the end that the ore will be made more competitive in the markets by reducing its silica content.

For some years the Province has been a substantial source of fluorspar, an industrial mineral of importance to the smelting of both aluminum and steel, and in 1954 shipments were 119,000 tons.

The above inventory of development in the Canadian mineral industries does not include a number of projects which have arisen during the wave of exploration but which at present lie on a technological frontier of one kind or another, but which promise to lend further value and diversification to the industry. Among these are several deposits containing elements of vast importance to the requirements of the rapid developments which are taking place in all branches of manufacturing, construction and fabrication.

It is hoped however that the account has been such as to lend point to the dynamic character of our Canadian mineral industry, which is gathering much strength in its assault on technological and economic frontiers, and which is enjoying the respect of the whole free world in the manner in which it is able to find ores and minerals for the human needs. With regard to the implications affecting other branches of engineering, as represented in the ranks of the Engineering Institute of Canada, the magnitudes of our requirements of electrical energy, improvements in the tools with which we work, the devising of new chemical and metallurgical processes, the planning of municipal services, the provision of transportation systems; all are greatly enhanced by the recent developments outlined here. They give much point to the claim that has often been made that the discovery of economic mineral resources leads the way in creating the initial incentive for engineering projects of many kinds that otherwise would either not come into being at all, or would at best be delayed for generations. √

Acknowledgments

In compiling this paper, a number of published sources have been drawn upon to augment and to lend specification to personal knowledge gained through travels in the former capacity of Editor of *Canadian Mining Journal*. Prominent among those sources are:

Graves, H. A., A Decade of Progress in Canadian Mining. Bull. Inst. Min. Met., London, 1955, No. 581, April

McLeod, H., et al. Canad. Mining Journal, Ann. Rev. Nos. (Feb.) 1950, 1951, 1952, 1953, 1954, et al.

The Northern Miner, Toronto. Ann. Rev. No., 1954, Nov. 25.

Les Caractéristiques mécaniques des sols et des solides

by

A. Couard,

Ingénieur Civil de l'École Nationale des Ponts et Chaussées.
Ingénieur Conseil,
Paris, France.

In this paper the author considers some theories relating to the compressive strength and shearing resistance of soils and solids. He shows how these theories can be applied to structural members subjected to torsion and triaxial stresses with special reference to reinforced concrete beams.

Comme les théories actuelles, avec leurs hypothèses de base, ne donnent pas d'interprétation satisfaisante des phénomènes expérimentaux, et que l'on s'explique mal la différence des points de vue de la mécanique des sols et de celle des solides, nous avons tenté de reprendre ces questions à la base, c'est-à-dire depuis les hypothèses physiques elles-mêmes.

Nous admettrons comme caractéristiques de base d'un corps quelconque: l'angle de frottement interne ϕ (avec la compacité comme correctif) et la résistance vraie à la traction R′ (avec la fragilité comme correctif).

Toutes les autres caractéristiques ne doivent être que les conséquences de ces données initiales, et doivent pouvoir s'en déduire qualitativement et quantitativement.

Résistance à la compression simple R

Si nous considérons un prisme rectangulaire d'épaisseur unité et de largeur *a* soumis à des contraintes orthogonales p et p^o avec $p > p^o$ et que nous écrivions simplement l'équilibre des forces suivant le plan de rupture AB, nous avons:

$N = p\sin\beta \quad N^o = p^o\cos\beta/\mathrm{tg}\beta \quad T = p\cos\beta \quad T^o = p^o\cos\beta$

et en admettant que R′ est réellement la résistance isotropique au déplacement intergranulaire, la résistance tangentielle à tout déplacement dans le plan AB est $R'/\sin\beta$ au coefficient constant *a* près, et l'équilibre des forces correspond à:

$$T - T^o - R'/\sin\beta = (N + N^o)\mathrm{tg}\phi \quad \text{ou}$$

$$p = \frac{R'}{\sin\beta\cos\beta - \sin^2\beta\,\mathrm{tg}\phi} + \frac{p^o\,(\sin\beta + \cos\beta\,\mathrm{tg}\phi)}{\sin\beta - \sin\beta\,\mathrm{tg}\beta\,\mathrm{tg}\phi}$$

dont la dérivée est

$$\frac{dp}{d\beta} = \frac{(\mathrm{tg}\phi + R'/p^o)\,(\sin 2\beta\,\mathrm{tg}\phi - \cos 2\beta)}{\sin^2\beta\cos^2\beta\,(1 - \mathrm{tg}\beta\,\mathrm{tg}\phi)}$$

nulle pour $\beta = 45° \pm \phi/2$ quels que soient p^o et R′ ce qui est la loi de Coulomb.

Si $\phi = 0$ on a $p = 2R'$ ce qui diffère des théories classiques, qui, d'après la courbe intrinsèque, veulent que la résistance à la traction et à la compression soient égales. En réalité, à notre avis, on appelle pour les solides, résistance à la traction, ce que l'on appelle cohésion pour les sols, pour masquer le fait que ce que l'on appelle résistance à la traction d'un solide et que l'on mesure à la rupture, n'est pas la vraie résistance à la traction:

Quand on casse un solide par traction, il n'est plus, à la rupture, dans son état initial, car son organisation moléculaire a été modifiée par écrouissage. Cet écrouissage par étirage élève la résistance à la traction, ce qui est bien connu pour les métaux, dans une proportion variable avec la fragilité, et le solide n'est plus isotrope: Il a changé de nature et de caractéristiques.

Des essais de cisaillement libre, de torsion par exemple, ne paraissent pas donner autant de facilités à l'écrouissage de se manifester, et la vraie résistance à la traction R′ devrait pouvoir être déduite, grâce aux formules suivantes, d'essais de torsion pure, ou de cisaillement libre (sans plan de rupture imposé), en fonction de ϕ mesuré par des essais de compression simple comme indiqué ci-dessus par exemple, si le matériau est idéalement fragile.

La fragilité pourrait être définie et mesurée par le rapport $\frac{R'\ \text{expérimental}}{R'\ \text{théorique}}$, le premier étant obtenu à la traction lente et rapporté à la section vraie après striction, à la rupture, et le second par des essais de cisaillement simple.

Résistance à la traction R′

Il est intuitivement évident que ϕ (en mouvement) doit être inférieur à 45° car $N\mathrm{tg}\phi > N$ est physiquement impossible sans abrasion. On ne peut pas admettre que le frottement puisse agir comme un levier multiplicateur de force, ou alors le coefficient d'enchevêtrement de Caquot n'est pas constant, ou la valeur maximum de ϕ est 32°40′ pour la surface polie d'un corps quelconque, et nous ne connaissons pas de cas réel de ϕ plus élevé.

Cette hypothèse concorde d'ailleurs avec notre formule de résistance en pointe des Pieux (Génie Civil 1/1/52) qui est pratiquement asymptotique pour $\phi = 45°$ et dont les résultats ont toujours concordé avec les mesures de laboratoire quand il en a été effectué. Notre courbe aurait d'ailleurs été parfaitement asymptotique si l'on avait admis que la compressibilité soit nulle sous une pression infinie, ce qui est évident, mais la loi logarithmique de Terzaghi est très suffisamment approchée dans le domaine pratique.

L'hypothèse de l'isotropie n'est valable que pour les matériaux idéalement fragiles; s'ils ne sont pas fragiles, l'écrouissage réoriente les particules élémentaires, le solide devient anisotrope, et la rupture par traction se produit nécessairement suivant une section droite $\beta = 90°$. Il serait néanmoins inexact d'en conclure $\phi = 90°$ et la verticalité de la tangente à la courbe intrinsèque.

L'intuition expérimentale incite à penser que l'étirage doit réduire la compacité, et par conséquent ϕ, au lieu d'augmenter sa valeur jusqu'à 90°, ce qui est de toute façon une impossibilité physique.

Si l'on nous objecte que les équations précédentes donnent $\pm p = 2R'$ nous ferons remarquer qu'elles ne représentent que l'équilibre tangentiel, et ne sauraient s'appliquer au cas de la rupture

normale sous traction simple qui ne peut être que $-p=R'$.

Cohésion—Ce mot n'a pas de signification propre distincte: il n'est qu'un synonyme de la résistance isotrope vraie à la traction, ou résistance au déplacement intergranulaire, ou tout au moins devrait être défini comme tel.

Torsion et Compression—Si nous considérons un cylindre annulaire l'intuition et l'expérience indiquent que la rupture doit se produire suivant un tour d'hélice, de sorte que l'analyse peut être ramenée à celle d'un prisme, car il suffit de fendre en long le cylindre suivant une génératrice et de le dérouler. La contrainte de torsion devient une contrainte d'effort tranchant, et rien n'est changé au comportement du solide. La faute qui nous paraît avoir été commise jusqu'à présent, a été de considérer des forces tangentielles appliquées, qui ne peuvent avoir de réalité physique, au lieu de considérer que l'angle de rupture β, ou le pas de l'hélice, doit être pris en compte, et que ce paramètre dépend de ϕ, ce qui est impossible avec la conception actuelle du cisaillement.

Si C est la contrainte conventionnelle de cisaillement, ou de torsion, on peut la remplacer par une contrainte latérale équivalente $p^\circ = C\,tg\beta$ sur la hauteur de la fissure (en négligeant le couple autour du milieu de AB, nécessaire pour rétablir l'équilibre, et dont l'action résultante sur AB est nulle) et l'équation d'équilibre des forces s'écrit comme précédemment

$$p=\frac{C\,(\sin\beta+\cos\beta tg\phi)}{\sin\beta tg\phi-\cos\beta}+\frac{R'}{\sin\beta\cos\beta-\sin^2\beta tg\phi}$$

et $dp/d\beta=0$ pour $R'/C=\dfrac{(tg^2\phi+1)\,tg^2\beta}{(tg\beta+tg\phi)^2-(tg^2\phi+1)}$

d'où p/C formules sans grand intérêt pratique, vu leur lourdeur d'emploi. Mais nous étudierons quelques cas particuliers, qui se prêtent à des controles expérimentaux relativement simples.

Si $p=0$ on a $\beta=90^\circ\pm\phi/2$ et

$$C=\frac{2R^2}{2\cos^2\frac{\phi}{2}+\sin\phi tg\phi}$$

ce qui donne pour le béton les résultats suivants:

Les travaux de Considère ont montré que le béton peut être considéré comme idéalement fragile, que le rapport $R/R'=10$ environ, et que R est une fonction linéaire de l'étreinte latérale avec $R/p^\circ=4{,}8$ qui d'après nos formules correspond à $(\sin\beta+\cos\beta tg\phi)/(\sin\beta-\sin\beta tg\beta tg\phi)=4{,}8$ d'où $\beta=25^\circ$ et $\phi=41^\circ$ avec $\beta=45^\circ-\phi/2$. Si l'on porte $\phi=41^\circ$ dans notre formule de torsion on a $\beta=69^\circ$ et $C=0{,}86R'$. D'autre part, les expériences montrent que la résistance au cisaillement sous compression (ou avec plan de rupture imposé) est très approximativement 3 fois plus grande que sous traction (ou en cisaillement libre) et l'explication physique de ce phénomène n'est pas encore connue, néanmoins, cela s'accorde assez bien avec nos formules, car la compression donne pour $\beta=25^\circ$ $\phi=41^\circ$. $R=4{,}3R'$, or 4,3 x 0,86 x 3 = 10 environ et 4,3 x 3,14 = 13,4 ordres de grandeur encadrant les résultats expérimentaux.

Nous nous aventurerons à proposer une explication physique. Tous les solides sont composés de cristaux ou particules, plus ou moins rugueux et enchevêtrés, et, tout le long du plan de rupture, tout se passe comme si l'on avait deux feuilles de papier de verre en contact, collées avec une colle élastique. Sous traction, la colle prête suffisamment pour qu'il y ait désenchevêtrement des grains, mais sans perte de résistance élastique ni de frottement; sous compression, il ne peut y avoir mouvement que si les grains sont cisaillés intérieurement, ou s'ils entrent en rotation, en vainquant la résistance R' de la colle d'enrobage à tout mouvement.

Dans le cas de la rotation, la surface cylindrique de rupture est 3,14 fois plus grande que la section plane AB. Si la résistance interne au cisaillement des grains est inférieure à 3,14. R' ou si la compacité n'est pas absolue, le rapport des résistances au cisaillement R' sous compression et sous traction est intermédiaire entre 1 et 3,14.

S'il n'y a pas d'accrochage des grains, du fait d'un film d'eau lubréfiant et isolant, comme dans les argiles où $\phi=0$, le rapport est 1.

Mais il faudrait des expériences nombreuses et difficiles à concevoir et exécuter pour tirer tout cela au clair avec certitude, quoique l'on puisse déjà vérifier certaines conclusions.

Le fait que l'on ne constate jamais que des ruptures à 90° en traction simple, signifie que la résistance tangentielle $R'-Ntg\phi$ est encore $\geqslant 0$ quand $N=R'$ donc $\phi\leqslant 45^\circ$. C.Q.F.D.

La torsion se traduisant par une traction périphérique non compensée par une compression symétrique, on ne doit considérer qu'un tour d'hélice complet pour l'équilibre, et il en résulte une striction des couches internes, moins sollicitées, du noyau, donc un allongement du cylindre, ce que l'on constate expérimentalement, et que la théorie classique ne peut pas expliquer. Si l'épaisseur de la paroi annulaire est trop faible, on a le flambement avant le cisaillement, sinon le cylindre se comporte à la fissuration en ressort hélicoïdal. Mais l'interréaction des zones concentriques inégalement sollicitées rend le phénomène triaxial et trop complexe pour être analysé. On conçoit néanmoins le glissement hélicoïdal de la matière, permettant la coexistence d'une traction et d'une réduction du diamètre, et la non coïncidence éventuelle des ruptures expérimentales avec notre théorie, ou d'ailleurs la théorie classique: elles conduisent curieusement toutes deux à la même position de la fissure en torsion pure, car les contraintes principales à 45° et $45^\circ-\phi/2=90^\circ-\phi/2$ des génératrices.

Si $\phi=0$ et $p=0$ on a $C=R'/\sin^2\beta$ qui est minimum pour $\beta=90^\circ$ d'où $C=R'$ ce qui prouve que les essais de cisaillement sur les argiles pour lesquelles $\phi=0$ donnent bien la vraie résistance à la traction qu'il n'y a donc aucune raison de masquer sous le nom de cohésion.

Si $\phi=0$ et $p\neq 0$ on a $p/R'=2\,cotg\beta$ et $-p/C=tg2\beta$ d'où $C=R'-p^2/4R'$ ce qui nous paraît cadrer très bien avec les expériences de M. Habib.

Si $R'=0$ ce qui est le cas des sols pulvérulents, une troisième contrainte est nécessaire pour empêcher l'échantillon de s'ébouler, et nous sommes amenés au problème de la triple étreinte.

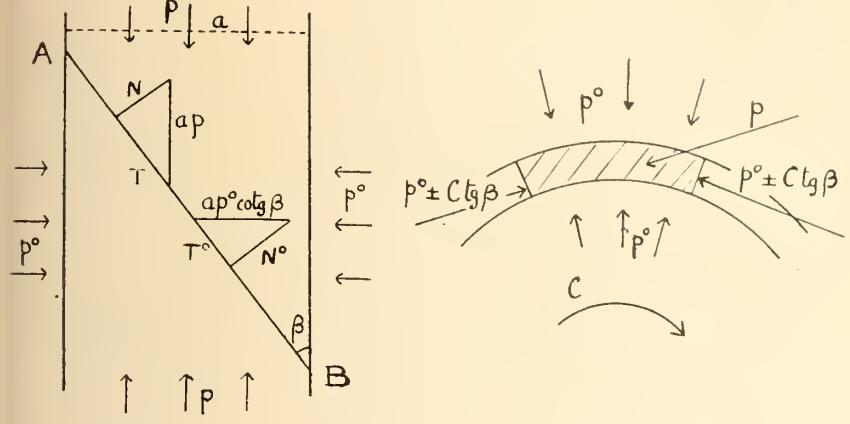
Triple Étreinte

Nous avions déjà utilisé dans le Génie Civil du 1/1/52 les excellents essais de M. Habib[2] pour vérifier notre formule de résistance en pointe des pieux, et nous lui sommes reconnaissants de cette publication sans laquelle nous n'aurions rien pu trouver. Nous nous étions servis auparavant des essais de M. Liang Sheng Chen[1] exécutés à Harvard sous la direction de M. Casagrande, et qui avaient complètement éclairé la question de la compacité critique.

Dans les essais de M. Habib nous avons noté que l'appareil triaxial sous étreinte triple variable, montre que sous compression simple on a $\phi=32^\circ$ et sous striction $\phi=25^\circ$ pour le même sable sec.

Nous en déduisons que la compacité critique varie quand la contrainte intermédiaire va d'une des

limites de son domaine à l'autre, et cela n'a rien de choquant pour le physicien. Par contre l'intuition expérimentale ne peut admettre la validité des conclusions tirées de l'application du cercle de Mohr suivant laquelle la compacité critique passerait par un maximum pour une valeur de la contrainte intermédiaire, intermédiaire entre son maximum et son minimum.



Nous formulerons donc l'hypothèse que la compacité critique ne peut varier que d'une façon continue, toujours croissante ou toujours décroissante, parallèlement à la variation de la somme des contraintes auxquelles l'échantillon est soumis.

Une première conséquence de ce postulat est qu'il n'y a pas de courbe intrinsèque, au moins pour les sols pulvérulents, puisqu'il devrait y en avoir une distincte pour chaque valeur relative de la contrainte intermédiaire au regard des contraites principales.

De plus, en utilisant notre interprétation du rôle physique de la torsion et de l'effort tranchant, du cisaillement conventionnel en un mot, nous allons le transformer en une contrainte latérale, qui va se combiner tout naturellement avec celle directement appliquée dans l'appareil triaxial, en + ou en − suivant le signe qui produira le plus facilement la rupture.

La contrainte latérale p° devient donc la contrainte intermédiaire les contraintes principales étant p et p±° Ctgβ et en supposant p > p° on a:

$N = p\sin\beta \quad N^\circ = p^\circ\cos\beta / tg\phi - C\cos\beta$

$T = p\cos\beta \quad T^\circ = p^\circ\cos\beta - C\sin\beta$

La résistance à la traction est toujours au coefficient a près $R'/\sin\beta$ et l'équation d'équilibre des forces sur la hauteur de l'hélice de rupture est:

$$p = \frac{R' - C\sin^2\beta + p^\circ\cos^2\beta(tg\beta + tg\phi)}{\sin\beta\cos\beta - \sin^2\beta tg\phi}$$

dont la dérivation dans le cas général est pratiquement inextricable. Nous nous bornerons donc à des cas particuliers.

Pour les terrains pulvérulents $R' = 0$ et nous avons montré dans le Génie Civile, en 1954, en nous appuyant sur les essais de M. Habib que notre théorie rend mieux compte des résultats expérimentaux que la théorie classique.

La conclusion s'impose donc que toutes les théories qui interprètent la torsion, l'effort tranchant, le cisaillement, à l'aide du cercle de Mohr et de la courbe intrinsèque, conduisent à des conclusions qui sont nécessairement fausses.

Béton Armé

Les conséquences de ces conceptions s'étendent si loin dans toutes les branches théoriques et pratiques de la mécanique que nous ne pouvons espérer même les envisager toutes: nous nous bornerons à examiner quelques répercussions dans les conceptions du béton armé.

Dans le Génie Civil (1/3/52 et 1/5/52) nous avions déjà montré[3] la grande illusion des calculs hyperstatiques qui ne tiennent pas compte de la dissymétrie des poutres en T et d'autres anomalies des théories classiques. Dans le numéro du 1/4/53 nous avions essayé de reconsidérer la distribution des étriers, à l'aide d'une méthode simpliste et non orthodoxe qui nous paraissait compatible avec les observations expérimentales.

Pour vérifier la validité de nos conclusions, M. Lebelle a coulé une poutre spécialement proportionnée pour se rompre à l'effort tranchant (section 15 x 30, portée 240, armatures 2Ø5 durs crénelés, pas d'étriers, 2 charges de 3t à 15 cm. de part et d'autre de l'axe de la poutre sur 2 appuis simples) et m'a informé qu'une fissure s'était manifestée, partant sous la charge presque horizontalement pour arriver avec une pente assez forte et curviligne à 34 cm. des appuis sur la sous face.

La règle pratique que nous avions proposée aurait empêché la rupture puisqu'il y aurait eu des étriers jusqu'à 62 cm. des appuis, mais néanmoins nous n'avions pas envisagé une telle fissure et cela nous a amenés à reconsidérer le problème depuis les hypothèses de base, la mécanique des sols et le cercle de Mohr.

Le résultat est que nous espérons maintenant avoir établi des formules qui cadrent convenablement avec les résultats expérimentaux.

Si nous admettons $\phi = 41°$, y épaisseur du béton comprimé au dessus de la fibre neutre, z le bras de levier, M le moment de flexion, T l'effort tranchant, h la hauteur de la poutre de largeur b, l'équation d'équilibre est:

$$y\,R'/\sin\beta + M(0{,}87\sin\beta - \cos\beta)\,bz - T(0{,}87\cos\beta + \sin\beta)\,b = 0.$$

Comme dans la poutre essayée, la rupture à l'effort tranchant s'est produite avant que le béton ou l'acier aient atteint leurs limites d'élasticité, nous pouvons admettre que $z = h - y/3$ ou $y = a\,h$, ce qui nous donne avec la formule pour m coefficient d'équivalence, avec ϕ pourcentage d'acier $m = a^2/2\,(1-a)\phi$ d'où $a = 0{,}21$ et $m = 1{,}1$ en supposant $R' = 40 kg/cm^2$ et la rupture se produisant d'un seul coup.

D'après notre théorie, la fissure sur la fibre neutre devrait être à $\beta = 69°$ sur l'horizontale, alors que les expériences la montrent infiniment moins grand et en tous cas plus proche de 45° que de 69°.

L'explication nous paraît très simple: dès que la phase élastique est dépassée pour le béton, le flux de force est modifié car le béton n'est plus isotrope, et la fissure finale, qui est la seule que l'on puisse voir, correspond à la disparition de la poutre rectangulaire prismatique initiale, et à son remplacement par l'arc sous tendu qui précède la rupture finale par écrasement du béton de sa clef ou étirage de son tirant, et, dans le fonctionnement en arc, la compression n'est pas nulle au niveau de ce qui était la fibre neutre de la poutre initiale, ce qui rend la dernière fissure beaucoup plus oblique.

La preuve est que si l'on applique l'équation précédente à cette poutre, et que l'on trace graphiquement, par tangentes successives dans chaque tranche horizontale élémentaire de la poutre, la fissure, en admettant simplement que l'épaisseur à la clef correspond à la compression

maximum du béton (400 kg/cm²) et que la compression et l'effort tranchant se repartissent uniformément dans toute l'épaisseur de l'arc dans chaque section verticale successive, vous retrouverez exactement la fissure expérimentalement constatée.

Dans ces conditions il apparaît que les hypothèses élastiques ou élastoplastiques ne peuvent être considérées comme acceptables si l'on n'a pas au préalable vérifié qu'il ne peut pas se produire un fonctionnement en arc sous tendu par fissuration à l'effort tranchant.

Aucun étrier ne peut empêcher une fissure d'effort tranchant de se manifester, puisqu'il est impossible de renforcer une section au cisaillement dans son plan.

S'il n'y a pas de fissuration, les étriers sont inutiles, et s'il y a fissuration, il y a création d'arcs sous tendus, superposés s'il y en a plusieurs.

Dans ce dernier cas, l'arc inférieur, le plus court, soulage la clef de celui qui le surmonte, en reportant la charge sur ses reins, par l'intermédiaire des étriers (qui ont avantage à être verticaux) qui travaillent comme des suspentes soutenant ses retombées; et les étriers sont inutiles en dehors de ce rôle, donc vers le centre de la travée.

On peut admettre qu'il y a un nombre infini d'arcs superposés, entre le plus court, délimité par la fissure la plus éloignée des appuis, et les appuis eux mêmes, tous travaillant à la clef au taux maximum de compression du béton. Dans ces conditions des étriers sont nécessaires entre les appuis et les retombées de l'arc le plus court, mais avec une densité d'aciers bien plus forte que la théorie classique ne le prévoit, car les fissures à l'effort tranchant pur sont à 69° et non 45°, ce qui fait qu'il faut 2,6 fois plus d'acier par unité de longueur près des appuis, alors qu'il n'en est aucun besoin au centre des travées.

Les théories classiques conduisent donc à une mauvaise sécurité et à une mauvaise répartition des matériaux: Trop d'acier là où il ne sert à rien, et pas assez là où il serait nécessaire. A l'heure actuelle, les étriers calculés à 14,4 kg, ou ne servent à rien car il n'y a pas de fissuration à craindre, ou travaillent réellement à 37 kg, ce qui peut être dangereux si les charges ont été calculées juste.

Les aciers tendus, dans le cas d'arcs sous tendus doivent être solidement ancrés, pour leur pleine section, en dehors de la portée de l'arc et de la courbe des moments, alors que dans le cas des poutres ils peuvent être arrêtés à la courbe des moments. De même la notion de coefficient de sécurité doit être vue de près, car on ne voit pas très bien ce qu'est la sécurité d'une poutre élastique, qui finit en arc sous tendu à la rupture: il y a un changement de nature assez déconcertant et non homogène. Enfin, nous sommes inéluctablement conduits à admettre cette notion nouvelle en mécanique, qui pourra choquer à première vue.

Le frottement est un phénomène continu, valable aussi bien en traction qu'en compression, et dont l'effet égal à $N\operatorname{tg}\phi$ peut aussi bien être positif que négatif.

C'est d'ailleurs la seule explication possible des ruptures en sifflet constatées en torsion pure, et dont l'angle du plan de rupture ne concorde pas avec les théories classiques: La rupture suivant une section droite quand $\phi = 0$ est impossible, du fait de l'enchevêtrement des grains d'abord, et du fait, ensuite, que le frottement négatif ne peut exister, et contribuer à vaincre la résistance à la traction isotrope R′ que dans le cas d'une contrainte de traction oblique sur le plan de rupture. Le frottement, et par suite ϕ, ne peuvent donc pas influencer sur la résistance à la traction simple, alors qu'il conditionne, avec R′, la résistance à la compression simple.

Quoique la surface de rupture oblique soit plus grande que celle de la section droite, l'effort de cisaillement nécessaire pour produire la rupture suivant un tel plan, est moindre que pour la produire suivant une section droite, même sans enchevêtrement des grains, du fait de l'intervention du frottement négatif.

Quelque surprenante que cette théorie puisse paraître au premier abord, c'est la base implicite de tous nos calculs, et elle paraît être la seule susceptible de s'accorder qualitativement et quantitativement, comme nous l'avons montré par le calcul de la fissure d'une poutre d'essai à l'effort tranchant notamment, avec les constatations expérimentales.

Mais cela ne permet pas de mieux comprendre ce qu'est le frottement, sa nature profonde, et sa relation avec les autres caractéristiques, cristallines, physiques, chimiques, des corps, ou sa variation en fonction de la pression ou de la température.

Résumé

En conclusion, nous dirons que les efforts tangentiels n'existent pas comme efforts extérieurs appliqués, car ils exigeraient $\phi = 90°$ ce qui est une impossibilité physique démontrée par l'absence de ruptures obliques à la traction simple; ils n'existent que comme efforts internes, et seulement dans le plan de rupture, comme sous produit de l'angle de frottement interne ϕ. Ce dernier n'a la possibilité de manifester son influence, qu'après que la résistance R′ ait été insuffisante, et qu'une possibilité de mouvement se soit créée.

Il nous semble donc que l'erreur de base des théories classiques est que lorsque l'on considère l'équilibre du parallélépipède élémentaire, on admet justement l'existence de forces tangentielles appliquées extérieurement à ce volume élémentaire, et que l'on exclut l'éventualité de sa rupture interne en sous éléments non homothétiques, lorsque les efforts dépassent une certaine valeur: ce fait expérimental montre justement que ce parallélépipède n'est pas le volume élémentaire. Tous les raisonnements basés sur ce postulat inexact sont donc faux, ou ne seraient valables au mieux que tant que $t \leqslant R' - n\operatorname{tg}\phi$, ce qui interdit leur application aux phénomènes de rupture par cisaillement interne.

Dans ces conditions, c'est la validité pratique et expérimentale de toute la discipline élastique que nous contestons: l'effort tranchant exprimé en contrainte de cisaillement rapportée à la section droite n'est qu'une conception comptable rapportée à un plan fixe de référence, mais n'a aucun rapport avec la contrainte réelle dans le plan de rupture, qui dépend de β, donc de ϕ, suivant une relation que le cercle de Mohr et la courbe intrinsèque ne peuvent pas interpréter. Toutes les théories concernant l'effort tranchant ou la torsion, et qui utilisent le cercle de Mohr et la courbe intrinsèque, sont donc nécessairement fausses dans leurs conclusions, qui doivent être reconsidérées.

Enfin, le frottement négatif est aussi réel que le frottement positif, ϕ ne peut être supérieur à 45°, et l'équilibre de la matière doit être considéré comme celui d'un massif granulaire, la résistance interne des grains étant indépendante de l'adhérence intergranulaire.

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[3]Couard: Palplanches Metalliques, Béranger, 15 rue des Sts Pères, Paris, 3° édition, 1949; Génie Civil, 5 rue Jules Lefebvre, Paris, 1949, N° 8; 1952, N°1-3-5-6-7-20; 1953, N° 3-7-12-14-21-23; 1954, N° 2.

DISCUSSION

of Technical Papers

Power Transmission by Insulated Cable

by

Dr. L. G. Brazier, Research Department, British Insulated Callender's Cables, London, England.

The Engineering Journal, July 1955, page 933.

F. L. Lawton, M.E.I.C.[1]

The author has presented an excellent comparative appraisal of insulated power cable design, fabrication, testing, installation and performance, comparing essentially British with North American practice, but not neglecting developments elsewhere. In so doing, the author has filled a long-felt need.

The author has referred to one characteristic of lead as applied in power cable sheathing—the so-called "drooping characteristic"—in accordance with which the sheath tends to behave in an extremely brittle manner when subjected to slow extension. Does this condition become increasingly significant at low temperatures, say minus 25° F.?

The author's incisive presentation of the differences between British and North American practice in respect of purchasing specifications is an invaluable feature of the paper, as is the performance data. While not necessarily directly comparable, the data on failures due to mechanical damage is most illuminating and leads one to question the economy of the extensive and costly duct systems used in North America except where winter temperatures enforce this solution.

W. J. Baxter[2]

From the user standpoint Dr. Brazier's paper is of particular interest because it provides in a single paper a comprehensive short history of the development of cable use for the transmission of power with particular emphasis in the high voltage range.

His discussion of Specification Tests infers that the C.S.A. has no specification for mains or power cable. However C.S.A. No. C68 has been issued and has been in common use in Canada for a number of years. A second edition No. C68A was issued in 1953 and covers solid type cables up to 69 kv. It is true that for high voltages A.E.I.C. specifications are generally referred to but are always amplified from the user standpoint. In this regard there is a similarity to the North American and B.E.A.'s approach in that they frequently require surge tests. For example, the Ontario Hydro specifies impulse withstand voltage level.

It should be noted that for voltages up to 33 kv. level rubber insulation on this continent has had considerable development, with indications that its cost is competitive with paper. If the cost is comparable and its life is likely to be equal to paper there may be considerable user preference for its use as it simplifies joints and terminations and eliminates the compound drainage problem.

The mass-impregnated, non-draining cables mentioned in the paper are limited to a maximum of 11 kv. rating. In order to compete with the prospective development of rubber insulated cables, it will be necessary to extend the availability of the mass-impregnated non-draining cables to cover the full range of solid type cables.

With regard to aluminum sheathing obvious advantages are seen but the user is going to require more assurance that the jointing techniques will not limit the life expectancy of a cable. It is noted that there is no mention of cable life but this is a very important item from the user's point of view. A conservative life of an overhead high voltage transmission line of steel tower construction could be 50 years. It is felt that a high voltage underground cable life should be its equivalent because of high initial cost.

D. M. Farnham[3]

The author must be complimented on his chronological description of the power cable business. Such has been done on several occasions by different authors in America — yet it is always useful to add to this historical background.

In passing, I would like to refer to the paragraph titled "Conductor Screening". The author states that in America screening by using layers of carbon paper is preferred. While some manufacturers use this method for conductor shielding, it is not general nor do I think it is preferred and, actually, it was not used before screening by metallized papers had been practised for many years.

In the paragraph on "Dielectric Screening", the author states that in the case of single core oil-filled cables reliance has in the past been on a tight fit between the sheath and the core, etc. I believe the Quebec Hydro-Electric Commission installed the first oil-filled

[1] Chief Engineer, Power Department, Aluminum Laboratories.

[2] The Hydro-Electric Power Commission of Ontario, Toronto.

[3] Chief Engineer, Engineering Design Division, Quebec Hydro-Electric Commission Montreal.

cable used in Canada, which cable had dielectric shielding on metallized paper, and it has always been our practice to use shielding on all high-voltage cables; in fact, on all cables 12-kv. and over.

In the last paragraph under the "Sheathing" the author refers to two cable installations of aluminum sheathed cable for high voltage in Canada, namely: the 300-kv. eable at Kitimat, and the 69-kv. 3SA cable in Vaneouver. Actually, the first high-voltage aluminum sheathed cable ever used to the best of my knowledge was the 120-kv. Pirelli type oil-filled eable with aluminum sheathing installed in Montreal in 1953.

I am happy to note the author's reference to high-voltage d-c eable transmission. We hope that the future may hold developments of reliable conversion and inversion equipment that will assure the continuous and suceessful operation for this means of transmitting energy—both by way of overhead lines and underground cables.

P. J. Croft, M.E.I.C.[4]

Unless I misinterpret Dr. Brazier's mcaning, he has been misinformed with respect to the Canadian Standards Assoeiation specifications in the field of "mains" cable. While it is true that the specification of the Asso-eiation of Edison Illuminating Companies, which by the way eovers only paper cable and not the whole field of cables, is well known and used by one or two of the larger utilities in Canada, there has existed since 1940 a well thought out Canadian standard specification on paper insulated power eable which is the most widely used instrument of its kind in Canada. This speeification has been completely revised and re-issued under the date of 1953. While many of the design clauses referring to such matters as insulation thickness, test voltages etc., follow quite closely those of the A.E.I.C. specifieation, the philosophy of its issuance is mueh more in keeping with the standards of the British Standards Institution. In other words it is a national standard rather than a purchasing instrument issued by a private group as in the ease of the A.E.I.C. speeifieation.

It is to be noted, however, that while the B.S.I. specifieation No. 480 eovers a very limited number of fixed voltage ratings, the Canadian standard specification, like the A.E.I.C. specification, provides detail design data for all voltages from 1,000 to 69 kv. in steps of 1,000 volts. In support of this it seems that there is a much larger variety of actual utilization voltages in existence in North America than in Great Britain.

Lead Sheath Alloys

Dr. Brazier's reference to the choice of suitable alloys of lead for the sheathing of cables is of great interest to all cable manufacturers and users. In North America, due to the prevalence of duct and manhole installation and the characteristic of our load eycles partieularly in municipal supply systems, a great bulk of the interest along these lines has been centered in the behaviour of lead sheaths under slow bending eycles, and the great bulk of the technical literature appears to be devoted to this aspect of the situation.

Little is available in the technieal literature concerning the behaviour of lead sheathing alloys under high frequency low amplitude vibration which assumes importance under some conditions. There have, for example, been a limited number of eases of trouble in lead sheath materials due to high frequency low amplitude vibration in transit by railroad. It is a peculiarly North American condition that eable shipments frequently proceed several thousand miles by railroad since most of our heavy manufacture is in the east and many of our customers in the west. The use of a lead alloy containing approximately 0.06% eopper has been used in some quarters for this purpose.

Another applieation in which the high frequency vibration characteristic of sheathing materials assumes importance is in the installation of cables on bridges, and the erection of several large and important suspension and cantilever bridges in various parts of Canada in the last few years has brought this into prominence. Vibration tests made by our Company eonfirm what had already been supposed, namely that a drawn aluminum sheath exhibits improvement in high frequency vibration characteristics greater than that of any available lead alloy in this type of application.

Aluminum Sheathed Cable

Dr. Brazier's remarks concerning the direct extrusion of aluminum as a cable sheath by the Alsheath process are of great interest. I believe that most cable engineers in this country and in the United States feel that the ultimate universal method of manufacture of aluminum sheathed eable will be by direct extrusion in the certainty that technieal difficulties will ultimately be solved. In the meantime it has been possible to make adequate field trials of the behaviour of aluminum sheathing and collect valuable operating experience on cables manufactured by the draw-down process. The company with which I am associated has been in the forefront of this development in Canada.

Dr. Brazier has mentioned the 300-kv. Kitimat cable and the 69-kv. gas-pressurized cable at Vancouver as being examples of the use of aluminum for the sake of its high tensile strength. There have been several other technically interesting and important cables in which aluminum sheathing has been similarly used, as for example, the single eonductor terminal ends for a high pressure pipe-type cable in Toronto, while there is a considerable installation of aluminum sheathed low pressure oil-filled cable in Montreal in which the high tensile strength of the aluminum sheathing has made it possible to eliminate stop joints altogether. Another important aluminum sheathed low pressure oil-filled cable installation is currently in progress here in Toronto. In view of their great technical interest these super-tension items have to some extent deflected attention from the broader use of aluminum sheathing for wiring the power distribution circuits in commercial and industrial buildings. This use of aluminum sheathed cable as a new wiring method is rapidly gaining momentum in Canada and is fully recognized in our code. Some two million feet of aluminum sheathed cable have been produced in Canada, but perhaps like the Scandinavians we in Canada are a little backward in shouting our achievements from the house-tops.

The Author

I am very appreciative of the

[4] Chief Engineer, Canada Wire and Cable Company, Limited, Toronto.

careful and detailed contributions to the discussion.

My temerity in venturing, as an outsider, to refer to the Canadian specification system has been rewarded, not unexpectedly, by finding that I was in error in respect of the details which are set out by Mr. Baxter and Mr. Croft, and I am much obliged for this correction.

I agree with Mr. Baxter that there may be considerable user preference for rubber insulated cable up to the 33-kv level, but I can find no evidence that the cost of such cable is or will be comparable to that of paper cable.

In reply to Mr. Lawton, I regret that we have no data on the "drooping characteristic" of lead at low temperatures such as those he indicates.

I am glad to have Mr. Farnham's comments on the dielectric screening of oil filled cable and on oil filled cable with aluminium sheath.

Mr. Croft's contribution to the discussion is valuable and most helpful. I am particularly interested in his reference to aluminium sheathed building wire. I take it that he refers to the rubber or rubber-like cable sheathed by means of an interlocked lapping of aluminium tape. The extent of the development of this type of building wire in Canada is certainly most impressive.

Newer Types of Magnetic Amplifiers

by

R. R. Jackson, M.E.I.C., Assistant Research Officer, Radio and Electrical Engineering Division, National Research Council, Ottawa.

***The Engineering Journal*, May 1955, page 635.**

C. H. R. Campling, M.E.I.C.[5]

First I should like to congratulate Dr. Jackson on the clarity of his exposition of the theory of magnetic amplifiers in general and of the half-cycle response amplifier in particular. Indeed when I first received the galley proofs of the paper there were no figures provided, yet the explanation was so lucid that at least for one with a prior knowledge of the subject there was no difficulty at all in following the argument.

Dr. Jackson commented in his introduction that much work on magnetic amplifiers had been done since the publication of Moore's paper in *The Engineering Journal* in 1950. This statement is certainly true. I think it may be interesting to cite a few statistics which are indicative of this growth of activity. It is apparent from the record of publications and manufacturing effort relating to magnetic amplifiers. For example, during 1950 about nine papers relating to magnetic amplifiers were presented at general meetings of the American Institute of Electrical Engineers. During 1953 about twenty-three such papers were presented. In 1955 there were some twenty papers on magnetic amplifiers and directly related technology at the winter general meeting alone.

In 1950, according to one annual listing, there were no manufacturers in the United States who considered themselves qualified to produce magnetic amplifiers. In 1954 there were eighty-one in the same listing.

There are other indications of the growing maturity of this technology. In 1948 there were only two little-known books available on the subject, both printed in Sweden. During 1950 a third appeared and in 1953 a fourth.(1) In 1954 there were two new volumes, one British and one American,(2); and already in 1955 a significant book(3) has been published.

Perhaps some additional comment on the extent of magnetic amplifier applications would not be out of place. I am a little afraid that Dr. Jackson may have given unintentionally, by the examples which he has cited, the impression that these applications are confined to some of the more rare and exotic branches of engineering. He has pointed out that magnetic amplifiers in one form or another are used at present for the amplification or control of powers ranging from micro micro watts to megawatts. This statement cannot be made with greater truth for any other type of amplifier. It means that these amplifiers are useful to engineers in a very wide diversity of fields.

Specifically, during the past five years magnetic amplifiers have been applied to regulators for voltage, current, speed and various other quantities which are expressible in terms of an electrical signal. Often they are used in conjunction with electron-tube amplifiers or rotating amplifiers or sometimes with both. Much experience has accumulated in the application of these devices in the steel industry where they have been used for the control of motors of a few thousand horsepower in cold-reduction mill drives. In the field of power generation the magnetic amplifier is being applied as an excitation regulator for large synchronous alternators(4). Significant and successful test installations have been made on a 50,000-kilowatt turbine generator at the Springdale Station of the West Penn Power Company, and as well in Canada on a 27,000-kva. alternator at the Otto Holden Generating Station of the Hydro-Electric Power Commission of Ontario.

In medium and low power ranges the magnetic amplifier has had increasing application in servo systems of all types, and perhaps particularly for those used in the services. At least one British and two American autopilot systems use magnetic amplifiers to the exclusion of vacuum tubes.

My final comment pertains specifically to the half-cycle response amplifier. I note that in Dr. Jackson's paper there is no reference to the work of R. A. Ramey. The particular circuit discussed was first put forth by Ramey in 1951(5). His explanation of its operation was immediately attacked by Krabbe of Denmark who claimed that the theory was not new and had in fact been expounded years before in Sweden. Ramey has been a somewhat controversial figure in the field ever since. It has been pointed out that amplifiers with half-cycle response necessarily also have low gain. Nevertheless, while there is a good deal of truth in what his critics have claimed I think it must be admitted that he was the first to establish clearly that a response time of one-half cycle could be attained in practice, and furthermore that his work did more than any other one thing to bring about the widespread use in North America of the method of amplifier analysis which has been used in Dr. Jackson's paper and which is so widely used today.

[5] Associate professor, Department of Electrical Engineering, The Royal Military College of Canada.

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2. Magnetic Amplifier Circuits, William A. Geyger, McGraw-Hill Book Company, New York, 1954.
3. Magnetic Amplifiers, H. F. Storm, John Wiley and Sons, New York, 1955.
4. Magamp Regulator of Synchronous Machines, J. E. Barkle, C. E. Valentine, J. T. Carleton, *Westinghouse Review*, Vol. 12, No. 6, November, 1952, pp. 204-207.
5. On the Mechanics of Magnetic Amplifier Operation, R. A. Ramey, *Transactions A.I.E.E.*, Vol. 70, Part II, 1951, pp. 1214-1223.

E. E. Newhall[6]

Dr. Jackson has indicated his paper is of the nature of a survey. I believe it is a very useful survey and a timely one. It is useful in bringing clearly to our attention the fact that the new amplifiers have almost all the advantages of the older type as well as a very fast speed of response. To me this means we should appreciate fully the merits of the newer type of amplifier before considering further extensive investigation or application of the older type.

Dr. Jackson mentioned what is probably the most serious drawback of the newer amplifiers and that is the inability to control the amplifier with very low signal levels. This difficulty will likely be overcome using transistors in the control circuit and the result will be a rugged device whose input impedance will probably be controllable over a wide range.

The speaker has given a good account of the manner of operation of the newer type of amplifier and I would merely like to extend his discussion of one area. I believe some confusion still exists in the field as to the relation between flux and magnetomotive force in a magnetic amplifier core.

Consider the simple circuit of Fig. 1 (a). During the blocked period of the rectifier the load current is zero and the core flux is established by the control current. During the rectifier conducting cycle the core flux will change from the value at $t=0$ to the value at saturation and if the prefiring current is neglected the load current waveshape will be shown in Fig. 1 (b). The determination of the current waveshape is a transient problem beginning with the initial conditions $i=0$ at $t=0$ and one would expect the transient current waveshape to be independent of the time duration between successive transients. However, it has been found by experiment using a deltamax core and a 400 cycle supply that the current output will change considerably depending on the duration of the rectifier blocked period. Under normal conditions the output was as shown in Fig. 1 (b). It was then arranged to apply only every third cycle of the 400 cycle source. This changed only the duration of the blocked period of the rectifier. However, the resultant output changed to approximately that of Fig. 1 (c). The change was from almost full output to almost zero output. This phenomenon occurs because under normal conditions eddy currents can persist in the core for appreciably longer than a full cycle of the supply voltage. The eddy currents tend to maintain the core in its saturated condition. When the eddy currents were given sufficient time to die out, by increasing the rectifier blocked time, the flux reached a value determined by the control current alone.

If one considers the design of magnetic amplifiers to control inductive load it is apparent that this effect, if neglected, can produce very large discrepancies between measured and predicted results.

The above phenomenon is described in detail in a report entitled "Magnetic Amplifiers" published by the Department of Electrical Engineering, Control Systems Laboratory, University of Toronto.

The Author

I wish to thank Professor Campling and Mr. Newhall for their kind remarks and provocative discussions.

If, as Professor Campling suggests, I have given the impression that applications of magnetic amplifiers are confined to "rare and exotic branches of engineering", it was certainly unintentional. The title of the paper indicates that it is concerned with more unusual applications — those Professor Campling has mentioned being well established already, but certainly very welcome in the discussion.

To add fuel to the fire of controversy a point may be added here. The circuit under discussion is similar, but not identical, to that in Professor Campling's reference 5. A circuit "just as similar" was described by F. G. Logan in "Saturable Reactor and Magnetic Amplifier Circuits", Magnetic Materials Symposium, U.S. Naval Ordnance Laboratory, Washington, D.C., June 15, 1948.

Mr. Newhall's discussion is much appreciated, as it draws attention to the different behaviours of a core under different conditions. The conditions of Mr. Newhall's experiment fix the current flowing in the control circuit. As he points out, eddy currents influence the rate-of-change of the core flux. In the circuit described in this paper, the voltage applied to the winding during flux changing periods is known. The rate-of-change of core flux here must equal the volts per turn on the winding. But eddy currents, which most certainly are here also tend to impede this flux change. Consequently sufficient current must flow in the winding to nullify the eddy current effects. This explains to some extent the varied type of hysteresis loops obtained under different conditions.

Once again, I wish to express my appreciation to these gentlemen for discussions which add greatly to the scope of the paper.

[6] Control Systems Laboratory, Department of Electrical Engineering, University of Toronto.

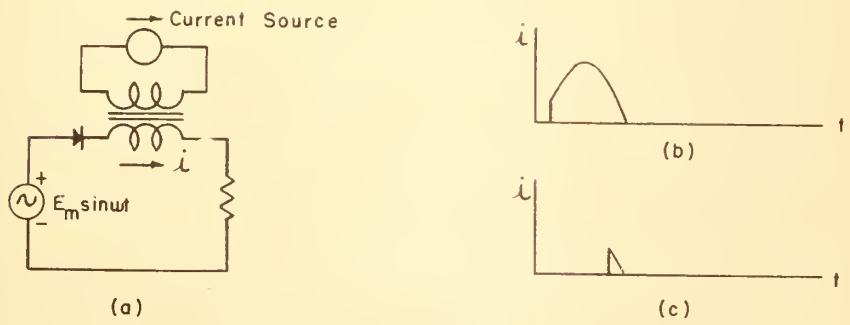


Fig. 1

Possibilities of Generating Atomic Electric Power at Competitive Rates

by

W. B. Lewis, Vice-President, Research and Development, Atomic Energy of Canada Limited, Chalk River, Ont.

The Engineering Journal, May 1955, page 621.

Editor's Notes:

1. The title of Dr. Lewis' paper is corrected above. In *The Engineering Journal*, May issue, 1955, by a misprint, the word "operating" was substituted for "generating".

2. The following additional information became available from the author after publication of the paper, due to declassification:

Addendum

The detailed fuel cycle envisaged was shown in presenting the paper and is reproduced in Table A, herewith.

By recycling eventually all plutonium is fissioned except that which becomes Pu-242 (neglecting radioactive decay of Pu-241); this fraction is taken as 0.089 for Pu-239 and 0.177 for Pu-240 and 241. The total energy at 3.67×10^{-22} MWD/fission from Pu-239 is 0.842 MWD/gm. and from Pu-240 0.758 MWD/gm. The total energy is then $16.0 + 0.842 \times 11.4 + 0.758 \times 4.18 = 28.8$ k MWD/tonne. No allowance has been made for processing losses which should not, however, be very significant.

The processing allowance was set at 0.5 mill/kwh electrical or \$12/MWD or \$12 × 0.22 = \$2.64/thermal MWD at 22% efficiency. The fuel yields 28.8 MWD/kg. so the allowance is \$76/kg., but for this the uranium has to be processed three times and the separated plutonium will also have to be reprocessed. Allowing \$2/gm. for the latter, or \$31/kg. of U, leaves \$45/kg. for the three uranium extractions, or \$15/kg. for each extraction as quoted in the paper. Clearly the fuel cycle depends on achieving 4,000 MWD/ton irradiation of uranium metal without its breaking up. On a small scale at Chalk River some metal has been irradiated satisfactorily to over 6,000 MWD/ton.

Discussion

H. Massue, M.E.I.C.[7]

A quick glance at the program of this 69th annual meeting of The Engineering Institute of Canada reveals the ever growing diversity of the fields of interest of engineers and the great contribution of the profession to the development of the country.

Dr. W. B. Lewis' talk, in this regard, is of particular interest as it deals with one of the newest industries, and one which holds the greatest promises for the future.

The optimistic view taken by Dr. Lewis that nuclear power reactors might, in the not too distant future, be built for some \$200 per kw. and be able to produce electric energy for about 6.5 mills per kwh. is really stimulating, especially so when one considers that the 60,000-kw. pressurized water reactor now being constructed by the Duquesne Light Co., on the Ohio river, near Pittsburgh, Pennsylvania, is estimated to cost not less than \$37.5 million or \$625 per kw.

When one considers the progress that has been accomplished in recent years in the field of nuclear energy one cannot but be very enthusiastic about the future. It is only about 12 years ago that Dr. Fermi and his associates established the first fission chain reaction at Chicago on December 2, 1942. Since that day, miracles indeed have been accomplished.

In the United States more than \$12 billion were expended on the nuclear program which is now requiring about 10% of the total energy supply of the country. Atomic submarines have become a reality, weapons research and development are far advanced, the five-year experimental program launched in 1954 by the A.E.C. is well on its way, and every day use of isotopes for research biology and medical applications is increasing rapidly. So far, shipments of isotopes from the Oak Ridge National Laboratory have reached 50,000 in number and are now proceeding at a rate of about 1,000 deliveries a month. Moreover, the interest of private enterprises in atomic matters is growing rapidly; up to April 1 of this

[7] Manager, Economic & Statistics Dept., Shawinigan Water & Power Co., Montreal.

Table A. Fuel Cycle for 3% Burn-up

Stage	Fuel type	Irradiation n/kb‡	Residue per tonne F.P.'s kg.	U-235 kg. †	Pu-239 kg.	Pu-240 + 241 kg
1	Natural Uranium	1.11	4.0	3.46	2.4	0.55
2	1st depleted Uranium*	1.66	4.0	1.19	2.8	0.95
3	2nd depleted Uranium	2.14	4.0	0.30	3.07	1.28
4	3rd depleted Uranium	2.33	4.0	0.066	3.13	1.40
	Total		16.0		11.4	1.18

*1st, 2nd and 3rd depleted uranium are the products from stages 1, 2, and 3 respectively after extracting Pu and Fission Products (F.P.'s).
†This column may also be read as kMWD/tonne heat output.
‡kb = kilobarn = 10^{-21} cm.^{2}.

year, five atomic power reactor projects, representing an installation of 705,000 kw., had been submitted for acceptance by the A.E.C.

In Canada, the Chalk River experimental station operated by the Crown company, Atomic Energy of Canada Limited, has been developed to become one of the leading experimental atomic power stations in the world, both on account of its personnel and its research facilities. Its recent decision to proceed with the Hydro Electric Power Commission of Ontario with the construction of an experimental 20,000-kw. power reactor places the country in line with what is being done in the United States and in Great Britain.

The fact that one pound of the uranium isotope U-235 contains 2,600,000 times as much energy as one pound of coal would seem to offer unlimited possibilities for the production of cheap power.

The fact also that research and practical experience has made it possible to reduce requirements of coal per kwh. produced, from six pounds at the beginning of the century to only 0.6 pound, in present day thermal power plants must certainly be an incentive to scientists and engineers whose combined efforts will undoubtedly solve the problem that must be solved in order to achieve economic atomic power.

The Author

I very much appreciate Dr. Massue's remarks and would like to point out that the fuel cycle I was discussing involved extracting the fission energy from 3% of the total uranium supplied. It is not only the uranium isotope U-235 which can yield 2,600,000 times as much energy as an equal weight of coal, but this holds also for the much more abundant U-238. Nearly four times as much energy is derived from U-238 as from U-235 in the cycle I was discussing.

Predicting the Runoff from Snowmelt

R. H. Clark, M.E.I.C., Assistant Chief, Water Resources Division, Department of Northern Affairs and National Resources, Canada, Ottawa.

The Engineering Journal, April 1955 issue, page 434.

Norman Aspin, M.E.I.C.[8]

Mr. Clark may perhaps be interested in the somewhat different point of view of this subject described in what follows. The subject is one that has interested me for many years in connection with the Shipshaw River in northern Quebec.

The contents of this comment are taken from a fuller study of the Shipshaw River which has recently been prepared by me, and which is at present appearing in the June 1955, issue of the Feuillet Météorologique of the Quebec Bureau de Meteorologie. Copies of this periodical may no doubt be obtained on request. As explained in that study, detailed information on the Shipshaw River has been available for a number of years, providing an extremely favourable background for investigation.

The three questions which normally arise are—

(I) How much water is available in the snow cover?

(II) What is the influence of spring rain on the snowmelt?

(III) At what date will all the snow be disposed of?

It is felt that these questions are simply and satisfactorily answered by the use of the curve sheet, shown in Figure I.

The year 1949-50 was chosen because subsequent to that date several major changes were made in the river (drainage area increased, new dam, new power houses) involving explanations which might confuse the issue.

The curves shown in full lines are, reading upwards, runoff, net precipitation (precipitation less losses) and precipitation, and represent cumulative figures from the 1st of November, in units of cubic-feet-days (one cubic foot per second flowing for one day).

It will be observed that certain ordinates and abscissae have been specially indicated and lettered. The ordinate $A1$-$D1$ represents the situation at the start of the break-up period. $A1$-$D1$ has been received as precipitation. $A1$-$B1$ has been used as runoff, and $B1$-$D1$ remains stored as snow.

The abscissa of $D1$ meets the runoff curve at $B3$ over date $A3$. At this date, the ordinate $A3$-$B3$ represents runoff of a quantity of water equal to $A1$-$D1$, and therefore represents the latest date at which snow can remain. This quantity must, however, include some part of the rain, $B3$-$D3$, which has been received during the period $A1$ to $A3$.

Consider now a date $A2$ at which the amount of runoff yet to come, $B2$-$C2$, is equal to the amount of rain received from date $A1$ up to that date. It can reasonably be assumed that the latter quantity, $C2$-$D2$, is that portion of the runoff, $A3$-$B3$, which *does not* come from snow and that therefore the portion $A2$-$B2$ *does* come from the snow. The implication of this is that all snow is melted at the date $A2$, that $A2$-$B2$ has been discharged as runoff and that $B2$-$C2$ is that portion of the snow which has melted and is now stored as water.

It will be seen that the assumption made above is the same as saying that the quantity of rain $C2$-$D2$ has melted an equal quantity of snow $B2$-$C2$. This relationship may not be one of equality, but its use seems to give results consistent with experience.

The date $A2$ can easily be obtained by drawing the median curve half way between the runoff and precipitation curves and taking the ordinate through the point where it is cut by the abscissa of $D1$.

To return to the three questions asked above—

(1) It will be seen that the quantity of water available in the snow cover is a definite amount whose quantity is known at the date of the break-up. In this area, the water available is obtained by summation of the yields of individual snowfalls. The same information could of course be obtained by snow surveys just before the break-up.

(2) It will further be seen that spring rain exerts a measurable influence on the snow disposal. Large amounts of rain do not necessarily increase the rate of runoff, which depends, as will be explained below, on available natural storage, but they do advance the date on which snowmelt is all out. Small amounts of rain do not necessarily decrease the rate of runoff, but they do retard the date on which the snowmelt is all out.

(3) The date $A2$ mentioned above is the date when all snow has been disposed of. After this date, no extra water can be expected from melting snow, and summer conditions prevail.

[8] Price Brothers & Company, Limited, Quebec, Que.

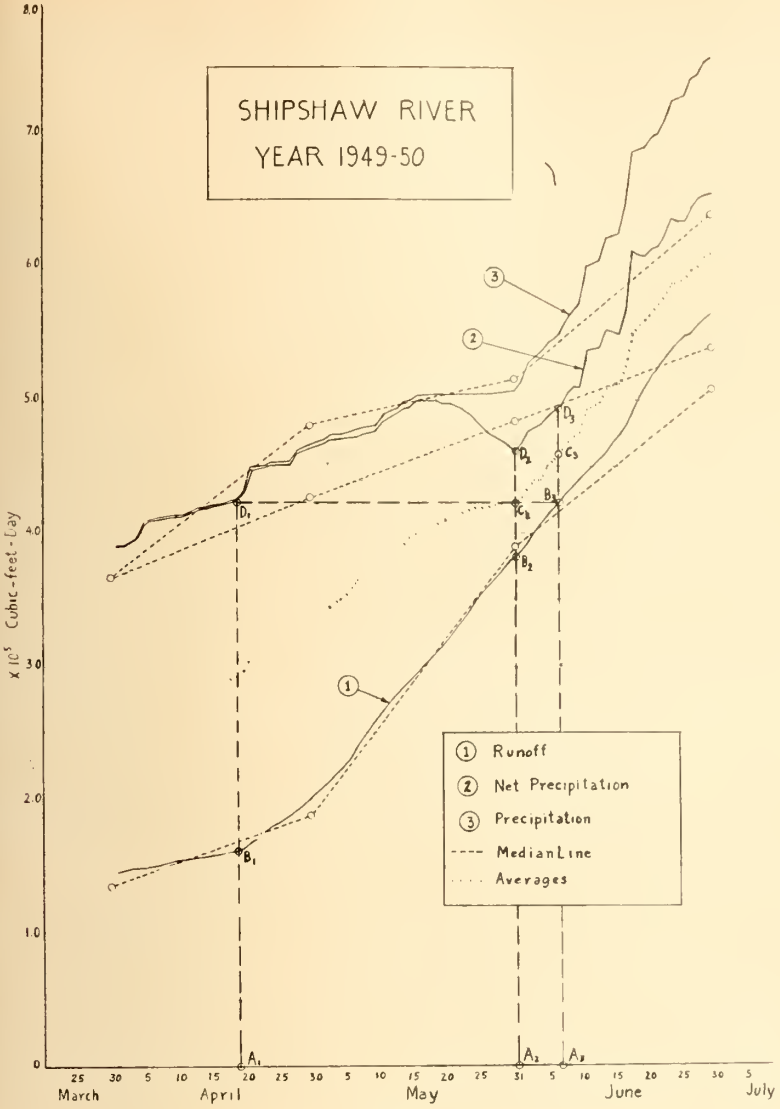


Fig. 1

The term 'available natural storage' referred to above, is a conception which has been developed of a fixed area adjacent to the river, which supplies and regulates the runoff, whose storage bears a fixed relationship to the runoff, and which is itself fed from the remainder of the area. It has been estimated that for the Shipshaw River basin, the relationship is of the form

$$s = ar^b$$

where s = available natural storage

r = runoff

a is a constant $= 2.82 \times 10^3$

b is a constant $= 2/5\ (0.4)$

It has also been estimated that its area is approximately 60 per cent of the total area. In passing, it might perhaps be noted that this proportion is almost exactly that of Mr. Clark's effective area of 23,830 of a total 40,166.

Assuming the validity of this conception, the 'melting index' and the 'soil priming index' become of secondary importance because all runoff is regulated by the water stored in the available natural storage area.

As regards the melting index, it is true that warm weather during the break-up period would accelerate the filling of this area, and hence increase the rate of runoff. At the same time, in any given year, since daily allowance must be made, it can just as easily be made by means of the median line described above as by a mass-degree-day method.

As regards the soil priming index, it is felt that fall conditions do not largely influence spring runoff. If fall flows are high, it means that the available natural storage is high and will appear in large winter flows. If however this factor remains high in the spring, it can be seen and allowed for. If fall flows are low, the only effect in spring will be to retard the increase of runoff until such time as the available natural storage is sufficiently high to support larger flows.

A. N. Andrew, Jr.E.I.C.[9]

The author is to be congratulated for his clear and concise description of the factors influencing snow melt floods in the Red River. Although Mr. Clark's analysis deals with a prairie stream, many of the factors which he has discussed influence the runoff from watersheds of different topography. Basically the methods of analysis used can be applied to most watersheds, if sufficient data is available.

It will have been noted by persons analyzing the data that the mathematical expression relating the several parameters to runoff was printed incorrectly in the *Journal*. The function $0.0821 X_2 X_3$ should have a positive sign not negative as found.

In presenting his work Mr. Clark has not indicated the accuracy of the equations in actually preparing a forecast of the spring flood event prior to its occurrence. The results indicated in Table I of the paper are those which can be obtained after the spring rains and melt rate are known. These two factors are most likely to remain unknown at the time the forecast is made, unless present long range weather forecasting methods improve immeasurably. Therefore, in preparing an estimate of the spring flood volume by Mr. Clark's methods it is necessary to assume mean values of melt rate and spring rainfall. In preparation of these comments, the writer estimated the spring flood runoff values for each year individually and by each method, on the foregoing assumption. The results indicated that the standard error of estimate of the flood volume by the graphical method was 0.481 inches and 0.612 inches when the mathematical expression was used. The standard error of estimate was calculated from the expression:

$$S_v = \sqrt{\frac{\Sigma\left(X_1 - X_1'\right)^2}{\text{D.F.}}}$$

[9] Hydrological Engineer, Aluminum Company of Canada Limited, Shipshaw, Que.

S_y=the standard error of estimate

X_1=the true value of the dependent variable, runoff

X'_1 =the estimated value of the dependent variable, runoff

D.F.=the number of degrees of freedom equal to $N - m$

N=the number of sets of data used and 'm' is the number of variables or variable functions used in the equation.

In calculating the standard error from the graphical equation 15 degrees of freedom were assumed, while 9 were used in the mathematical analysis. The number of degrees of freedom used in the graphical analysis of the results has no mathematical derivation, 15 were used as a reasonable allowance. It may be argued, with some reason, that since two of the parameters were given their normal values the sample of data has changed and the equation is less dependent on them than was originally the case and, therefore, more degrees of freedom could be allowed. This may be true but the extent of change would be difficult to calculate, if not impossible.

In doing similar type analysis of stream flow in northern Quebec this writer has found that a more reliable estimate can be obtained if an equation is derived which includes only those parameters which are measurable at the time the forecast is to be made. To illustrate this point the following simple linear equation was derived, from the data in Table I of the paper, to express the relation between the dependent variable (X_1), runoff, and the two known independent variables, snow fall accumulation (X_2) and soil priming index (X_3).

$$X_1 = 0.3866X_2 + 0.0043X_3 - 0.8161$$

The standard error of estimate of this expression was found to be 0.445 inches. The multiple correlation coefficient and both of the partial correlation coefficients are significant. These results are an improvement over those of each of the above methods when they were used to prepare a forecast prior to the flood event. Variations of this equation could be tried, for example, the graphical equation indicates that the soil priming index may vary logarithmically with runoff. A logarithmic function of X_3 could be substituted to determine whether or not it improves the results. The simple form presented serves to illustrate the point in question. If any methods are available, or thought to be, for an advance calculation of the melting index or spring rain, then separate estimates of these could be prepared. These estimated values could be included in a new equation so that it can be determined whether or not they actually improve the final estimate. The degree of significance of each such parameter will indicate its value.

In many cases simple equations, such as the one presented above, will give more accurate results than will more complex solutions. They are simpler to derive and as quick to apply. Neither of the methods employed by Mr. Clark should be used with data containing only ten or twelve samples because of the insufficient number of degrees of freedom available. The simpler equations are readily applicable in these situations.

In his final summary Mr. Clark makes the statement that "the use of snow survey results would be more desirable than the use of accumulated snow fall in the analysis and these should be used where there is an adequate history of snow surveys". This concept may well be the case in many areas, perhaps most, and is widely accepted as fact by most hydrologists. It it not always true, as was illustrated by the writer in a paper entitled "Volumetric Forecasts of Snow Melt Floods of the Lake St. John Watershed" presented at the Eastern Snow Conference in Burlington, Vermont, February 1955. Separate correlations of both snow survey data and accumulated winter precipitation records to spring flood volume were made from data covering approximately the same period of years. The standard error in estimating the flood volume from the snow survey data was found to be 152% of that obtained by using the accumulated winter precipitation. In general it would seem advisable to test both types of data, if both are available, and let the results indicate which should be used. Both might be incorporated to good advantage.

The Author

I would like to thank Mr. N. Aspin and Mr. A. N. Andrew for their interesting comments on my paper "Predicting the Runoff from Snowmelt". It is relevant that certain similarities should have been found in river basins so different in topography and climate as a prairie and Northern Quebec stream. However it should be remembered that each river is a law unto itself and only a detailed analysis of a river basin will reveal the factors which influence runoff and to what extent.

In presenting his findings on a study of the Shipshaw River, Mr. Aspin has posed three questions regarding snowmelt runoff which are not entirely pertinent to the complex problem of river stage forecasting. His method of determining runoff relations is presented in part but no attempt is made to show the accuracy of this method in forecasting runoff. Mr. Aspin has questioned the writer's use of a melting index and a soil priming index. It is conceded that the melting index is not too significant in the analysis for the Red River Basin (and this can be shown statistically), but the soil priming index is highly significant and is an accurate gauge of what Mr. Aspin calls "the available natural storage".

Mr. Andrew has made several comments most of which are well taken. It should be noted however, that the main purpose of the method presented was to lay the basis for short-period forecasting of river stages. Using the estimate of the volume of runoff from the graphical analysis at the beginning of, or during, the early part of the rise of a snowmelt hydrograph of the Red River, the peak river stage at Emerson can be estimated by the application of the unit-hydrograph principle. For this purpose all the factors used in the analysis would be known or could be estimated very closely.

For longer-term forecasting such as is required for the operation of storage reservoirs, Mr. Andrew has suggested that only those factors which are known at the time of the forecast be used in the analysis. This procedure could give better results in some cases, but the analysis upon which Mr. Andrew has based his conclusion is erroneous in that there is no method by which the standard error of estimate can be computed for the coaxial graphical correlation.

Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

DEFLECTING YOUNG SALMON DOWNSTREAM

Water Power, November, 1954, p. 418

The problem of getting young salmon-fingerlings or smolts—safely past power dams on migration to the sea is a major concern on many waterways. Salmon are an economic as well as a sporting asset to many large rivers, and provision has to be made not only for their ascent, by salmon-ladder or Borland "lift" but also for steering them safely from the turbine intakes on their descent.

Three biologists of the Fisheries Research Board of Canada have recently studied the practical values of half-a-dozen methods of deflecting the descending salmon to the desired course. A large experimental trough was built at Lakelse Lake, British Columbia, in order to carry out adequate tests on the fish-guiding values of light, sounds, air bubbles, chain deflectors, odors and dyes in the water. Suspended chains gave the best results and further experiments are being made with this method. Salmon fingerlings, were released, 800 to 1,000 at a time, from special release pens at the upper end of the experimental trough. This trough, a wooden construction, measured 58 ft. by 10 ft. and was 3 ft. deep with metal screens at either end to permit the water to flow through.

Vertical Slits

The salmon used in the experiments were all young Pacific sockeye salmon, better known in Britain as Atlantic salmon. There are, however, some differences in salmon behaviour when in schools, e.g. between coho, spring and sockeye Pacific salmons. It appears to be a character of sockeye salmon schools to flatten in one plane only, and while the fingerlings would not converge to pass through vertical slit openings (5 ft. deep and 2 in. wide) they would readily enter these slits placed in the horizontal plane. Thus a series of vertical slits formed by chains or air bubbles might act as a deterrent to fingerlings.

Light Deflectors

The experimental use of light deflectors employed four 60 W. white bulbs arranged in a linear series in a light box, placed either diagonally across the trough to give a vertical band of light, or in line with a glass divider to illuminate one half of it. Intensity was varied by a transformer, and colour by the use of amber and blue filters at 18.5 and 5.0 foot-candles respectively. Results varied. Little if any deflection was obtained with shining a narrow beam diagonally across half the trough; but the salmon noticeably avoided it when one half the area was totally illuminated. Intensity made no difference until it dropped below 10 foot-candles, when the effects deteriorated, and 0.2 foot-candle had no effect on the fish. Neither of the colour filters had any effect.

Odours

No effect was gained by trying to deter the fish with odours produced from human hands or the skins of certain fish which prey upon the young salmon. Bursts of deep methylene-blue dye ejected under pressure through perforated copper tubing every five seconds were good deflectors during the daytime, but not very good at night. No deflection could be produced by day or by night when sound was carefully employed at 1 to 10 kilocycles from a cylindric 1 transducer "beamed" at right angles to the long axis of the trough from a place inside and near the wall and remote controlled. During daytime, but much less at night, successful deflection was obtained by producing a rising screen or wall of air bubbles forced at pressure to rise through perforated copper tubing, having holes of 1/32 in. at ¼ in. intervals and so placed on the trough floor as to screen one side of the dividing area. Even after 11 p.m. it was deflected 58 per cent., but no such deflection was obtained with young "spring" salmon, a different species with different schooling behaviour.

Hanging Chain Wall

The most successful result — between 94 and 98 per cent deflection — was obtained by hanging small chains of 3/16 in. by ½ in. links, at intervals of 2 in., vertically in a wooden frame, to undulate gently in the flow of the trough. It worked on the principle that sockeye schools would not pass through vertical slit openings although they would pass through similar slits placed horizontally. Even at very low light these chains deflected the sockeye fingerlings, and at night low-frequency vibrations from the chains may have deflected the fish. It is suggested that migratory fish might be collected sufficiently far upstream above a high dam to be free from the accelerated flows of spillways and penstocks, and then guided into large side intakes in order to by-pass the dam.

Even at night the effectiveness of a hanging chain wall fell only to an average of 71 per cent. When the interval between the chains was extended to 4 in. there was a slight lowering of its effectiveness, which became more marked when the spaces were increased to 6 in. On the other hand, coho salmon were inconsistent in their responses, sometimes showing no deflection at all. It seems that by mechanically vibrating the chain, increased deflection is obtained.

For the young sockeye salmon, which forms a very large proportion of the Pacific American salmon populations, the screen of agitated chains seems to be the most promising deflector to keep them away from high dams and intakes as they come down from their breeding haunts, in the higher waters.

AIR POLLUTION CONTROL AS IN EFFECT ON THE CANADIAN NATIONAL RAILWAYS

C. R. Patterson, *Air Repair*, v. 4, n. 4, February 1955, pp. 188, 218.

In Canada, matters of air pollution control in the railway industry come under the jurisdiction of the Board of Transport Commissioners. In addition, each city and town may pass its own municipal ordinance governing these industrial operations which are the causes of air pollution.

As we review our performance of the past few years, I am amazed at the progress that has been made to make our cities and towns cleaner and healthier places in which to live. The railroads have kept astride with other industries in controlling air pollution.

Due to the network of railway yards and roundhouse terminals extending from coast to coast on the Canadian National System, our problem in respect to controlling air pollution was by no means a simple one. In order to attack this problem systematically, and because of its prime importance, top management took the initiative in establishing an organization capable of coping with the problem, which, due to the increased volume of wartime and post-war traffic, had become very acute. Financial appropriations were made to cover the purchase and installation of the necessary equipment to satisfactorily control air pollution and to establish supervision for the education of personnel in the proper handling of this equipment.

Supervision

On the Canadian National System, our two most troublesome points of operation from the standpoint of air pollution control are Toronto and Montreal, where traffic movements are ex-

tremely heavy and roundhouses are located in heavily populated districts.

In order to cope with the problem at these terminals, 3 full-time smoke supervisors were appointed at Montreal and 2 at Toronto. These men were chosen from the ranks of locomotive firemen and they were carefully selected for their ability to grasp and put into effect practices pertaining to smoke abatement. Consideration was also given to their aggressiveness, their willingness to accept responsibility and their suitability for promotion to supervisory positions. These men continually police the terminals, frequently accompanied by city officials, to ensure that our railways fully observe the air pollution bylaws that are presently in effect. In addition, every motive power officer takes an active part in enforcing smoke regulations.

Enforcing Smoke Abatement Regulations

To enforce a program of this kind, disciplinary action can be taken by supervisory officers against those employees who wantonly disregard company regulations. In most instances, suitable instructions and warnings by the supervisory officer are sufficient. In the exceptional case of an employee who will not cooperate, after a warning has failed to have the desired effect a statement is taken of the violation and 5 demerit marks are assessed against his record. For subsequent offences, the disciplinary action is doubled. We consider that the locomotive engineer has direct jurisdiction over the fireman and unless it can be established that the fireman was not carrying out the engineer's instructions, the engineer is held equally responsible.

Firebuilders

After extensive studies were made of building and cleaning fires, nearly all our main terminals were equipped with an oil steaming-up system. This system utilizes Bunker "C" fuel oil and consists of a storage tank and oil circulating lines extending around the shop and returning to the originating point. Drop leads from these lines are coupled to air and oil hose of sufficient length so that when coupled in turn to a steaming-up burner, it will extend into the firebox door of an engine standing on the pit. The burner consists of two ½-inch pipes, one oil and one air, individually valved, leading to an atomizing chamber. The outlet end of the atomizing chamber is slotted and it is surrounded by a suitable hood to protect against overheating. The oil is pumped from the storage tank at approximately 180°F. and is forced through the line under pressure. Air pressure is approximately 100 lb./in.

Methods of Steaming and Firebuilding

To use this burner to best advantage, line the grates with a horseshoe bank of coal 8 in. deep at the front of the firebox, increasing the depth to approximately 20 in. at the firebox door end. When lighting the burner by placing a small piece of lighted, oily waste at the nozzle, crack the blower or use the shop blower to guard against blowback. Adjust burner to clear flame as quickly as possible after lighting and point flame of burner directly at top arch brick. At no time should the flame be directed at the fuel bed. As the fuel bed is gradually ignited, volatile constituents and particles of carbon are released and pass through the burner flame which burns them before leaving the firebox.

After the fuel bed has been properly ignited and the fuel is in a coke condition, the firebuilder removes the burner, and then places a suitable bank in the firebox over the bare spot in the center of the grates. The rate of ignition of this center bank will be very slow and there will be no violation of smoke regulations, the smoke density not exceeding No. 1 Ringlemann.

Some firebuilders have complained bitterly about the amount of coal they were required to shovel to line the firebox on large engines. To avoid this complaint, we built a triangular box, with dimensions of 8 in., 8 in., and 7 in., each side being 7 in. deep. This hollow, triangular box is fitted with an offset handle and it can be held in position on the distributing plate with very little effort to distribute coal for a bank, using the stoker if steam is available on the engine. If the engine is cold, the burner may be used to raise the steam pressure to a point where the stoker can be used. The heavy coke fire (from the horseshoe bank) is an asset to the engineman taking charge of the locomotive on the shop track because it eliminates the necessity of building a heavy fire and makes it possible for him to operate through smoke-restricted districts without violating smoke bylaws.

Brick Arch

It has been our practice to seal or place the brick arch tightly against the front sheet on all yard and transfer engines that are required to work continually in smoke-restricted areas. With the open or spaced arch, smoke released from the fuel bed has a direct outlet through the flues to the atmosphere. We have found that the sealed arch assists greatly in controlling the amount of smoke emitted from locomotives.

Overfire Jets

Over the entire system, hand-fired engines are equipped with overfire jets of various makes. Two makes are located on the sides of the firebox, three jets on each side, with those on one side staggered in relation to those on other side. Another type of jet extends down the boiler head and through the top of the firebox door ring. The purpose of overfire jets is to create the necessary turbulence that will permit the burning of the gases as they are released from the fuel bed.

On all stoker-fired engines, firebuilders, hostlers and locomotive firemen are taught to use the stoker jets as a means of controlling smoke while operating in restricted areas.

Draughting of Locomotives

The draughting of locomotives is a most important feature in any smoke abatement program. Therefore, we should constantly be on the look-out for blocked-up flues, slagged flue sheets and air or steam leaks around or in the smokebox. Nozzle bars, grate openings and air space between the firebox foundation ring and the ashpan coping should be inspected. On all road engines, we have installed air-deflector plates between the rapper shell and ashpan coping. With this arrangement, we get an even flow of air underneath the entire grate area, the fuel consumption decreases and the smoke hazard is reduced.

Quality of Coal

If we are to operate in territories where rigid smoke abatement regulations are in effect, then a good quality of fuel should be supplied in order to assist our men in the observance of these regulations.

Labor Conditions

I believe that we are all agreed that experienced and qualified workmen are one of the most important requirements for good performance in any railway smoke control program. Railroads, like all other industries during the past few years, have had very heavy labor turnover, necessitating the training of new employees.

Educational Program

A definite program pertaining to smoke control should be followed to have an outstanding performance in smoke abatement. The features I have covered in this paper have been brought to a successful conclusion through trial and error, study and research, and we are now in a position to impart this information to our employees through bulletins, audiovisual education, lantern slides, lectures, etc., and in addition, we are constantly talking smoke control to enginemen, firebuilders, engine watchmen, hostlers, work equipment men and others who in any way are in a position to improve our smoke control performance.

DEVELOPMENT OF FREON REFRIGERANTS

Gordon O. Roe, *Canadian Refrigeration and Air Conditioning Journal*, v. 21, n. 1, January 1955, pp. 23/24.

The development of fluorinated hydrocarbon refrigerants occurred in 1930 as the result of deliberate and planned research for a *safe* refrigerant.

Test Book, Not Test Tube

Unlike so many chemicals which had their beginning in the laboratory test tube; the fluorinated hydrocarbon refrigerants were "discovered"—or perhaps I should say "developed" in a research *library*.

The International Critical Tables were studied as were tables of elements. By the way, the International Critical Tables are made up of seven volumes, larger than letter size, each volume consisting of about 400 pages.

It was during this search that a mistake was found in the boiling point of one of the fluorine compounds and it is this fact that drew *attention* to these compounds, even though fluorine as such was known to be more toxic than

chlorine. Further research (still in the library) revealed that fluorine in combination with certain other elements should become completely non-toxic and would also have the other desirable features for an ideal refrigerant.

Many tests were made from the first laboratory production of fluorinated hydrocarbons, and in April 1930, the scientific world was told of the discovery of these products for use as refrigerants. The following year, Kinetic Chemicals Incorporated offered "Freon" refrigerants to the refrigeration and air conditioning industry.

"Freon" Qualifications

To bear the trade mark "Freon" these new refrigerants had to measure up to the following qualifications for an ideal refrigerant:

They must be non-explosive, non-toxic and non-flammable.

They must have a suitable boiling point as well as the many other physical properties required for an effective refrigerant.

They must be non-corrosive, practically odorless and non-injurious to foods, flowers, furs and fabrics.

"Freon" Types

There are six "Freon" refrigerants in common use today.

The one most widely known is Freon-12 dichlorodifluoromethane. It has a boiling point at atmospheric pressure of —21.6°F. and is used in industrial and commercial *air conditioning* systems and in industrial, commercial and household refrigerating equipment.

Freon-11 trichloromonofluoromethane has a boiling point of 74.7°F. at atmospheric pressure and is used principally where medium temperatures are desired for industrial and commercial air conditioning and refrigeration systems using centrifugal type compressors.

Freon-22 monochlorodifluoromethane has a boiling point of —41.4°F. It is used where low temperatures are necessary in industrial and commercial installations.

Freon-113 trichlorotrifluoroethane is used in industrial and commercial air conditioning systems employing centrifugal type compressors. It boils at 117.6°F. which is one of the reasons it can be used outside of refrigeration. Because Freon-113 also possesses outstanding solvent properties, one of its uses is to clean motion picture film.

Another comparatively high temperature refrigerant is Freon-114 dichlorotetrafluoroethane with a boiling point of 38.4°F. It has been widely used in household refrigeration with a rotary type compressor but has largely been replaced by Freon-12 except in certain industrial and commercial applications.

Freon-13 monochlorotrifluoromethane is a real low temperature refrigerant with a boiling point at atmospheric pressure of —114.5°F. Liquid air is almost warm by comparison as its temperature is only —80°F. Dry ice comes close at —110°F.

The use of Freon 13 and the probable future use of Freon-14 (which boils at —198.2°F.) requires a thorough technical understanding of their physical properties and in some cases, further research into the behaviour of metals under stress; lubrication of mechanical compressors; and the possible development of more efficient insulating materials.

Other Uses of "Freon"

You are, no doubt, familiar with aerosols and I assume you know that the propellent is one or more of the Freon compounds.

As solvents, the distinctive properties of Freon have led these products into use as *specialty* solvents where toxicity coupled with flammability is a problem. Now that more knowledge is being gained about this use of these products, it is expected that more such applications will develop.

As chemical intermediates, Freon-22 and Freon-113 are used in the production of such plastics as Teflon tetrafluoroethylene resin and Kel-F polyperfluorovinyl chloride plastic.

Because of its high relative dielectric strength, Freon has found a use in the manufacture of high voltage equipment. The heat values and the stability of some of the Freon compounds are attracting interest for their use as heat exchange fluids.

A new and promising application for Freon is fire extinguishing agents. The high degree of effectiveness, stability and low toxicity of certain of the Freon compounds make them especially attractive as fire extinguishing agents. The new bromofluoro compounds are being extensively tested in military and commercial laboratories for use in this field. Physical properties that make these compounds valuable as fire extinguishing agents include high liquid and vapor density, low boiling point and low viscosity.

THE EVOLUTION OF ARCTIC AIRWAYS

John Grierson, F.R.S.C., *Journal of The Royal Aeronautical Society*. v. 59, n. 529, January 1955, pp. 15/29.

The North-West Passage

When men of the first Elizabethan era looked to the Arctic, they dreamed of a North-West Passage over the sea to enable them to reach by a short cut the fabulous riches of the Far East.

With the invention of the aeroplane, men again looked to the Arctic for a North-West Passage of the air.

Andrée's Balloon Attempt To Reach the Pole

The earliest recorded flight of any kind in the Arctic was that of the Swedish aeronaut, Dr. Andrée, who set out to cross the Pole from Spitzbergen in a balloon in 1897.

Three days after leaving Spitzbergen the Eagle lay helpless on the ice, about 280 miles from its starting point. 33 years later a sealer discovered the remains of Andrée's last camp on White Island, East of Spitzbergen. From the diaries it was revealed that the men had faced unceasing difficulties in trekking over the drifting ice for nearly three months before reaching this barren island, only to perish.

Roald Amundsen Tries the Aeroplane

Soon after the Kaiser's War, the Arctic began to be recognised as the area of future long-distance airways, but the distances were so staggering—calling for stage lengths of over 4,000 miles between existing aerodromes—that no one could foresee the advent of sufficiently long-range aeroplanes for many years to come. However, Roald Amundsen, the great Norwegian explorer (who had sailed the North-West Passage 21 years earlier, plotted the position of the North Magnetic Pole, and had also been the first man ever to reach the South Pole) determined to try a flight over the North Pole. In May 1925, together with the American, Lincoln Ellsworth, he left Spitzbergen with two Dornier flying-boats, each carrying three men.

All went well until they reached 88° where engine trouble forced one boat to land on a lead of open water in the ice. The other machine got down safely, but before they could take off in the serviceable aeroplane, the lead filled with pack ice. Only one way of salvation remained—to prepare a smooth enough runway over hummocky ice for a flying-boat to take off. To make such a strip, no more than 500 yards long, took the marooned men over three weeks, and when the Dornier eventually staggered into the air, Amundsen's party missed crashing among the ice boulders by the narrowest margin. Before reaching Spitzbergen, they were forced to land in the sea and finished the last few miles by taxiing over the water.

Amundsen's Airship and Byrd's Trimotor Triumphs

Besides the aeroplane there was another aerial vehicle, the airship, which had been developed during the war and which seemed to offer better range possibilities for Trans-Polar flying. In May 1926, Roald Amundsen again prepared for a Trans-Polar flight in a semi-rigid airship of Italian manufacture, called the *Norge*, accompanied by its designer, Umberto Nobile. Amundsen's starting point was Kings Bay in Spitzbergen, but he was surprised to find that Commander Byrd, of the U.S. Navy, had arrived in Spitzbergen with a three-engined Fokker before the airship was ready to go.

After all his previous endeavour, Amundsen deserved to be the first man over the Pole, but this was not to be for on May 9th Byrd set off and in a brilliant flight of 15½ hours, at an average height of about 3,000 ft., flew over the Pole and back to Spitzbergen. This was undoubtedly the greatest feat of aerial navigation in the first quarter century of flight.

A day later Amundsen set out in the *Norge*. He not only flew over the Pole but went right across the Polar Basin to Alaska, where he landed at Teller on the Bering Sea, having covered 3,000 miles in 71 hours.

The Nobile Disaster

Two years now passed before Nobile himself, captaining the airship *Italia*, began from Spitzbergen the most disastrous flight in Arctic history.

Captain Ejnar Lundberg, a Swedish pilot, flew a two-seater Fokker IVD ski-plane from Spitzbergen, located the scene of the *Italia's* crash, and landed on the ice. After successfully flying off with Nobile and his dog, the biplane was capsized on the return journey through landing on rough ice. The pilot was therefore marooned with eight survivors from the airship, but fortunately the Russian icebreaker *Krassin* managed to force a passage and rescue the whole party.

To the sufferings and losses of Nobile's men, a far greater tragedy was added by Roald Amundsen himself who went out to join in the search, and whose Latham flying-boat was lost without trace between Bergen and Spitzbergen. An Italian Court of Enquiry was held in 1929, and found Nobile responsible for the loss of the *Italia*.

American Pioneering of the Lower Arctic

While long range flights were proving so difficult in the Far North, it had been noticed that the lower Arctic had another attraction; it provided as a bridge across the North Atlantic a series of stepping-stones so spaced that the stages might fall within the range of existing aircraft design. Such a possibility had first been demonstrated as long ago as 1924, when the American Army Round-the-World Fliers made the attempt to cross the North Atlantic by way of Iceland and Greenland. Their machines consisted of Douglas DT-2 biplane seaplanes, each powered by a single 400 h.p. Liberty engine; and the extraordinary success which this enterprise achieved with very primitive equipment has received less than its fair share of acclamation on either side of the Atlantic.

Three machines left Kirkwall, Orkney, on the 2nd August 1924 for Hornafiord, Iceland. Thence their route lay via Reykjavik, Frederiksdal, and Ivigtut (South Greenland), Icy Tickle (Labrador) to Hawkes Bay. Their mission was accomplished in 32 days with the loss of only one aeroplane, which force-landed with engine trouble south of Iceland: the crew were saved.

In spite of this successful flight (which admittedly had been achieved with a narrow margin of safety) neither the American Army nor the American Government showed any immediate interest in following it up. Apart from three unsuccessful private ventures, American aviation endeavour in the lower Arctic was dormant for nine years.

But in the extreme north, American airmen had outshone all others by Byrd's flight in the race for the Pole.

Hubert Wilkins' Crossing of the Arctic Basin

Another flight almost as remarkable as Byrd's was that of Hubert Wilkins, the great Australian explorer, who, with a Norwegian pilot, Lieut. C. B. Eilsen, in April 1928 flew a single-engined Lockheed Vega ski-plane from Alaska to Spitzbergen via Ellesmere Land, a distance of 2,200 miles in 20 hours.

British Arctic Flying

In the meantime, British interest in Arctic flying found an advocate in Gino Watkins. Watkins, who was far more an explorer than an airman, had been casting around for a reason to take an expedition to the Arctic when he hit on the idea of making Arctic Air Routes the theme which could reasonably and usefully justify his ambition. He learnt to fly with the Cambridge Air Squadron and, at the age of 25, he sailed for East Greenland in 1931 as leader of the British Arctic Air Route Expedition; this was to be the first serious investigation of flying in the Arctic throughout every month of the year.

With Air Ministry support (which consisted of loaning two R.A.F. officers and obtaining a 15 per cent price reduction on the aircraft) the British Arctic Air Route Expedition sailed from London in the *Quest*, a wooden vessel of 300 tons, for East Greenland and set up their base at Lake Fiord, some 40 miles west of Angmagssalik. Their aircraft consisted of two 85 h.p. de Havilland Gipsy Moths (seaplanes or ski-planes), equipped with special long range tanks, since the original intention was for these machines to carry out a route survey right through to Winnipeg: this part of the plan was thwarted by gale damage to the aircraft, but in spite of these mishaps many local air reconnaissances were made. These were backed up by sledging parties, one of which went right across the Ice Cap to the West Coast.

An important objective of Watkins' expedition was the establishment of a station for meteorological observations on the top of the Greenland Ice Cap. The double dome-shaped tent for this was pitched 130 miles from base at a height of 8,000 ft. and was manned throughout the winter for six months. The observation from the air and from the ground of climatic conditions over a whole year on the East Coast of Greenland, together with the results of long sledging reconnaissances to Cape Farewell and across the Ice Cap, actually laid the foundation of all Arctic air routes.

Following the British Arctic Air Route Expedition came an unofficial attempt by the present author to make a survey flight along the route. This undertaking was distinguished by the facts that it took the longest period of any Arctic flight to accomplish—390 days from the first start at Brough to the final landing in Ottawa, involved the greatest number of crashes—two at Reykjavik and one at Ottawa—and was the only solo flight to the Arctic ever attempted before the Hitler War. Originally in 1933 an 85 h.p. Gipsy Moth seaplane was used, and the hops Brough-Kirkwall-Thorshavn (Faeroes) — Reykjavik were more or less successfully accomplished, although, thanks to sticking exhaust valves, part of the last leg had to be flown on three cylinders—and in bad weather. After repairs to the engine in Iceland, the machine was capsized and wrecked while taking off in a rough sea for Greenland.

Next year a bigger and better aircraft —a Fox Moth called *Robert Bruce* of 120 h.p. was used. The flight began from Rochester, the nearest seaplane base to London, and went by way of Londonderry to Reykjavik. Here during an attempted take-off, *Robert Bruce* struck a rowing boat and the pilot had to return to England by sea, in order to fetch a new wing and take one float for repairs. The next take-off for Greenland was successful, but trouble was experienced in picking out Angmagssalik (a settlement of 53 eskimos). After flying unknowingly right past this East Greenland metropolis, the pilot was lucky to spot a small fiord free of ice. He therefore sent out an S.O.S. on his short-wave transmitter, and landed to await events. Eighteen hours later he was reached by a party of eskimos under Pastor Rosing and given directions for finding Angmagssalik, which was about 20 miles away.

From Angmagssalik two abortive attempts were made to fly across the Ice Cap, each time the *Robert Bruce* being forced back by bad weather. However the third endeavour was successful, and the flight over to Godthaab was made in exceptionally fine conditions. After that the flight ran without serious incident from Godthaab to Lake Harbour (Baffin Land) — Povungnituk — Fort George — Eastmain and finally Ottawa, which was reached on the 30th August 1934. Then, during flight after overhaul, a crash occurred in landing on the glassy calm Ottawa River, so for the final hop to New York the floats were replaced by wheels. This was actually the first flight from London to Ottawa.

German Interest

The Germans had in the Dornier Wal a flying-boat capable of surveying the Arctic Air Route, and under the command of Wolfgang von Gronau they began to operate a series of surveys through Iceland and Greenland. The most ambitious one, in 1931, involved a flight across the Inland Ice (which was believed to reach up to 11,000 ft.) between Scoresby Sound and Sukkertoppen, a remarkably difficult 4-hr. hop for the flying-boats of those days.

During July of the same year, Dr Eckener took the *Graf Zeppelin* on a successful reconnaissance of the Polar Basin. He went from Spitzbergen to Franz Josef Land, where he tethered his ship to a Russian ice-breaker for a spell in order to deliver mail, before proceeding farther east to Severnaya Zemlya and returning to Germany. This was the last airship flight ever to be made in the Polar regions.

These flights, sponsored by the German Government, were the first serious attempts to survey an Arctic Air Route between the Old World and the New. The routes of Gronau's flights were as follows:—

1930—Lyst on Sylt, Trangisvaag (Faeroes) Reykjavig, Ivigtut, Cartwright, Queensport, Mary-Joseph, Halifax, Nova Scotia.

1931—Lyst on Sylt, Trangisvaag, Reykjavik, Scoresby Sound, Sukkertoppen, Godthaab, Povungnituk, Port Harrison, Long Lake, Chicago.

1932—Lyst on Sylt, Seydisfiord (Iceland), Reykjavik, Ivigtut, Cartwright, Montreal, Ottawa, Detroit, Chicago.

By way of contrast to the flights of von Gronau was that of Hirth and Weller in 1930. They flew a Klemm monoplane with a 40 h.p. Salmson engine

and declared, when they left Kirkwall (Orkney), that their destination was New York. After flying 11 hrs. 20 mins. they landed successfully in a small rough field at Kaldadarnes, some 30 miles S.E. of Reykjavik. But with such light hearts had these two aviators set out on their long flight, that they had omitted to seek permission from Denmark to land in the "closed country" of Greenland.

Even more serious was the fact that the coast of East Greenland completely lacked any flat ground where a land aeroplane could alight. In these circumstances the two had no alternative but to continue their journey westwards by ship. However, they had been the first men to land a landplane in Iceland.

The Italian Armada

The most publicized of all Arctic flights before the 1939-45 War was the mass formation of 24 Savoia Marchetti flying-boats, led by General Italo Balbo, which in the summer of 1933 flew from Orbetello to Chicago in 14 days with the loss of only one machine. This crashed when landing on calm water at Amsterdam. Their route was via Amsterdam, Londonderry, Reykjavik, Ivigtut, Cartwright, Shediac and Montreal.

The Lindbergh Surveys

Also in 1933, Pan American Airways decided to investigate the possibility of air routes over Greenland and Iceland. To this end they chartered a Danish cargo vessel, the *Jelling*, to act as base ship, and employed Charles Lindberg and his wife to fly a single-engined Lockheed Sirius float seaplane. The flight survey which followed was easily the most comprehensive ever to be made of Greenland and Iceland. However, the consequent finding of Lindbergh had a sobering effect upon the optimistic, for this was the picture he presented.

Throughout the length of the Arctic Air Route as we then understood it (that is to say roughly a Great Circle route between London and the Middle West, or West of North America), there was not a single intermediate land aerodrome. The use of flying-boats or floatplanes in northern harbours was limited to about three months in the year by ice conditions, and there was no aeroplane in prospect which, with a commercial load, could regularly take-off from ice and land on water, or vice-versa. Moreover the question of ground supplies in such places as the East Coast of Greenland and the Hudson's Bay area depended on the yearly voyage of a single ship. At that time few settlements in the Canadian Arctic had radio transmitters, so that day-to-day meteorological information over vast areas was non-existent. Admittedly the Arctic weather itself had proved to be less formidable than had been expected, and often of such a local nature that a Phön gale might blow in one place when there was calm only 60 or 70 miles away.

In the face of these generally bleak prospects the future seemed to depend on landplanes or flying-boats of far greater range than any then flying, able to cover the whole distance without refuelling. It was small wonder, therefore, that Pan American and air lines of other interested nations put the Arctic Air Route into cold storage, to await the evolution of bigger aeroplanes with longer range potentialities.

Russian Interest

With her Arctic coastline of over 5,000 miles, Russian thought has always looked to the North as a fertile field of development. However, it was not until 1937 that Russian achievements in the Arctic began to be shown to the world in all their seriousness.

The first sign was the Polar floating ice station devised and organised by Professor Otto Schmidt. The plan was to use Rudolf Island, in the Franz Josef archipelago as the main base and fly four men with nine tons of stores the 560 miles to the Pole. Transport consisted of four four-engined T4 Russian aeroplanes on wheel undercarriages. Owing to the fact that there is no land at the North Pole, any camp set up there will not remain at the Pole for long—it may in fact be borne along at anything up to half a mile per hour. Knowing this, Schmidt had Ivan Papanin and three companions established on an ice floe near the Pole. This drifted for nine months, until on reaching a point just north of Scoresby Sound on the East Coast of Greenland, the scientists were taken off by ice-breaker, having added greatly to the magnetic, meteorological and oceanographic knowledge of mankind.

While Papanin and his companions were being drifted along on their iceberg, Russia announced her intention of starting a commercial air service between Russia and North America across the Arctic Sea. By way of proving that this was no idle boast, Chkalov in June 1937 flew a single-engined Russian monoplane from Moscow to Vancouver, 5,300 miles over the Polar seas. This was followed next month by Gromov, who flew the same type of machine non-stop from Moscow to San Jacinto, California, a distance of 6,262 miles.

It was a harsh twist of fate which ordered the course of a further flight. This time the Russians used a four-engined T4 machine, so as to correspond with the normal formula of a long-distance civil aeroplane and ensure a good margin of safety even if an engine should stop. Levanevsky was the captain, and with a crew of five he set off from Moscow in August of the same year. Just after passing over the Pole, they reported engine trouble and then —silence.

The Search for Levanevsky

Now began the greatest search in Arctic history—far greater both in scope and in speed than anything that could have been done for Sir John Franklin, almost 100 years ago. The Russians appealed to Vilhalmur Stefansson to coordinate the effort from the American side and within a week air operations under Sir Hubert Wilkins began. For the first two months these could only be pursued in daylight, but after that they were carried on in moonlight, which in the Arctic actually gives clearer shadows than daylight. The Russians, of course, also ran their own searches from the other side of the Arctic. All was in vain, however.

Hitler's War

The outbreak of war in 1939, when we in this island were to find ourselves so isolated and our lines of communication to the munition factories of Canada and the U.S.A. so strained, might logically have made us seek the benefit of the northern stepping stones. But in spite of appeals from members of Gino Watkins' Expedition, the Air Ministry showed itself entirely unmterested in the possibilties. So the problem was left to the Americans to tackle, when they came in 1941. This they did with characteristic speed and determination.

A network of land aerodromes to cover Hudson's Bay, Baffin Land, Greenland and Iceland was planned for construction in the least time the short Arctic summer would allow. The very speed with which this conception was developed naturally resulted in mistakes —the outstanding one of which was the siting of Bluie West One in one of the worst weather areas of Greenland, but the project went through and a workable chain of aerodromes was established.

Between 1941 and 1943 landing strips were built at Goose (Labrador), Port Chimo (North Labrador), Frobisher Bay (Baffin Land), Narsassuak or Bluie West One (South Greenland), Sondre Stromfiord or Bluie West Eight (West Greenland), Angmagssalik (East Greenland) and at Keflavik (Iceland). This gave the Allies a chain of seven aerodromes whereby thousands of aeroplanes from Canadian and U.S. factories were safely ferried over to the battle zones of Europe and Africa. Today the key aerodromes of that route remain on an operational basis and are being used for civil purposes.

And After

The notable features of the post-war years in Arctic aviation has been the profound shift of emphasis away from the civil field towards the predominantly military one. In fact between 1945 and 1952 not a single long-distance flight over the Polar Basin was made by a civil aeroplane. As soon as hostilities were over, the R.A.F. was quick off the mark with the flight of the *Aries*, a four-engined Lancastrian landplane, over the pole from Iceland in 1945. The R.A.F. School of Navigation at Shawbury and Flying College at Manby then embarked on an extensive scheme of Polar flying, carrying out a number of reconnaissances in the vicinity of the Northern Magnetic Pole, as well as other Arctic surveys, first with Lancastrians and later with Canberras (the twin-jet bomber type of landplane).

In July 1945 the first jet flight across the Atlantic, by way of the Arctic Air Route, was made by six Vampires of No. 54 Squadron, which arrived at Goose just two days before an American Squadron of sixteen Shooting Star fighters took off on a flight in the reverse direction. More recently the British North Greenland Expedition has been revictualled by R.A.F. flying-boats and landplanes at Britannia Lake and beyond.

The U.S.A.A.F. can truthfully say that since the war they have "gone big" in the Arctic. Today North-Eastern Command owns a chain of aerodromes centred on Thule, in the N.W. corner of Greenland. There are Resolute and Alert in the Canadian Arctic Archipelago, Nord on the extreme north coast of Greenland, and the weather station T.3 on the ice somewhere between Greenland and the Pole.

The Great Air Base At Thule

Thule exemplifies man's challenge to the Arctic. Seagoing ships can reach Thule during only two or three months of the year so that construction of the base had to be aided by an air-lift. In the twelve months from September 1951, 12,500 short tons of freight and 20,000 passengers were flown 2,000 miles from the main base of Westover, without accident.

Because the Thule subsoil is permanently frozen, normal foundations cannot be used. The technique is to mount all buildings on pads, consisting of unadulterated crushed rock. Air has to be ducted under the whole, in order to prevent the heat of the building from thawing the subsoil.

Thule's nine enormous hangars present a major problem in central heating at a spot where ground temperatures fall to —50°C. and winds can blow at over 120 m.p.h. Yet in spite of these extremes, visibility is generally excellent, little snow falls and only during June and July is there any trouble with fog. Bernt Balchen was responsible for the survey and planning of this base, which must rank as the most expensive and remarkable aerodrome in the whole world, glittering like a diamond in the Arctic night—a diamond invoiced to Uncle Sam at £96,000,000.

The Russian Enigma

Since the war the Soviet Unionists have remained extremely quiet about their Arctic work. The day when they would proclaim to all the world the achievements of Russian scientists and airmen seems to have vanished, like Papanin's iceberg. But it does not require a vivid imagination to visualise the bases which must have been set up, perhaps approaching the Thule standard, at Rudolf Island, Sevenaya Zemlya, and probably at Wrangel Island too, the last being a territory in which Britain relinquished her claim in a moment of Arctic disinterestedness by Disraeli.

Whether for peace or for war, Russia is going to play an increasingly important role in future world air strategy. If it be for peace, then the Russian Arctic will form the link between London and Tokio, with the possibility of an intermediate landing on the Yenisei, where the Russians are developing industry on a large scale. If it be for war, the Arctic would form a common frontier between the British Isles and the American continent on the one hand, and Arctic Russia on the other. The need for lateral communications on such a vast front requires no emphasis.

While the political outlook in Russia remains uncertain, and the economical advantages of running an airline to Tokio may be doubtful under conditions prevailing at this very moment, Winnipeg and Vancouver, particularly the latter, can be considered as the basis of a shorter term policy. An aircraft would have to cruise at only 300 m.p.h. in order to connect London with the Pacific coast of America in a matter of sixteen hours: double the speed and half the time are possibilities of the foreseeable future.

The Arctic Milestone of S.A.S.

That these proposals are not outside the bounds of technical achievement at the present time has been proved in a striking way by S.A.S., the Scandinavian Airline Company. In November 1952, when the North Polar regions were clad in continual darkness, S.A.S. sent off their first DC-6B, commanded by the famous Danish Captain Povl Jensen with a crew of eleven, on its delivery flight from the makers in Los Angeles to the new owners in Copenhagen. This was more than an ordinary delivery flight, for 24 passengers were on board and the route chosen lay via Edmonton (1,676 nautical miles), Thule (1,696 nautical miles) to Copenhagen (2,082 nautical miles). They flew within 150 miles of the Northern Magnetic Pole. The proving flight, accomplished in 24½ hours flying time, was no mere flash in the pan, for S.A.S. proceeded to announce their intention of establishing a trans-Arctic airline to West America and to Japan.

Within a month a second aircraft had left Los Angeles and this one deviated at Thule to Sondre Stromfiord (Bluie West Eight) on the West Coast of Greenland, where it landed in order to examine the facilities available there. Sondre Stromfiord is a valley site, first surveyed by the Watkins' Expedition of 1931. Topographically and from the point of view of radio facilities, it is inferior to Thule and unsuitable for all-the-year operations. Thence the DC-6B flew direct to Stockholm. In May 1953 another S.A.S. DC-6B made the first flight from Scandinavia to Japan, a performance repeated almost exactly a year later. The route was: Bodo-Fairbanks (2,840 nautical miles), Fairbanks-Shemya (Aleutians) (1,513 nautical miles), and Shemya-Tokio (1,775 nautical miles).

Political and Security Obstacles

These well organized and impressive preliminary flights of S.A.S., which had heralded a new era in Arctic aviation, were gradually leading to the establishment of a regular airline. But the obstacles of this have proved slow to yield. From the point of view of political clearance, agreements had to be obtained from Denmark (for Greenland), Canada, U.S. and Japan. The U.S. Authorities did not at first wish the service to terminate at Los Angeles (which only saves 250 miles compared with the Chicago-New York route) but at Seattle, where the saving would be over 1,200 miles. The U.S.A.A.F. did not, and still does not, agree to the use by regular Civil Airlines of Thule, so Sondre Stromfiord is the nearest permitted alternative as an intermediate landing place. Therefore the Scandinavian-U.S. route will have to run Copenhagen-Sondre Stromfiord - Edmonton - Seattle, and the Japanese one Copenhagen-Bodo-Fairbanks-Shemya-Tokio. The U.S. Government have eventually conceded to S.A.S. the right to run right through to Los Angeles. On this Polar route the normal complement in the DC-6B's will be 9 crew and 48 passengers. (Because the runways at Edmonton had not been lengthened in time, initial services had to be routed through Winnipeg, resulting in a Los-Angeles-Copenhagen nautical mileage of 5,160.)

The First Arctic Air Line in the World

15th November 1954 was the day of triumph for S.A.S. From Los Angeles the *Royal Viking* headed Eastbound to the Arctic and from Copenhagen the *Helge Viking*, carrying the Prime Ministers of Norway, Sweden and Denmark, flew west. One hundred miles East of Greenland the two pioneer services passed each other in bright moonlight. Both flights were completely uneventful and the elapsed time in each case was just over 24 hours.

Canada's Contribution To Arctic Flying

Although our Canadian cousins have not hitherto appeared in the picture of long-distance Polar flights, they have nevertheless made great contributions to Arctic aviation in operations peculiarly suited to the needs of their vast Northern Territories. Mining settlements, oilfields and trapping stations have led to the perfection of Arctic bush-flying in Canada with seaplanes, skiplanes, amphibians and landplanes. While much of these operations is done by private individuals and charter companies, regular air lines have spun their mesh over the Arctic, as is evidenced by the regular services of Canadian Pacific Airlines to Aklavik. The first Comet to be flown across the Atlantic, too, was taken via Iceland by the Royal Canadian Air Force.

That Canada has no intention of being satisfied with internal Arctic Airways, or of being a mere staging post for other nations, was strikingly indicated in September 1954. Then Canadian Pacific Airlines filed an application for permission to run from Vancouver to Amsterdam via Sondre Stromfiord. The reason Amsterdam was suggested as the European terminal was because the Canadians give regular traffic rights to the Dutch at Montreal, and wished to utilise the reciprocal provision in the agreement.

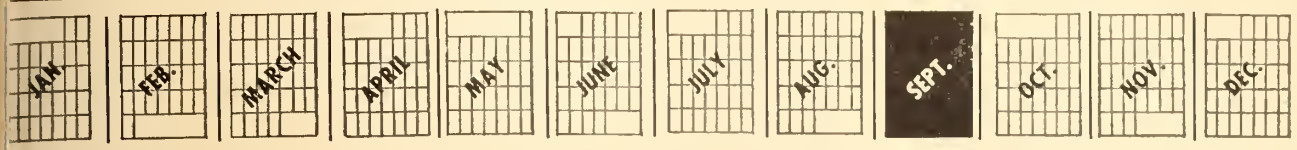
Britain's Backwardness in the Arctic

Seeing the progress which the Scandinavians have achieved in pioneering Arctic aviation, we in this country may well reflect with humility upon our standing in the matter. True, the Royal Air Force has done some splendid scientific work in the Arctic since the war, but what has happened to our Civil Ensign? There has been no question even of civil aviation observers being attached to the R.A.F. to study Arctic flying. Both our Ministry of Civil Aviation and B.O.A.C. seem too preoccupied with other things to spare a second for the Arctic. But the problem is pressing. If one line can fly from Copenhagen to Tokio by the Arctic, reaping all the prestige of pioneering a new and shorter route, then surely another should be able to operate between London and Tokio across the top of the world, thus knocking more than 2,000 miles off the distance of the present B.O.A.C. route.

Canada and British Partnership the Answer

In the Arctic lies a field of great opportunity for Britain and for Canada. On the one hand, speedy long-distance communications with the outside world are vital to the economic survival of the inhabitants of this island: on the other, the development of her Arctic territories is vital to the future of Canada. Not only our needs are complementary but also our means; the Old Country has unrivalled experience in the running of long-distance air lines and no one knows better than Canada how to operate aircraft in Arctic conditions.

Month To Month



Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Co-operation with ASME

At the July meeting of the Council of the Institute held in Montreal a resolution was passed by which agreement was made with The American Society of Mechanical Engineers whereby the initiation or entrance fee of one society will be waived in the case of a member of the other society making application for membership.

The resolution itself is printed in full later in this article but the meaning is simply that an ASME member who wishes to join The Engineering Institute of Canada does not need to pay, in the case of a Member the ten dollar entrance fee, or in the case of a Junior the five dollar entrance fee.

Similarly a member of the Institute who wishes to join The American Society of Mechanical Engineers will not have to pay the twenty-five dollar entrance for a Member or the ten dollar entrance fee for an Associate Member (equivalent of Junior E.I.C.).

Negotiations along these lines have been underway for some time. ASME and E.I.C. by written agreement have a joint committee on co-operation known as the ASME-E.I.C. International Council. This is the group that have worked out this new arrangement, and now that their recommendation has been approved by both Councils, the privilege is available immediately.

Just last year a similar agreement, with regard to entrance fees, was reached between the Institution of Electrical Engineers (Great Britain) and the Engineering Institute. Similar negotiations have been underway for some time with the Institution of Civil Engineers and the Institution of Mechanical Engineers. Every effort is being made to bring together as closely as possible all the engineers in Canada regardless of the country of their origin.

A similar feature is a part of the cooperative agreement which the Institute has had for many years with various provincial professional organizations.

It is a hopeful sign that more and more engineering organizations are taking thought as to means by which they may work more closely together. As far as Canada is concerned the situation appears to be improving steadily, and day by day conditions become more favourable for real confederation.

Text of Agreement

The Council of The American Society of Mechanical Engineers and the Council of The Engineering Institute of Canada by identical action have agreed upon this provision by which a member of one of the two societies may become a member of the other without payment of initiation or entrance fee in the other society. In each case, the member of one society must present an application for membership in the other society and meet the membership requirements of that society.

The elimination of entrance fee in the second society shall apply only to the fee for entrance at the equivalent or lower grade. If an applicant to the second society is upgraded by the second society, his promotion fee shall be paid to the second society. The Fellow grade in The American Society of Mechanical Engineers is upon nomination.

A Student Member of ASME who has transferred to the Associate Member grade of ASME upon graduation may apply for entrance as a Junior in E.I.C. and upon acceptance may become a Junior in E.I.C. without payment of the entrance fee in E.I.C.

A Student of E.I.C. who has transferred to the Junior grade of E.I.C. may apply for entrance as an Associate Member of ASME and upon acceptance may become an Associate Member of ASME without payment of the initiation fee in ASME.

Geneva Conference

The United Nations International Conference on the Peaceful Uses of Atomic Energy, held in August at Geneva, was voted the now customary success accorded to recent meetings between our major political divisions. Who "votes" on these occasions, apart from press observers, is usually obscure; however, this conference certainly seems to have left a very favourable impression of good personal relations between the various delegates.

What was the outstanding impression? There must be many, according to the point of view. Perhaps the most striking, certainly one of the greatest import, was the energy being devoted by Russian enterprise, both official and industrial, to the useful de-

Cover Picture

The cover picture is a view of the Montreal General Hospital. The article starting on page 1159 of this issue discusses some engineering aspects of this interesting new hospital building.

velopment of nuclear energy. Regardless of conflicting comments on the relative standards of current achievement, there can be little doubt that the next decade or so is critical if the western powers are not to be outstripped by Russia in both the technical and commercial fields.

Manpower is the theme. Russia is developing and grooming the best material among scientists, engineers, and technicians in order to make the most of the potential of nuclear energy. With this drive, and the ability to learn and to apply the lesson, she cannot fail to overtake other nations unless they are prepared to face these facts and provide the right incentives to induce the best-suited men into the field.

Whatever the attitude of the politicians, there seems to have been a general feeling between the scientists of all nations that for the first time since the end of the last world war there existed a widespread outlook that might no longer include the term "cold war". Certainly relations were most cordial between these scientists of many political loyalties.

The general press of the world made much of the wholesale revelation of hitherto closely guarded secrets. Although many grains of salt might have been taken with some of the headlines, there can be no doubt that the larger nations placed most of their cards on the table as far as fundamental data on nuclear physics concerning civil applications were involved. In addition, a fair amount of information on practical applications was released, though some industrial know-how was withheld—as is only to be expected.

It would appear that the "secret" classification will, in future, be applied mainly to work in the fields of engineering, metallurgy, and chemistry.

The term "larger nations" refers to those who are the present leaders in the field, namely, the United States, the United Kingdom, Russia, Canada, and France. Other nations, for technological and economic reasons, will be largely dependent on the engineering knowledge of these leaders for their own major nuclear energy developments, although much valuable work is being done in many countries in the fields of physics, chemistry, metallurgy, and the medical, biological, and agricultural sciences.

It may be of interest to note that, of 24 participating nations, contributions to the general sessions were roughly (per cent): U.S.A. 38; U.S.S.R. 16; U.K. 15; France 7; Canada 2.5; Norway and Sweden each 2.1; and the rest less than 2. In addition, contributions were made by such organizations as U.N.; UNESCO, WHO, FAO, and ILO.

The production of power from nuclear energy is obviously the major benefit to mankind, at present. In this field many extravagant claims have been made, but it is apparent that the United Kingdom is in the lead as the result of a bold and imaginative approach to the problem. This approach has, of course, been stimulated by the economic necessity of finding suitable alternative sources of energy to the traditional coal.

Local heating from reactors has been used at Harwell, England, for some years, and power-producing reactor units are in existence in the U.S.A. and Russia; however, Britain will be the first with an economical power plant feeding directly into the country's electrical distributing system.

The Russians scored with an excellent piece of propaganda in the form of a film showing their industrial nuclear power station, which, it is claimed, was the first in the world to operate. Nevertheless, this reactor station, of 5,000 kw. electrical output, is definitely uneconomical and would not be a serious proposition in a country such as Canada.

The most advanced reactor was claimed by Canada with the new NRU at Chalk River; Britain has built a fast breeder reactor which is designed to produce nuclear fuel rather than power, but will be the basis for future highly efficient power-producers.

The engineering and technical standards of the United States and Britain, as evidenced at the exhibitions of material and equipment, were of the highest order. In spite of some rather outdated items in such fields as instrumentation and radiological treatment, the Russians also appeared to be very well equipped, and far from lagging behind to any serious extent.

To summarize, the conference has undoubtedly created a friendlier feeling and a wider understanding between many scientists of different nations; and a great deal of information on the civil uses of nuclear energy has been made available to all who may wish to use it. It has also made quite apparent the fact that, although the western powers may be in the lead, each to different degrees in different fields, Russia is also very far advanced and has the potential to overtake the field.

This is no longer a question of surviving an arms race but an economic race in the peaceful applications of nuclear energy. It is a new field, and it will require the best of the new men; to keep in the lead the west must see that these men — among whom engineers must be well to the fore — are attracted to continue the progress so well started.

Canso Causeway Completed

The Canso Causeway from the mainland of Nova Scotia to Cape Breton Island is completed—after many years of investigation and planning.

It was officially opened on August 13 by The Right Honourable C. D. Howe, Canada's Minister of Trade and Commerce, with ceremonies recalling the Scottish ancestry of the people of Nova Scotia. Mr. Howe cut with a Scottish claymore a tape of Nova Scotia tartan, and declared the $23,000,000 Canso Causeway open. Later one hundred kilted pipers, to the strains of the "Road to the Isles," led a procession of thousands across the mile-long road over the Strait.

Mr. Howe described the causeway as one of the great engineering projects of Canada. The need for a link between Cape Breton and the mainland had always been apparent, he said. The problem had been how the link should be built. A causeway had proved to be the final solution.

In the past Cape Breton's heavy industries centred upon Sydney have had only ferry transport across the Strait of Canso. The contribution of these industries to the economy of Canada in peace and war has been great despite

this difficulty. The causeway will benefit Cape Breton, Nova Scotia, the Atlantic Provinces and the whole of Canada.

Other distinguished guests and speakers included the Hon. Alistair Frazer, lieutenant-governor of Nova Scotia; the Rt. Hon. George Marler, federal minister of transport, who introduced the speakers; the Hon. Henry D. Hicks, prime minister of Nova Scotia; Mr. Donald Gordon, president of the Canadian National Railways, and Mrs. Angus L. Macdonald, widow of the late premier of Nova Scotia.

Following the invocation by the Ven. A. F. Arnold, Archdeacon of Cape Breton, the Rev. S. P. Macdonald gave greetings to the audience in Gaelic, an event which provided considerable pleasure to the predominantly Scottish gathering.

The Hon. Henry D. Hicks then spoke upon the unity of all Nova Scotians which is symbolized by the causeway and paid tribute to the men who had conceived and carried out the undertaking. "Only a very short time ago," he said, "no man could have stood where we are standing now." He paid warm tribute to the memory of his great predecessor, the Hon. Angus L. Macdonald, whose dream the causeway was and who lived to dump the first truckload of rock fill into the Strait.

Last of the platform speakers was the Most Rev. J. R. Macdonald, Bishop of Antigonish, who delivered a message. The bishop expressed three hopes—that this physical bond should be an instrument of bringing people closer together, that the material progress the causeway offered should extend to all and that the causeway might prove a symbol of the strength of Nova Scotia's solidarity and the unity of Canadian citizenship.

It is planned that the *Journal* will describe the engineering aspects of the causeway at a later date.

This is the second major engineering development coming to completion in the province this year. The Angus L. Macdonald Bridge from Halifax to Dartmouth was opened on April 2.

Evaluation of Engineering Education

The American Society for Engineering Education has just issued a report on this subject, prepared by a committee of forty-five of its members, among whose names we recognize those of many of the best-known engineering teachers in the United States and that of at least one Canadian, Dr. J. B. Phillips, M.E.I.C., of McGill University. Three years of hard work, coupled with extensive criticism, both by the engineering schools and by industry, have resulted in a thirty-six page document, which is certainly required reading for all who are concerned or interested in engineering education.

The title, it seems to us, is a little misleading, for the report has much to say about existing conditions. It aims to present the broad outlines of ideal curricula, both undergraduate and graduate, and to investigate the means whereby such curricula can be made truly effective—by the provision of really top-notch faculties, for instance. This is a *very* brief summary of what the report con-

Student Delegates at E.I.C. Meeting

The student conference forms part of the annual meeting of The Engineering Institute each year. The students sat at the head table with Institute officers during a dinner at the Toronto annual meeting in May. From left to right: Cadet B. R. Carter, R.M.C.; John G. Hall, past-councillor; B. G. Ballard, vice-president; Jean Roquet, Ecole Polytechnique; K. H. Platt, Institution of Mechanical Engineers; Irving R. Tait, past vice-president; H. D. Atkins, University of Alberta; John E. Campbell, University of Saskatchewan; J. O. Martineau, vice-president; James A. Vance, past-president; Jean Villeneuve, Laval University; L. F. Grant, past-president and field secretary; Don J. Kawaja, Nova Scotia

Technical College; D. M. Stephens, retiring president; W. M. Huggins, chairman, Toronto Branch; Ira P. Macnab, past-president; Eskil Johnsson, University of British Columbia; J. B. Stirling, past-president; Michael Orlander, McGill University; R. L. Dobbin, past-president; Andrew Blair, Queen's University; C. D. Carruthers, past-councillor; George A. Keith, University of New Brunswick; Norman B. Eagles, vice-president; D. W. Craik, University of Manitoba; G. R. Henderson, past vice-president; Paul B. Walters, University of Toronto; M. McMurray, councillor. Also present were D. D. Whitson, and W. H. Paterson, councillors.

tains, for it goes into exhaustive detail regarding each of the many topics it covers and they are legion.

As for undergraduate curricula, it assumes that they will cover four years, though it suggests that an additional year might be useful. Such curricula, it thinks, ought to be about one-quarter basic sciences (mathematics, physics, chemistry, etc.); one-quarter engineering sciences (mechanics, thermodynamics, etc.); one-quarter engineering analysis and design (structures, heat engines, etc.); one-fifth humanistic and social studies; and one-tenth options or electives in a wide field.

The report urges that more be done to acquaint students at the high school level with the meaning and requirements of an engineering career, both so that those attracted to it, and who have the necessary talents, may use their school time to the best advantage and also to reduce the number of misfits who now reach the universities. Our joint E.I.C.-C.I.M.M.-C.I.C. committee is doing what it can along these lines on a limited budget. But our universities do not go much beyond examining an applicant's academic record, to separate those who will probably swim from those who will probably sink.

Some regard a failing engineering student as a complete economic loss. This writer does not. He feels that even the poorest student gets *something* of value from the time he spends at the university; whether value received or not is another matter. A fair proportion of such students do well in other fields, others may get a quasi-engineering education in industry, but most of them will tell you that the little dose of engineering discipline they got was no bad thing.

The report feels that engineering teachers should have had some graduate training in their fields In the great majority of cases this is no doubt true. And it also feels that they should be research minded, also no doubt generally true. But this writer believes that the ability to teach is more or less an inborn talent, which can be developed by study and practice, of course, like a talent for music or for painting. We can all remember some of our teachers, excellent teachers, who held no graduate degrees and had no interest in research nor in anything but teaching. Faculty appointment rules should not be so rigid as to deny such teachers, not very numerous perhaps, the opportunities and status they deserve.

In several places this report emphasizes that engineers as a class are not good at "communication", which means, we take it, that they have a poor command of spoken and written English; in fact, the report says so elsewhere. The writers of the report might well have taken a dose of the medicine they recommend; there are too many ten-dollar words where ten-cent ones would have been better and some of the writing is pretty involved. Many passages require more than a single reading if their exact meaning are to be realized.

If this report is widely circulated among engineering schools, it ought to lead to self appraisals of their curricula and methods, with resulting improvements. No school is likely to accept the report's suggestions *in toto*, but all will find some that can be adopted to advantage.

There is no hint as to the price of this report nor as to where it may be obtained. Presumably a letter to the A.S.E.E. secretary Prof. W. Leighton Collins, University of Illinois, Evanston, Illinois would bring this information.

Correspondence

ASME Anniversary Meeting

Dear Mr. Wright:

We extend a cordial invitation to members of your society to attend the Diamond Jubilee 75th Anniversary Annual Meeting of the American Society of Mechanical Engineers the week of November 13, 1955, at the Congress, Conrad Hilton and Blackstone Hotels, Chicago, Ill.

In addition to the rather elaborate program of our annual meeting (Headquarters, Hotel Congress), there will be held a National Exposition of Power and Mechanical Engineering at the Chicago Coliseum which ASME sponsors and for which we would be pleased to provide your interested members with gratis tickets. The exposition will be unusually attractive and, in itself, is worth a journey to Chicago.

According to our policy, it is necessary to charge a registration fee of $10.00 to all persons attending the meeting of the Society who are not ASME members, except in the cases where other organizations join us as co-sponsors of sessions. In the case of E.I.C. members, this charge will not apply because of the cooperative agreement between our two organizations.

If your members will write us (The American Society of Mechanical Engineers, 29 West Thirty-Ninth Street, New York 18, N.Y.), we will send a copy of the preliminary announcement, giving full details regarding the program.

ERNEST HARTFORD,
Consultant

Invitation to Australia

Dear Sir:

As you are aware, the 1956 Olympic Games will be held in Melbourne in November next year.

It seems quite possible that some of your members may be attending as competitors, officials or visitors, and the members of this Institution would be very glad of the opportunity to extend hospitality to them. Should any such visitors desire to inspect engineering works or industries in the State of Victoria, we will be very pleased to make the necessary arrangements to enable them to do so.

It would be greatly appreciated if you would bring to the notice of your members our desire to welcome them if they visit Melbourne next year, and it would also be greatly appreciated if they would write to the Hospitality Officer The Institution of Engineers, Australia, Kelvin Hall, 55 Collins Place, Melbourne, giving details of the time they will spend in Australia, their particular interests, and anything they would particularly wish to see.

C. H. D. HARPER,
Secretary

As the Life Members See It

Dear Mr. Editor:

It was with pleasure I received your letter advising of my election by E.I.C. Council to Life Membership.

This honour came to me at a very opportune time as I retired from active employment on January 1, 1955 after thirty-one years

of service as manager of Montreal office for the Dominion Flow Meter Co., Toronto.

On that date I completed sixty years of work, two weeks of which time I was out of employment and off a pay roll. I left the old Nova Scotia Steel & Coal Co., New Glasgow as mechanical superintendent in 1918 and spent two years with the Leaside Munitions Co., Toronto, as superintendent of shell forging on 12-in. shells for the U.S. Government. This position terminated after the close of the first World War and I moved from Toronto to Montreal in 1920. It was at this time that I was two weeks without a position.

Many thanks for the good wishes which you so kindly extended to me. If I can be of any service to the Life Members' group, the Montreal Branch or the Institute at large, I will be pleased to co-operate to the best of my ability.

H. T. Doran, M.E.I.C.,
Westmount, Que.

Club Facilities in London

Recently the Institute has been advised that any of its members who are able to use the facilities to advantage are welcome to join the Society for Visiting Scientists. This organization has its building at 5 Old Burlington Street, London, W.1., England.

The facilities offered are excellent and the costs are extremely low. For members "who reside in the United Kingdom for six months or longer, the annual subscription is three guineas. For other members there is no annual subscription. Membership is open to scientists and others who have an interest in or a contribution to make to relations with scientists in countries other than their own".

The Society has some nice housing accommodation at something really better than reasonable prices. For instance a bed and breakfast (single room) is only 10 shillings. A luncheon can be obtained for only 3 shillings.

A rather general description of the club facilities and its objectives follows. This has been taken direct from some of the literature which has been sent to Institute Headquarters.

Applications for membership can be made at any time during the year by means of a letter addressed to the assistant secretary of the society or by a personal call at the building.

Established in the spring of 1944, when Britain had the honour of welcoming many scientists from Allied countries, the Society for Visiting Scientists seeks to be a focus for all scientists visiting the United Kingdom, and to put them in touch with British scientists and with one another. The society aims to provide and encourage an active exchange of scientific thought and discussion between scientists of the United Kingdom and scientists from overseas.

The house of the society provides a meeting place, a refectory, a library, a bar and some residential accommodation. In addition an information service is provided which is open to all members, and any scientist arriving in this country can, if he wishes, proceed at once to the house and be given such advice and information as is available, and details of how he may apply for membership.

One of the most stimulating of the society's activities has been the holding of discussion meetings on subjects of general interest to scientists. A program committee is responsible for arranging these meetings, and the speakers have been eminent men of science from the United Kingdom and abroad.

The society's council includes among its members scientific representatives of several countries, as well as many distinguished British scientists. The president and chairman is Professor A. V. Hill, C.H., O.B.E., F.R.S.

The society provides facilities for that personal contact and understanding among scientists which is essential for the advancement of knowledge and the establishment of a lasting peace.

Orientation and Training in Industry

A group of four papers discussing orientation and training in modern industry are now available in a publication of the proceedings of the 22nd annual meeting of the Engineers' Council for Professional Development, held in Cincinnati, Ohio.

The papers were presented by representatives of four industrial firms which have been participating in the pilot study of the ECPD program known as "The First Five Years of Professional Development".

A summary of highlights given in these papers includes the following suggestions:

1. The essential need of industry is a loyal, efficient and aggressive working organization.

2. Training is basically a way of operating with new people in the total work situation.

3. Habits start being formed the first day on a job whether or not you want to train a man.

4. Making the trainee a part of a working team is an essential part of any realistic training program.

5. To work, not merely to observe, should be the key to each training assignment.

6. Put responsibility into trainee jobs. Make the trainee carry a burden and learn to produce.

7. A challenge to the individual is essential in the first job. It will bring out the best in any man and will effectively reduce turnover by holding the really good men.

8. Select the best boss for the trainee. This is particularly important on the first few assignments.

9. Flexibility in training assignments is necessary to serve the best interests and abilities of the individual and the company. Regimentation in training is to be avoided.

10. Follow-up on training must go on for a period of several years. Carry-over should be checked and provided for.

The publication also includes an introduction to the question of professional industrial training.

In addition the publication includes a copy of the brochure describing the program for young graduate engineers during the "First Five Years" and a copy of the brochure reporting on "The Community Project in Professional Development" which has been studied recently in Cincinnati. Copies of the publication are available free by addressing ECPD Committee on Professional Training, 322 Baldwin Hall, Cincinnati 21, Ohio.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

Annual Meeting, October 13-14, 1955

King Edward Hotel, Toronto, Ont.

ECPD Meets in Canada

The Engineers' Council for Professional Development is holding its twenty-third annual meeting at the King Edward Hotel, Toronto, on October 13 and 14. With the exception of certain special sessions, the meeting is open to visitors. Two important subjects will be discussed by specialists, i.e., Ethics, and Education and Utilization of Engineers, with audience participation.

The Program

Thursday, October 13

9.00 Registration

9.30 Meeting of Council, Administration Session
(For members of council and committee chairmen only)

10.00 Meeting of Council, Executive Session
(For members of council and education committee only)

10.00 Meetings of Standing Committees
Guidance, Student Development, Training, Ethics, Recognition.

10.30 Ladies' Social Hour

12.30 Luncheon (Ladies included)
Presiding: L. F. Grant, president, ECPD
Welcome to Canada: Dr. R. E. Heartz, M.E.I.C., president, The Engineering Institute of Canada
Speaker: S. C. Hollister, Dean, College of Engineering, Cornell University
Subject: "Survey of Education and Utilization of Engineers".

2.00 Open Committee Meetings
Guidance, Student Development, Training, Education, Ethics, Recognition
General discussion.

3.00 Open Council Meeting
Presiding: L. F. Grant, president
Presentation of reports.
For the standing committees: Guidance, A. Paul Shackleton, AIEE; Education, Harold L. Hazen, AIEE; Student Development, N. W. Dougherty, NCSBEE; Training, Edwin L. Yates, ASEE; Recognition, Russell G. Warner, NCSBEE; Ethics, Scott Turner, AIME; Information, John B. Mellecker, AIChE.
Reports from participating societies.

4.00 Reception by The Honourable L. O. Breithaupt, Lieutenant-Governor of the Province of Ontario, and Mrs. Breithaupt.
(Note: It is especially requested that ladies who will be attending this reception send their names to Colonel L. F. Grant, 236 Avenue Road, Toronto, not later than October 1, in order that the official secretary to the Lieutenant-Governor may send them cards of invitation.)

5.45 The Engineering Institute of Canada Reception for delegates and ladies

Thursday, October 13 (Continued)

7.30 Annual ECPD Dinner
Presiding: M. D. Hooven, vice-president, ECPD, and president, American Institute of Electrical Engineers
Speaker: Sidney Smith, Q.C., LL.D., president, University of Toronto.

Friday, October 14

9.00 Registration

9.30 ECPD Annual Meeting (continued)

9.30 Panel Discussion
Subject: "A Profession Without Ethics is a Contradiction in Terms"
Presiding: Scott Turner, AIME, Chairman, Ethics Committee, consulting engineer, New York.
Speakers: C. J. Freund, ASME; J. E. L. Roy, EIC; G. Ross Lord, EIC; W. S. Wilson; J. H. Foote, AIEE.
General discussion.

11.30 Ladies assemble for Luncheon at Guild of All Arts

12.30 Luncheon
Presiding: L. F. Grant, president
Speaker: Russell G. Warner, vice-president, United Illuminating Company, New Haven, Conn., chairman ECPD-EIC Committee on Practice of Engineering.
Subject: "Professional Aspects of the Practice of Engineering."

2.00 Open Forum
Presiding: M. D. Hooven, vice-president, ECPD
Discussion of Survey of Education and Utilization of Engineers, Dean Hollister's luncheon address of October 13.

3.30 Student Development
Presiding: N. W. Dougherty, chairman, ECPD Student Development Committee.

4.30 Adjournment of 23rd Annual Meeting

4.45 Meeting of New Executive Committee

6.00 Informal Buffet Supper

Reservations

Reservations should be made as early as possible

The following information is required:

Name, address, affiliation, names of guests
Reservations for annual dinner, luncheons, buffet supper
Names of ladies who wish to attend reception of Lieutenant-Governor.

Please address all inquiries to:

Toronto Office, ECPD,
c/o The Engineering Institute of Canada,
236 Avenue Road, Toronto, Ont.

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

Progress by Ontario Hydro and NYSPA

A contract for channel improvements at and adjacent to Galop Island was awarded to C. A. Pitts General Contractor, Limited, for $11,700,420. The work involves excavation of some 14,500,000 cubic yards of common excavation and about 1,000,000 cubic yards of rock. It is scheduled for completion by July 1, 1958.

A contract for channel improvements and pier construction adjacent to Chimney Island was awarded to the Canadian Dredge & Dock Company Limited (Toronto), for $4,374,020. The work involves some 2,000,000 cubic yards of common excavation, pier construction and associated work. It is scheduled for completion by July 1, 1958.

A contract for 48 gates and hoists for the Canadian powerhouse was awarded on August 7 to Dominion Bridge Company Ltd., at a price of $1,698,800. Deliveries are scheduled between August 1957 and February 1958.

Tenders were called on July 17 for manufacture and supply of 1,500 tons of anchor and tie bolts and riveted steel checks and sills for the headworks and tailrace of the Canadian half of the powerhouse. Tenders closed August 9.

A contract for the installation of sewers, water mains and house services at the site of the new Village of Iroquois has been awarded to the Beaver Construction Company of Montreal at $332,424. Completion is scheduled for October 31, 1955.

Ontario Hydro has announced the appointment of Malcolm E. Bradden as rehabilitation information officer for the St. Lawrence Power Project. He will be responsible for providing information on rehabilitation work in communities to be relocated. His duties will also include assistance to families being relocated, so that the program may be carried forward in a smooth, efficient manner.

On the American side, the contract for the Massena intake and appurtenant works was awarded by the New York State Power Authority on Aug. 11, to a Morrison Knudsen-Perini-Walsh-Utah joint venture group, at a price of $7,780,157.

Progress by the Canadian Seaway Authority

Tenders were called on July 27 for the construction of Côte St. Catherine Lock and approaches in the Lachine Section. This is one of the two locks to be built in this section, the other being the one at St. Lambert, tenders for which will be called shortly.

The work extends a distance of two miles, and in addition to the lock, consists of excavation of a navigation channel and dykes which form the approaches to the lock. It includes the excavation of a turning basin downstream of the lock, regulating works for the control of the water level of the upper reach of the canal and the formation of a reservoir pool upstream of the lock. It extends from a point in the Laprairie Basin near the village of Baurette, upstream and then overland to a location inland in the westerly limits of the town of Côte Ste. Catherine, on the south shore of the river. The contract is to be completed by July 31, 1958.

Common excavation will amount to some 2,800,000 cubic yards, rock excavation to some 1,653,500 yards. Concrete required will amount to some 350,000 yards. Contracts will be let at a later date for lock equipment and for electrical installations.

Tenders were called on August 3 for enlargement of Piers 1 to 11 of the Jacques Cartier Bridge, in the Lachine Section. Tenders closed on August 23. The work is to be completed not later than September 30, 1956. This work is preparatory to the eventual raising of the southern span of the bridge, and will be co-ordinated with the channel excavation work now under way.

A contract for the seven storey Seaway Authority office building at Cornwall was awarded on August 17 to M. Sullivan & Sons Limited of Arnprior at a price of $1,337,337, the lowest of three tenders. Completion by April 30, 1957 is called for.

Dredging Operations

Work is now well under way in the considerable dredging operation from Cornwall Island to the foot of Lake St. Francis and in Lake St. Louis, to deepen the Seaway channel to at least 27 feet. The St. Lawrence Seaway Authority has awarded four separate contracts.

Different conditions on the river dictate different methods. Working two shifts, the "Midland's" eight-cubic-yard dipper removes some 2,500 cubic yards a day from the channel; the "Sydenham's" six-cubic-yard dipper lifts around 1,600 yards and the "Monarch" moves about the same amount. These three constitute the "main armament" of Canadian Dredge and Dock Company Limited, working in the westerly portion of Lake St. Francis. Working with these dipper dredges are four tugs, six scows, two work-boats, an oil barge and a floating derrick.

Dredging the Lake St. Louis channel, Marine Industries Limited is working 24 hours a day with its dipper-dredges "M-101", and "M-107" and "J. B. Kennedy" and the bucket dredge "Bruxelles XXXX". Here 3,800,000 cubic yards of overburden and 100,000 yards of solid rock must be removed from the Seaway channel to disposal areas.

In Lake St. Francis at the approach to the Beauharnois Canal, McNamara Construction Company is also on a 24-hour day with its 12-in. suction dredge "Charlie M". On this contract 1,100,000 cubic yards of sand, silt and clay must be removed. This company has its dipper-dredge "George M" and the 16-inch suction dredge "J. Holden" working in the upper part of Lake St. Francis.

To dredge part of the Lake St. Francis channel, at Lancaster Bar, for which the contract has been awarded to Marine Industries Limited, involves the removal of 600,000 cubic yards of sand, silt and clay.

A total of some 8,200,000 cubic yards of overburden and 100,000 cubic yards of rock must be dredged under terms of these four contracts, the value of which totals some $14,000,000. About 250 men

are now employed on these dredging contracts, with expectation of a working force of some 400 at the peak, in some months' time.

Seaway President Speaks at Montreal

President Lionel Chevrier of the St. Lawrence Seaway Authority was guest speaker at the Montreal Rotary Club luncheon in the Mount Royal Hotel on July 19. Recounting the background of the waterway project and an outline of the work now in progress, he indicated his belief that healthy criticisms of Seaway plans was all to the good, although certain criticisms did not survive a close analysis.

Referring to the contention that the Seaway channel should have been built in the middle of the stream, he listed compelling reasons why it was placed on the South Shore. There could be no industrial development located upon the Seaway if the channel were in the middle of the river, he stated. The old Lachine Canal along the Montreal shore had permitted the development of industry along its banks. The new canal along the Laprairie Basin would permit extension of Montreal Harbour, already overcrowded, to this area. It would create an important industrial area which would not otherwise be as attractive to industry if the canal were in the middle of the river.

The plan of development now proposed avoids bringing large Upper-Lakers through the St. Mary's current and the congested harbour area, he explained. Rail traffic conditions at Victoria Bridge will be materially improved as compared with a canal crossing at the Montreal end of the bridge.

Referring to proposals made recently by the city of Montreal for improved transportation facilities across the river, Mr. Chevrier indicated the Seaway Authority would much prefer a vehicular project across the river at Nun's Island from Montreal to the South Shore, which would provide direct north-south communication between the two shores. It would be more practical and effective, he believed.

This was followed by an announcement on August 17 by the Hon. George Marler, Minister of Transport, that a new four lane toll bridge would be built between the Island of Montreal and the South Shore across Nun's Island. Plans would be prepared immediately by consulting engineers, and it was hoped to have it opened to traffic by 1960.

The bridge will come under the jurisdiction of the National Harbours Board, and tickets will be valid for use over any one of the three bridges. Legislation will be presented for approval by Parliament at the next session. Municipal authorities in the Montreal area contend that six lanes would be a minimum requirement.

Land Acquisition by NYSPA and USSDC

A pamphlet published late in July by the power authority of the State of New York outlines the master plan drawn up to cover the changes arising from the Seaway on the American side of the river. Mainly discussing land acquisition, and including coloured maps of land to be acquired for reservoirs, park areas, Seaway and construction areas, the text reads in part as follows:

". . . . we must take sufficient land at the outset to meet all possible needs and to avoid future disputes and claims. Within limits determined on these principles and considerations we aim, where feasible, to give owners access to new water levels consistent with fee ownership by the State and permits or easements carefully limited by future power and seaway needs.

"In this instance we are printing a booklet which tells exactly what we require in the way of land acquisition for both the Power and Seaway projects. Under an arrangement with the American Seaway Corporation, the Power Authority has assumed responsibility for acquiring all land required for the joint project.

"It has been essential to speed up the land acquisition program in order to keep up with the schedules for both Power and Seaway construction. We are working on an accelerated construction program. We must have the title to all land on or before January 1, 1956. This will allow time for residents who must relocate now to make their arrangements in an orderly manner. . . . We invite the co-operation of owners on terms which are described in this booklet in language that can be readily understood by everyone.

"Land on which major power facilities are being built, including the Barnhart Powerhouse, Long Sault Dam, Iroquois Dam, and highways, railroads and other facilities in the Barnhart area, has been acquired and settlements have either been made or are in process. Dykes are the most important structures remaining to be put under contract. Some are still in the design stage. . . . These designs are rapidly being completed and land acquisition will follow promptly.

"Land required for the Seaway has been largely acquired and settlements have either been made or are in process. Areas required for the deposit of dredged material are now being acquired and remaining areas will be acquired as rapidly as designs are completed, maps prepared and appraisals and title examinations made.

"It will be noted that the huge quantities of excavation involved must be deposited as close as possible to points of excavation or the haul will cause an inordinate increase in the cost of the work. After deposit considerable time must elapse depending upon the exact nature of the material before buildings can be placed on the fills. In some instances years will be required to allow for settlement. Contracts for reforesting and landscaping these areas cannot be let until the general trend of the fill settlement is determined.

"It has been suggested that the Authority acquire easements only, and return filled property to the original owner after the fills have been completed. This is not practical. No one can determine in advance the future value of land on which millions of yards of excavation of various types are deposited. In many cases adjoining land under water will be filled and large areas and islands created.

"Land required should be paid for fairly by the Authority and any benefit as a result of the expenditure of millions of Authority funds in excavating channels should accrue to the Authority. Finally, proper treatment after completion of the fills requires an extensive program of reforestation and landscaping. Such a program could not be carried on if ownership in filled parcels re-

mained with scattered individuals. . . . Unless control is retained by the Authority this project would quickly take on the appearance of the strip mines in Western Pennsylvania or West Virginia.

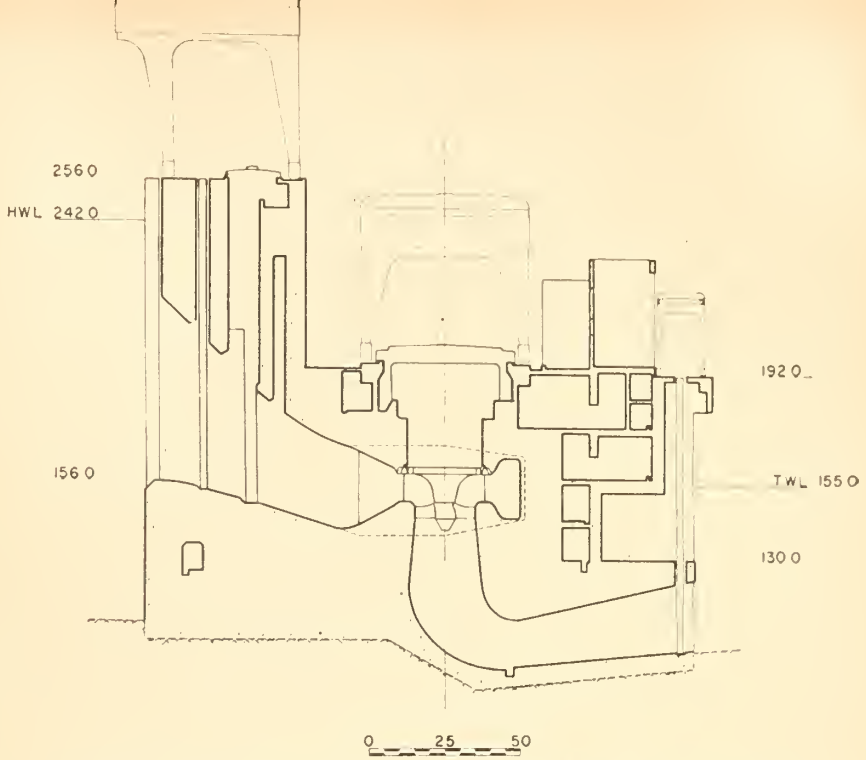
"Much of this final improvement must await settlement of huge quantities of excavated material. No one knows just how long this will take. As soon as possible after the completion of channel excavation, this phase of the work will commence. Discussions with the St. Lawrence Seaway Development Corporation and Ontario Hydro have resulted in a general informal agreement for a co-ordinated power and Seaway program of river conservation and beautification.

"The final category of land acquisition involves river frontage not required for construction purposes, but needed because of raised water levels or for protection from flooding. Most of this property will be permanently flooded and will be under the pool created by the construction of the powerhouse, dams and dykes.

"The remainder is required to enable proper regulation of the river . . . the final method of regulation of the River and Lake Ontario has not yet been officially promulgated, and since some fluctuation of levels may result in the future because of subsequent changes in regulation methods, designs of necessity must cover all assumptions. . . .

"It is the unanimous opinion of the staff and waterfront consultants that river frontage should be owned in fee by the Power Authority and that limited reservations be made to upland owners, cut off from the river by the Authority, for access to the river from upland property. The Authority must retain jurisdiction over this area and cannot be placed in the position of acquiring insufficient rights which might have to be augmented later at additional cost to the Authority.

"While the Authority could reserve to an adjacent property owner from whom it took land some rights to the area between the water's edge and the property taking line, most of the rights which it would be possible to reserve would have to be subject to cancellation or modification.



Typical Section through C/L of Unit—St. Lawrence Power Project.

"For instance, it could allow by formal reservation in a conveyance right of access to the water, but the building of a boat house or a dock would have to be subject to a permit. This is true not only because of the provisions of the license but also because of the risk that at a later date, as a result of experience gained in operating the pool or of orders of the Federal Power Commission, the Authority would have to acquire a new and further interest in the land in order to effect the removal or relocation of the facilities.

"While it is clear that the Authority must exercise a large measure of control, it is impossible to foresee in detail just what this measure is. It would, therefore, be impossible in acquiring an interest less than fee simple in property to spell out the interest which the Authority would need. Common sense property-taking lines will have to be established somewhere beyond the 246-foot elevation. They must be relatively straight.

"The only practical method of handling land acquisition is, except in unusual situations, to take fee title to the property taking line, and to reserve to the adjacent owner a right of access to the water and provide that his use of the property between the property-taking line and water, including the building of access roads, docks and other structures, will be subject to permit from the Authority."

Nothing comparable to this pamphlet had yet appeared by mid-August for the Canadian side of the Seaway. The absence of such planning for Canada may leave fundamental problems unsolved, and may even be creating new problems for the future. Speculation in land buying along the Canadian shore is already active. Until the Canadian authorities concerned make clear what they intend to do, little planning can go forward to take care of the developments arising from the construction of the Seaway.

Industries for Seaway Valley

First signs of a wave of industrial development are appearing along the Canadian side of the Seaway, heralding the reward to follow the inevitable dislocations of its construction boom. Plans for improved harbour facilities have been announced for several lake and river ports, leading to a sharp rise in land values.

In Ontario, several industrial building plans are announced. P. Leiner and Sons of Britain will build a gelatine plant at Cobourg on a 35 acre site. Raw materials will come from Wales, India and Pakistan. At Clarkson the St. Lawrence Cement Co. will build a major cement plant.

Canada and Dominion Sugar Co.

plans a 100-200 million pound annual capacity cane sugar refinery at Toronto costing $6 million. Raw cane will come from the Caribbean, Australia and Mauritius, transshipping at Montreal to lake freighters. At Cornwall major developments are expected with a 1,000 acre industrial area set aside with rail links and wharfage facilities. Several British construction companies have opened Canadian offices in Toronto, planning to participate in dockage construction.

In Quebec, Iron Ore Co. of Canada has completed a terminal at Contrecoeur for the transfer of ore from large ships to canalers. A European syndicate has been buying land for industrial development in the Varennes-Contrecoeur area, while another group has purchased a 90 square mile tract of land. At Préville a British group is planning a 50 acre industrial estate, while U.S. Steel interests are studying the possibility of a mill in Laprairie Basin.

Land speculation has upped values all along the south shore of the river around Montreal, mainly because the Seaway development will permit extension of the congested Montreal harbour. Location of the channel along the south shore rather than mid-river, will create an industrial area adjacent to the port. Here highway development will be easier, while there is also an ample supply of cheap power with 6 million hp. of energy available, much of it still untapped.

No Lack of Engineers for Seaway

Government and private industry are watching Seaway Authority recruitment of engineers with envy. It appears only the Seaway can get its full and increasing quota without difficulty. Other industries are finding the supply short, yet the Seaway Authority reports a "tremendous number of replies" to recent advertisements.

Officials of the Technical Service Council point out a reason for this. Not only has the Seaway a sort of glamour in itself, but it is of particular technical interest. The salaries offered compare well with those offered in other sections of industry. Family men can expect to find accommodation reasonably near their work, unlike many of the defenee or resource projects going forward in remote areas.

Parliament Discusses Seaway

Opposition members in the House of Commons have protested payment of higher wages to Americans working in Canada on the Seaway, than Canadian workers are getting. They claim it is causing discontent among Canadian workers. The United States, it is claimed, has opened investigations into the employment in the U.S. of Canadians, and the Canadian government should do the same. Health Minister Martin, acting minister of labour, replied each country establishes its own wage scales. Americans working in Canada for U.S. companies may receive more money, but the wage at least must meet Canadian minimum standards. An American contractor building in Canada may not bring in labour if Canadians are available, he said, apart from executive and managerial officials.

Answering criticism in the House of Commons that Parliament and the public were being kept in the dark respecting improvement plans for the Port of Montreal, Transport Minister George Marler assured Parliament the $7 million program now planned to improve port facilities at Montreal would be more than sufficient to enable the harbour to meet the demands imposed by the Seaway and normal traffic increases. About $2 million would be spent this year for extension of two wharves, for raising Sutherland Pier 14 feet, and for transit sheds and grain conveyor galleries. Dredging would likely be carried out in 1956 and 1957 as part of the later stages of the program.

Other News Concerning the Seaway

Governor Lauche of Ohio has signed a new measure authorizing cities and counties to create port authorities along Lake Erie and the Ohio River. He has urged communities to set aside local rivalries so as to take full advantage of opportunities created by the Seaway.

The Toledo Port Authority plans a $20 million waterfront industrial district on Maumee Bay, with bulkheads for 30 slips. Consultants for Cleveland have recommended the city spend $29 million to meet port demands. In Indiana a $60 million seaport on Lake Michigan between Michigan City and Gary, to be built with private capital, was declared legally feasible by an advisor to Governor Craig. After the port is built the State Board of Harbours and Terminals would acquire the facilities through a bond issue to be retired out of port revenues. The federal government would build a breakwater and dredge the harbour.

Television, already getting serious considerations as a traffic control device, may be employed in operation of Seaway locks. If tests being conducted by R.C.A. and army engineers on Illinois waterways prove successful the system would operate thus: A TV camera would be trained on the lock gates so one man could watch them on a screen. He would open the gates from a master control point. This would save posting an operator at each gate, as is now neeessary.

A Year Overseas for Engineering Graduates

T. A. Lindsay, president, Phillips Electrical Company Limited, has announced a plan whereby his Company will arrange for the first time to send outstanding engineering graduates from Canada to England to work in the laboratories and factories of British Insulated Callender's Cables, Limited.

Phillips, the Canadian affiliate, is making arrangements on behalf of B.I.C.C. Those selected will be under no obligation to join either firm.

The plan provides a salary of $3,900.00, plus travelling expenses to England and return, with provisions for payment in pounds sterling and dollars. Married engineers may take their families at their own expense and they will be given assistance in locating accommodations.

Interested graduates should send applications in writing direct to Mr. Lindsay at the Company's head office in Brockville, Ontario. Information submitted should include name, address, marital status, university, year, course, work history. Married applicants should say whether their families will accompany them. It is planned to have selection completed by November 1st, and to arrange sailing for around New Year's Day.

CEA Meets in Vancouver

The Canadian Electrical Association held its 65th annual convention at Vancouver, June 27 to 29, and were welcomed by Mayor F. J. Hume. Total association membership was reported at 1,238, compared with 1,137 a year ago. J. A. Pagé, vice-president and general manager, Southern Canada Power, was elected president for the coming year, with A. C. Abbott of Shawinigan Water & Power Co., as vice-president.

CEA President A. W. Howard predicted Canada's electrical power industry would install more generating plant in the next ten years than it had in all its history to date. Seventy-five billion kilowatt hours had been produced in 1954 and consumption was increasing at 7 per cent annually, he reported. Thermal power was gaining in importance, today representing 11 per cent of total installation vs. 7 per cent in 1950. Forecasts showed it would represent 14 per cent by 1958.

The average domestic use per consumer had been increasing steadily, to 3,100 kwh. per year compared with 1,423 kwh. in 1939, he stated. Use of electricity on the farm, though increasing, remained comparatively small. There were some 60 different electrical appliances in common usage, compared with a dozen 25 years ago. Transmission at 350,000 volts was quite common today; 500,000 volts seems quite practical and even higher voltages seem possible. A continued growth in population and in productivity per worker gave promise that Canada's demand for power in the future would likely make the past seem quite unimpressive.

Electrical manufacturing was today Canada's third ranking industry, he said, employing over 75,000 people and producing goods valued at almost a billion dollars. Due to intensification of international competition the industry was experiencing some real problems, but he expressed no doubt that this competition could be met.

To adequately plan the future supply of electric power, Mr. Howard advocated serious consideration for a re-appraisal of Canada's energy resources, including investigation of further system interconnections; steps necessary to improve the economic position of the seriously depressed coal industry; revised estimates of coal, oil and gas resources; and a review of hydro potential in the light of commercially practical power development.

Managing Director's Report

Managing Director B. C. Fairchild quoted recommendations from the Report of the joint CEA/CEMA Committee in Service Voltage Standardization, issued last November, that "electric utilities should, (1) so design and operate their distribution systems as to enable them to reduce service voltage spreads to offset . . . spreads within interior wiring installations, and (2) give greater support to the Adequate Wiring Bureau and to the various provincial leagues in the promotion of adequate wiring promotions. . . . " Extra copies of the complete report were available from CEA.

The first joint report of CEA and DBS on an "Annual Electric Power Survey of Capability and Load" had been published on a provincial and national basis for years 1950-54 inclusive, with a forecast for 1955-58 inclusive, he stated. The Industrial Research and Development Committee's future activities would be expanded to study all statistics pertaining to the electric industry in Canada.

The suggestion that domestic voltage in Canada be doubled to 230/460 volts had been referred to the Engineering Division, and recommendations as to the feasibility of such a project would be submitted in due course. Discussions had been held between committee representatives of CEA, Bell Telephone, and CMHC respecting distribution to new subdivisions.

Reports from the Engineering, Sales, and General Divisions were presented by J. C. Dale and H. F. Beique, D. A. Hansen and M. A. Perry, and by A. C. Brittain, respectively.

The Industry's Forward Course

A. E. Grauer, president of British Columbia Electric, discussing the forward course of the electrical industry, told delegates that a century ago 79 per cent of work energy was supplied by animals, 15 per cent by humans and only 6 per cent by machines. By 1960, it is estimated animals will supply one per cent, humans three per cent and machines 96 per cent. Similarly in Canada 100 years ago wood supplied 95 per cent of Canada's energy; it is now down to some five or ten per cent of the total.

An American study showed that in the United States hourly productivity per man hour had increased nearly 3 per cent annually from 1914 to 1947, while hourly earnings increased by almost the same amount, and the use of power per man increased 7.68 per cent. Electrical consumption per Canadian worker has remained virtually unchanged at just under 30,000 kilowatt hours yearly since 1939, while consumption per American worker has risen from 10,000 kwh. in 1943 to just under 16,000 in 1953, an annual 5 per cent increase. The apparent stability of Canadian figures arose from the fact that our basic manufacturing industries are becoming relatively less important as secondary industries develop, which use less electricity in relation to manpower, he observed.

Quebec, British Columbia and to a lesser extent Newfoundland were the only provinces left with large amounts of reasonably priced hydro. This gives them a tremendous economic leverage. The rest of Canada appeared to be on the verge of losing its most important historical advantage, viz., low cost hydro power. Development of atomic power would not necessarily help Canada, because countries with large concentrations of population would get at least as cheap power from nuclear fission because of the economics of large scale production.

"When transmission, transformation and distribution costs are added to those of turbines and generators, the area of cost which can be affected by atomic power would characteristically amount to some 15 per cent only of total cost of electricity," said Mr. Grauer. "The general expectation is that a generating range of six to eight mills per kwh. might be achieved. On this basis hydro power will more than hold its own, as will future hydro power developed on a reasonable cost basis. The role of atom power will be to supplement steam power from conventional fuels, and eventually to replace it in many areas as far as new plants are concerned".

Mr. Grauer then quoted John von Neumann of the U.S. Atomic

Energy Commission:- "It is not a law of nature that all controlled release of nuclear energy should be tied to fission reactions as it has been thus far. . . . Fission is not nature's normal way of releasing nuclear energy. Industrial exploitation of nuclear energy may shift reliance on to other and still more abundant modes.

"Reactors have been bound thus far to the traditional heat-steam-generator-electricity cycle, just as automobiles were at first built to look like buggies. It is likely we shall gradually develop procedures more naturally and effectively adjusted to the new source of energy, abandoning the conventional detours inherited from chemical-fuel processes. A few decades hence energy may be free, with coal and oil used mainly as raw materials for organic chemical synthesis, to which their properties are best suited."

Foundation For Tomorrow

Harold Quinton, president, California Edison Co. and immediate past president, Edison Electric Institute, told members that the United States had in one decade built a utility industry equal to what it took more than six decades to achieve by 1945, and in the next decade it was expected to double again. A conservative estimate forecast a trillion kilowatt hours at sales by 1970, nearly a decade ahead of what seemed astonishing a year ago.

EEI's electric power survey showed over 1 million kilowatts per month were scheduled for installation in 1955, for a record-breaking 13 million kilowatts this year. Additions for 1956, 1957 and 1958 were presently shown as about 7.8, 5.6 and 7.7 kilowatts respectively. In less than a decade the amount of coal to produce one kwh. had been cut by 23 per cent from 1.29 pounds in 1946 to .99 pounds in 1954. In 20 years, he predicted, the industry would be three or four times what it is now.

One of the most serious problems in connection with the prospects of electrical living, he warned, was the problem of wiring in customers' homes. Proper wiring was a "must". Of the nation's 50 million homes, 21 million did not have the wiring to permit improvements such as ranges, dryers, water heaters and better lighting. Forty-two per cent of American homes had only two-wire service of 30 amperes or less. Full utilization of today's modern home appliances calls for three-wire services of not less than 100 amperes.

Generally speaking, U.S. utilities had found a fairly satisfactory market for their equity offerings in the past few years, due to their growth characteristics and a tendency in most States to the allowance of a somewhat more liberal rate of return, he stated. There was an increasing understanding on the part of regulatory commissions that the rate base on a historical cost concept included a great amount of investment in 100 cent dollars, whereas revenues were received in terms of approximately 50 cent dollars.

Symposium On Manufacturing

During the CEMA symposium on the Canadian Electrical Manufacturing Industry, chaired by H. H. Rogge, president, Canadian Westinghouse Co. Ltd., delegates heard addresses by Dr. Clarence L. Barber of the University of Manitoba, by J. W. Kerr, general manager, apparatus, Canadian Westinghouse Co., and by Archie M. Doyle, vice-president and general manager, apparatus, Canadian General Electric Co. Ltd.

Dr. Barber stated that since 1949 one dollar additional business out of every three had gone to foreign suppliers. Ninety per cent of all imports of apparatus in 1953 came from United States, with 9 per cent from the United Kingdom. U.S. competition was strongest in standardized products readily mass produced, and where style and advertising are important. Competition from Britain was strongest in custom built equipment. Imports so far in 1955 provided about the same share of total market as they had last year.

While tariff changes had played some part, the most important single cause of increased import competition had been the currency devaluation carried out by Britain and Western Europe. It seemed doubtful that the present degree of advantage would persist. His own guess was that about half the present advantage Britain derives from devaluation would disappear in five or ten years, but a significant portion of it was likely to persist for a long time to come, he stated.

Mr. Kerr, with the aid of slides and exhaustive statistics, demonstrated that the industry had under way a highly organized drive to reduce all forms of cost and expense. The Canadian industry, he pointed out, had not waited for external help, but had applied its best brains to the job of becoming more competitive. No action would assist this drive for lower costs so much as an increase in the volume of orders.

Mr. A. M. Doyle described, with the aid of illustrations, the technical progress achieved in Canadian design development and manufacture of electrical apparatus, and told how this progress had been aided by the adoption of ideas from foreign countries, and by manufacturers risking their capital in new developments. All of this proved, he observed, that though their attitudes must be governed by economics, Canadian manufacturers were not standing still.

Nuclear Energy For Power

W. Kenneth Davis, director, reactor development, AEC, pointed out there was inevitably some overlapping in programs of United States, Britain and Canada, and this seemed highly desirable. No single type or class of reactor would satisfy the various requirements. Results would not be attained overnight. Well founded optimism should not be mistaken for substantial achievement.

A truly economic nuclear power industry must be based on re-use of by-product fissionable material as reactor fuel rather than for weapons purposes, he said. The "dual-purpose" route was not one which would of itself lead to economic power reactors. Weapons needs were presumably taken care of by the reactors now in operation or building in the United States, none of which would produce any electric power. "Dual-purpose" reactors would not provide the answer. It would be necessary to carry on a large development program on "power only" reactors in any case to obtain the necessary information. Power reactors would always have the potential to produce fissionable material useful for weapons in case of emergency.

The United States, he concluded, had therefore chosen to launch its power reactor development program in the direction of "power only" reactors, rather than follow the "dual-purpose" approach. Government assistance to private industry might be required for some time to come to achieve the desired goal. An important question was

the impact nuclear power would have on our industrial pattern and economics as well as that of the world as a whole. "These questions deserve early study," he said.

Canada's First Power Reactor

Canada's objectives in building the NFD reactor, as described by John S. Foster, of Atomic Energy of Canada, Limited, were to demonstrate generation from a plant of relatively low rating; to determine the economics of full scale nuclear power from "power only" plants; to gain experience in design, construction and operation; and to train personnel; all at a relatively low capital cost. Grouped with AECL for the task were engineers from B.C. Electric, Babcock-Wilcox, Canadian Brazilian Services, Ontario Hydro, Shawinigan and Montreal Engineering.

The reactor would employ natural uranium fuel in the form of metal rods immersed in a pool of heavy water moderator, Mr. Foster reported. Estimated cost for a 20,000-kva. plant: reactor, $8 million; conventional plant $2 million; site improvements, buildings and serviecs, $1¼ million; total $11¼ million including overheads and contingencies but excluding development costs and land. Canadian General Electric would be the prime contractor and would contribute all engineering and development to a value of $2 million. Ontario Hydro provides the site, builds the conventional plant and building and operates the plant.

Britain's Nuclear Power

J. A. Jukes, economic adviser, U.K. Atomic Energy Authority, London, told delegates it was now believed possible to design nuclear power stations in the U.K. which have a good chance of being competitive with conventional coal fired stations, which produce energy at about 7 mills per kwh., the gross cost of which is divided about equally between capital and operation.

Britain's program is one for building commercial type stations to serve her industrial economy, rather than experimental or "dual-purpose" stations, he said. It covers the completion of 12 stations in the next 10 years, using the gas-cooled graphite-moderated type, operating on slightly enriched uranium. Later ones may be of the liquid-cooled type. The first stations should be operating by 1960-61. Total output from the 12 stations should be at least 1½ to 2 million kilowatts, saving 5 or 6 million tons of coal annually. Total cost of the program would be some $800 millions.

Britain believes her nuclear power system will expand very rapidly after 1965, and that total nuclear power capacity installed by 1975 might be 10 to 15 million kilowatts, said Mr. Jukes. The whole of it would be used for base load operation and would result in savings of some 40 million tons of coal per year,—about equal to the present day consumption by conventional stations.

Thirty-five Years Ago

Comment on the *JOURNAL* of September 1920

The *Journal* for September, 1920, contained five papers to be read to the seventh annual meeting at Niagara Falls. All of them dealt with projects in the Niagara area, four of them with the Queenston-Chippawa development of the Ontario Hydro-Electric Power Commission. This series of four papers seems to have been the Institute's first attempt at a program arrangement which has now become relatively common, that of persuading several authors each to treat the aspect of a common project with which he was personally concerned, and then to publish the resulting papers in logical sequence.

In this case, T. H. Hogg, A.M.E.I.C., wrote on the design of the Queenston-Chippawa power canal; M. V. Sauer, M.E.I.C., on the hydraulic features of the development; H. G. Acres, M.E.I.C., on its general design and economics; and E. J. T. Brandon, A.M.E.I.C., on its electrical equipment.

Mr. Hogg, who was then H.E.P.C.'s assistant hydraulic engineer, explained in detail how the most economical dimensions and slope for the canal were determined. Mr. Sauer, the Commission's hydraulic engineer of design, among other things dealt with the canal's head gate, the largest built up to that time, 48 feet wide and 42½ feet high, and arranged to lift high enough so that a small vessel could pass under it.

The most economical penstock diameter was found to be about 15 feet, "but so great a diameter at the lower end required a plate thickness of over 1½ inches . . . beyond the limit for safe field rivetting." Today's designers would not be much worried by such thick plate. Actually, the penstocks were made 16 feet in diameter for the upper two-thirds of their lengths and 14 feet in diameter for the lower thirds and were provided with Johnson valves at the bottom.

Mr. Acres — he was H.E.P.C.'s hydraulic engineer — outlined the economic studies on which the choice of the type of development was based and gave a general account of construction methods. One of the schemes studied and abandoned would have taken water from Lake Erie west of Port Colborne and carried it 24 miles across country in canals and a section of canalized river to near Jordan Harbour on Lake Ontario, where the power plant would have been located.

Mr. Brandon's paper must have set a record for brevity; it covered exactly one page of the *Journal* and a quarter of that was taken up by the author's portrait. In a single page one could not say much, so Mr. Brandon confined himself to listing the various electrical units installed and to giving their voltages, capacities and so forth. The author was the Commission's electrical engineer.

Of these four writers, Dr. Hogg is now director of the Canadian Dredge & Dock Co. in Toronto, while Mr. Sauer lives in suburban Montreal, whence he carries on a limited consulting practice. H. G. Acres died in 1945, having for many years headed the consulting firm of H. G. Acres and Company, Niagara Falls. Mr. Brandon died in 1940.

Study of the St. Lawrence

The fifth paper in this journal is "The St. Lawrence Route and the Welland Ship Canal", by A. J. Grant, M.E.I.C., engineer in charge. Anybody who wants a concise, but clear, history of the St. Lawrence canal system will find it here, where it takes up nearly half the paper. The story begins in 1700 with the attempts to build a combined mill

race and canal around the Lachine rapids. The promoter was Fr. Dollier de Casson, superior on the Seminary of St. Sulpice in Montreal and the contractor was Gédéon de Catalogne, who failed after working about a year. The scheme was revived from time to time, but finally abandoned in 1733 because of its cost. The first canal was opened in 1798.

The other half of the paper was given over to a general description of the new Welland Canal and to a summary of the state of the work in 1920, when about 40 per cent of the estimated cost of $50 million had been spent.

Mr. Grant, one of our honourary members, died recently at the age of ninety-two. He made his home in Montreal with his son, A. J. Grant, Jr., M.E.I.C., and was by no means idle. Naturally he was in recent years much interested in operations on the St. Lawrence Seaway.

Salaries

The Committee on Remuneration, appointed in April, 1920, reported in this September *Journal*, to the effect that "it would be an unnecessary duplication of work to prepare a salary or fees schedule." Instead, it recommended the adoption of that of Engineering Council of December, 1919. The committee confessed that it had made no attempt to fix fees for consulting services.

The Branches

The program for the annual meeting in Niagara Falls was published in full, embellished by portraits of eleven members of various grades, who were serving on Committees in connection with it. Four of the five papers in this *Journal* also included portraits of the authors, a practice which we might do well to revive.

The Toronto Branch accepted the "so-called" challenge of the Niagara Peninsula Branch to a game of indoor baseball — see our last month's notes — but considered itself the challenger: "As the suggestion originated . . . (in) Toronto . . . we regard Mr. Clark's letter as an acceptance of *our* challenge."

The Saint John Branch had presented a plan and sketches for a civic centre, including a court house and a municipal building, to the city council, which decided to have detailed plans made. The Border Cities Branch reported having entertained some visitors from the east on July 22, 1920. According to the *Journal*, after polishing off the serious business of the evening, which does not seem to have taken long, the meeting became a feast of friendship and a flow of soul. One speaker said that "too little stress was . . . placed on good fellowship among . . . engineers." There seems to have been no lack of it on this occasion, for "no further remarks were possible . . . due to Messrs. . . ., the old celebrities, taking the floor . . . (and) the meeting closed with many expressions of appreciation from all sides of the table." What *could* have been on that table?

The Sault Ste. Marie Branch had a note about a new mill being installed at the plant of the Algoma Steel Co., which would roll 24-inch shapes.

Council's August meeting appears to have been devoted exclusively to the consideration of applications for admission or transfer. One of the applicants was C. F. Gray, consulting engineer and mayor of Winnipeg. Others were N. F. Nutter, now of Truro, N.S., probably then the only fellow alumnus of the writer's in Canada; Stanley Shupe, now city engineer of Kitchener; and Arthur Macnamara, until recently deputy minister of labour in Ottawa. F. E. V. Dowd, then as now on the engineering staff of the city of Montreal, was asking for transfer, as was C. J. Mackenzie, now Hon. M.E.I.C., ex-chairman of the National Research Council and scientific adviser to the Canadian Chemical & Cellulose Co. in Montreal. No doubt there are others mentioned in this *Journal* just as deserving of note here as these, but a body can only know so many people.

This issue of the *Journal* carried an unusual volume of advertising. The papers on the Queenston-Chippawa development attracted some of it and there was a 13-page insert prepared by the Niagara District Industrial Association and entitled "The Hub of Canadian Industry". In make-up this section was so like the text of the *Journal* that one might easily mistake it for an official publication of the Institute. Perhaps this was the advertiser's hope, though he acknowledged his child clearly enough. The Queenston-Chippawa suppliers advertised the most powerful turbines (55,000 hp.), the biggest transformers (45,000 kva.) and the largest electrically operated shovel; they really let themselves go in this issue.

News of Other Societies

The annual meeting of the **Canadian Chamber of Commerce** (Board of Trade Building, Montreal 1) will be in Winnipeg, Man., October 3-6, 1955.

Under the leadership of the **Engineers Joint Council** (29 West 39th St., New York 18) a dozen organizations representing more than 250,000 American scientists, engineers and industrialists will take part in a Nuclear Congress and Atomic Exposition to be held December 12-17, 1955, at the Cleveland Municipal Auditorium, Cleveland, Ohio.

The **Society of Automotive Engineers** (29 West 39th St., New York 18) celebrating its golden anniversary this year has a series of meetings listed for the coming months: an aeronautic meeting and aircraft production forum and engineering display, October 11-15, at the Hotel Statler, Los Angeles, Calif.; a transportation meeting October 31-Nov. 2, at The Chase, St. Louis, Mo.; and a fuels and lubricants meeting, November 9-10, at the Bellevue-Stratford, Philadelphia, Pa.

The 43rd national safety congress and exposition is to be held October 17-21, in Chicago, Ill. It is arranged by the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

It is the policy of the **Engineering Society of Detroit** (100 Farnsworth Ave., Detroit) to exchange publications and facilities with other engineering societies.

Members of the Engineering Institute will be granted temporary courtesy privileges for use of E.S.D. facilities by presenting their membership card to the managing director of the Society, Frank G. Horton.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Nova Scotia

"Halifax and All the Facts"

From *The Canadian Professional Engineer*, July, 1955

"Bridges . . . every young boy . . . and older ones too, would like to be able to build a bridge. What is there about a bridge which excites so many? A *professional engineer* who designs a bridge can always come back and admire his triumph over stubborn nature. What does an engineer see when he looks at his own creation . . . is it like a composer . . . does he see it as a work of art . . . a thing of beauty, or does he think only in the tight frame of an engineer . . . so many tons of this and that . . . stress, strain, deflection? Whatever it is, the sense of accomplishment must be rich in reward. The man who builds a bookcase at home or the lady who crochets a mat . . . each one in turn is proud of the masterpiece . . but, to come back and look at a mighty bridge. That must have its own feelings . . . especially a graceful, flowing thing arched against the sky . . . whispery, spidery web, but powerful . . . the result of the principles of physics . . .

"Bridges are more than mere spans across a void or chasm. . . . A bridge is the test of a road . . . for a highway can be no better than the bridge which makes it possible. A broken down bridge or one inadequate for the volume of traffic can make the grandest expressway less important than a country lane. Bridge building in Canada has some notable achievements. Another glittering chapter will be added to the story of bridging on April 2nd when the Angus L. MacDonald Bridge is formally opened at Halifax. This is the long awaited Halifax-Dartmouth Bridge across the great Atlantic harbour. This graceful suspension bridge will give Halifax a new profile. Wherever pictures of the city are seen, the bridge will be a landmark . . . just as the old citadel and clock tower have been used in the past. It will be the highest elevation in the area . . . the bright international aviation red will sparkle in the morning sunlight. This bridge is very high because it spans the entrance to the inner Harbour of Halifax . . . the famous Bedford Basin."

The speaker — Dr. John Fisher — Mr. Canada on his "John Fisher Reports" broadcast, March 18, 1955.

Then, later in the broadcast speaking of Dr. P. L. Pratley, P.Eng., he says:

"He has built these gracious things over our harbours and international borders, yet, who knows his name outside the fraternity? Vancouver should honor him for they rightly are proud of Lions Gate bridge. The Peace River suspension has been painted and photographed. The Ambassador at Detroit. The Blue Water. The Ivy Lea high over the Thousand Islands. Ile d'Orleans. Montreal Harbour Bridge. Here is a Christopher Wren of Bridges and the public does not know him.

"But, does this bashful engineer in his late sixties care? He is a composer. He has a tight form within which he must write his music . . . the cold, hard, irrefutable, inexorable laws of engineering . . . he must conform to the harsh orders from the approaches . . . a certain place, in a certain manner . . . he must listen to the navigators who tell him how high . . . he must look into the stern faces of the budget men who shout at him . . . only so much . . . and the equipment men . . . and the contractors . . . and every Tom, Dick and Harry, but, after all that, the music starts . . . ah, first there is the melody of the land . . . the bridge must reflect the contours which nature put there . . . sometimes it calls for a long dip and spidery sweep and saucy towers and great flowing approaches . . . sometimes it must run with the hills . . . sometimes it must stand there always majestic and heavy and proud and arrogant . . . sometimes it must speak for the city.

"Remember early Rome and her bridges . . . think of Paris and her bridges . . . and old London . . . did not they write about London Bridge falling down . . . and could you imagine San Francisco without that long, graceful leap-frog of a bridge? And Brooklyn and Washington, and oh, so many of them in New York, and in Prague it was old King Charles who built one of eggs, and in Korea they use bamboo . . .

"Bridges can speak . . . bridges smile . . . bridges express . . . bridges sigh . . . bridges make profiles . . . bridges when beautiful can sell a town abroad. Halifax will have a new face — formally opened April 2 . . . the genius who built her truly has . . . 'all the facts'."

John Fisher believes that the story of Canada is incomplete without reports of the accomplishments of the engineering profession. It is possible that he also believes that professional engineers are unduly backward in presenting the products of their training, research and imagination to the public.

Certainly the engineering profession appreciates the fact that this outstanding reporter of Canadian ways is careful to give credit to professional engineers where credit is due.

Thank you John Fisher!

Quebec

Granting Memberships to Aliens

(From *C.P.E.Q. Bulletin*, July, 1955)

Under section 14 of the Quebec Professional Engineers' Act only Canadian citizens can be admitted to the Corporation and thus to the practice of engineering. However, parliament has provided that Council may, at its discretion, waive this requirement in the case of alien engineers employed as professors in our Universities or employed by industrial firms or public services as specialists. Members admitted under this exception clause are called special yearly members; they must reapply for membership at the beginning of each year.

In granting special yearly memberships, Council had been governed by the spirit of the law. But with the number of applications increasing every year, it became necessary to formulate a set of rules which Council could follow in determining whether special yearly membership should be granted or not. A Committee composed of Messrs. T. A. Monti, chairman, J. A. Burke, R. Lessard, G. Piette and J. Asselin was appointed to undertake the necessary study and to make recommendations to Council.

Hereunder is an extract of the minutes of the April 1, 1955, meeting of Council, stating the conditions for the admission of non-Canadian engineers as members of the Corporation.

1. "The applicant must meet the requirements of Article 8 or Article 9 of the Professional Engineers' Act; (respecting engineering knowledge and competence).

2. The applicant must be an employee remunerated on a salary basis;

3. The applicant's services must be required as a specialist because of his particular competency and experience in a branch of engineering; (The discretion of Council to be exercised either broadly or strictly according to whether there is a shortage or a surplus of Canadian engineers at the time of the application.)

4. The employer must be required to establish without doubt that the applicant is employed in his capacity of specialist in a branch of engineering for the sole purpose of the employer and that the applicant will not directly render professional services to others than the employer.

5. The services of the applicant must be required, not for a temporary duration only, but for an indefinite period having the character of permanency.

6. Reasonable efforts should have been made by the employer to ascertain that no Canadian engineer is available when required for the work and for the employment contemplated at the time of the application.

7. In determining the question of availability of Canadian engineers the Corporation should ascertain that the salary offered was not lower than the prevailing rates and in any event not lower than the Schedule of Minimum Salaries for the type of employment offered.

8. All cases of special yearly members must be reviewed annually to ascertain that the conditions under which membership was granted are still met by the applicant." C.P.E.Q. *Bulletin*

3,000 People Visit Engineers' Art Exhibition

The second Annual Art Exhibition of members of the Corporation was held this year again with great success, thanks to the untiring efforts of Paul M. Bégin and of his committeemen.

The exhibition was first shown in Quebec City, at the Chateau Frontenac, on the occasion of the Annual General Meeting of the Corporation. There, it was inspected by art critics, government officials, members of the Corporation and the general public.

The paintings were then transferred to the Hall of Honour of the Montreal City Hall at the kind invitation of the Mayor Jean Drapeau who personally opened the show with a group of art critics.

Visitors were asked to cast votes for the three paintings they preferred. At least 2,000 people toured the exhibition in Quebec; 1,000 in Montreal.

The following paintings received the greatest number of points on the ballot on the basis of ten points for a first choice, five for second, and two for a third.

Art Critics

F. W. Moss, "Old Sawmill", (30); Felix M. Kraus, "Farmhouse, Eastern Townships", (25); Karel R. Rybka, "Before the Storm", (17); Louis Beaudry, "Pastel", (12); Allan K. Grimmer, "Street Scene, Old Quebec", (9); A. Benhamin, "Portrait of a Girl", (10); Paul E. Rose, "Fond de cours à Baie St-Paul", (5); H. S. Weldon, "The Deserted Barn", (5).

General Public

Paul M. Bégin, "Scène d'Automne", (810); Paul M. Bégin, "Sous bois d'Hiver", (742); Roger Fyen, "Dr. Ignace Brouillet", (616); H. S. Weldon, "Sugar Camp, Autumn near St-Jérôme", (348); Paul M. Bégin, "Rocher Percé", (332); Roger Fyen, "Riviere Chochocouane", (286); Louis Beaudry, "Pastel", (228); H. W. Flemming, "Two Q.N.S. and L. Railway Engineers", (190).

C.P.E.Q. *Bulletin*

Engineers on the Air

The C.B.C. has been broadcasting a series of programs which illustrate the contribution which Quebec engineers are making to modern living.

These broadcasts, entitled "Engineers at Work", have been heard over C.B.M.

The following programs have been broadcast: "Water Unlimited"—Speakers: J. C. Bouchard, P.Eng., F. Y. Dorrance, P.Eng.; "The Telephone"—E. H. Hayes, P.Eng., A. J. Groleau, P.Eng.; "A look at TV"—Allan B. Oxley, P.Eng., Henri P. Audet, P.Eng.; "Air Pollution"—G. Lorne Wiggs, P.Eng., Bernard Beaupré, P.Eng.; "Lumbering"—S. J. Simons, P.Eng.

"Noise"—Dr. F. S. Howes, P.Eng., Associate Professor of Electrical Engineering at McGill University, and R. E. Penton, P.Eng., of the C.B.C., a specialist in acoustics.

C.P.E.Q. *Bulletin*

Ontario

Expansion of Courses Recommended

The 14,000-member Association of Professional Engineers of Ontario has recommended to Education Minister W. J. Dunlop that the "scope of courses offered by the Ryerson Institute of Technology should be broadened to make available a greater number of engineering technicians, particularly in the civil, mechanical and electrical branches."

"The expanding economy of the province of Ontario has created a strong demand for increased numbers of professional engineers. It has also caused a serious shortage of draughtsmen and technicians. The latter shortage results in a number of professional engineers being retained in positions as technicians long after the required experience period has passed," the Association reported to Mr. Dunlop.

The Association said immediate expansion of established departments would enable diploma students, trained in draughting and detailing, to act as assistants to professional engineers. It particularly cited mechanical, electrical installations, including refrigeration and air conditioning, and the general field of civil engineering.

While the subject has not yet been referred to the education minister, the Association also believes that facilities for preliminary university engineering education at other schools throughout Ontario should be expanded.

First year engineering courses are presently available at McMaster University, Lakehead Technical Institute, Western University, and Assumption College. At Carlton College, Ottawa, a two-year course is provided. Students complete their four-year course in engineering in Ontario at either Queen's University or University of Toronto.

If two-year courses were instituted at all of these schools and facilities expanded to accommodate a greater number of students, it would afford the opportunity of an engineering education to more students, particularly in various sections of the province, and would probably enable Queen's and Toronto to enlarge their facilities for students attending third and fourth year. The Association's 20-man executive council has been studying this matter with a view to making a recommendation to the minister of education.

Association Scholarships

Winners of the Association's Scholarships to undergraduate engineering students at the University of Toronto and Queen's University have been announced.

The successful students at the University of Toronto are as follows: *First Year:* T. A. Brzustowski, Toronto; J. W. Stevens, Blenheim, Ont.; and F. Schaffer, Ridgeway, Ont. *Second Year:* W. K. So, Toronto; C. J. Myszak, Hamilton, Ont.; and J. F. Skrabec, Toronto. *Third Year:* S. M. Uzumeri, Toronto; W. P. J. Andrews, Toronto; and A. J. Alexander, Owen Sound, Ont.

At Queen's University, Kingston, the winners are: *First Year:* R. R. Bowen, Peterborough, Ont.; R. A. Eveleigh, Picton, Ont.; and G. R. Loffree, Fort William, Ont. *Second Year:* R. S. Crabbe, Deseronto, Ont.; P. H. Weiland, Stoney Creek, Ont.; and G. F. Bennett, Roseland, Ont. *Third Year:* D. A. Evans, Wellington, Ont.; A. R. Snyder, Chippawa, Ont.; and E. R. R. Funke, Morrisburg, Ont.

These scholarships are of one hundred dollars, seventy-five dollars and fifty in the first, second and third years of the engineering faculties of the above Ontario universities. They are awarded to those who, taking honours, obtain the highest per cent of the total number of marks in their respective courses. Under the terms of the awards, the scholarships are not awarded to students who hold other scholarships.

News of Members

H. J. Herbst has moved from the Toronto office of Gunnar Mines Ltd., to Uranium City, Sask., where he is the assistant mill superintendent at Gunnar Mines.

F. S. Hutton has resigned his former position as district engineer of the Board of Transport Commission in Winnipeg, Man., and has returned to the Canadian National Railways as office engineer for the chief engineer, Central Region, Toronto.

J. C. Farrell, of the engineering staff of Ontario Hydro, has moved from Toronto where he was on the municipal service engineer's staff, to Hamilton where he is consumer services superintendent.

Harras Kullango has returned to Toronto and is employed as a structural design engineer by Abitibi Power and Paper Co. Ltd. in the Toronto engineering department, 408 University Ave., Toronto.

William Miller has moved from Windsor, Ont., to Alhambra, Cal., where he is a mechanical engineer with C. F. Braun and Co. Prior to the change, Mr. Miller was a design engineer in the plant engineering division of Ford Motor Co. of Canada Ltd., in Windsor.

Two appointments in the Linde Air Products Company, Toronto, have been announced by its president, David S.

Lloyd: **Robert J. Anderson** has been named chief engineer and **John W. Ross,** manager of engineering service.

Mr. Anderson has been with Linde Air Products Company, a division of Union Carbide Canada Ltd., and its predecessor, the Dominion Oxygen Co., since his graduation from the University of Toronto in 1931. For some years he has been manager of the engineering service of the company.

Mr. Ross, also a graduate of Toronto University, has been associated with the company for over ten years.

R. F. C. Tanner has left Toronto for an indefinite stay in England where he is living in North Harrow, Middlesex, England.

Gordon L. Sutin has left Tatti Construction Co. Ltd., Hamilton, and has formed Sutin Construction and Engineering Ltd. of which he is president.

The address of the new company, which will engage in general contracting and consulting, is located at 21 Bond Street South, Hamilton.

John W. MacLea, of Canadian Line Materials Ltd., Toronto, has been promoted to the position of manager of sales promotion of the company.

Mr. MacLea started with Canadian Line Materials 16 years ago as cost accountant. During World War II he served with the R.C.A.F. and after the war attended the University of Toronto, graduating in 1949 in engineering and business. For the past six years he has been a sales representative of C.L.M. in western and northern Ontario.

Ross B. Elliott has left Sangamo Company Ltd., Toronto, where he was employed as industrial engineer, and has joined Collins Radio Company of Canada Ltd., 11 Bermondsey Road, Toronto 16, in the same capacity.

James C. Stewart, formerly employed at Naval Headquarters, Department of National Defence, Ottawa, has moved to Hartford, Conn., where he has joined the Maxim Silencers Company as sales engineer in the evaporator division.

Alan W. Bennett has joined Davison Chemical Company Ltd., and has opened an office at 199 Bay Street, Toronto, to direct sales in Canada of Davison petroleum cracking catalysts.

The opening of the new sales office follows announcement of the $6 million plant for production of synthetic fluid petroleum cracking catalysts which the company is building at Valleyfield, Que. Davison Chemical Co. Ltd., is associated with the Davison Chemical Company Division of W. R. Grace & Co., whose headquarters are in Baltimore, Md.

Mr. Bennett is a graduate in chemical engineering of 1938 of the University of Toronto.

Charles A. McCurdy has returned to Canada from Buffalo and is now residing in Stoney Creek, and employed by Proctor and Gamble Co. of Canada Ltd., of Hamilton, as a project engineer. While in the States, Mr. McCurdy was works engineer with Linde Air Products Co. in Tonawanda, N.Y.

Marvin Green has joined the Ontario Research Foundation in Toronto as a field engineer, and has left the paint and varnish development laboratory of Canadian Industries (1954) Ltd., Toronto, where he was employed as a development chemist.

Kenneth A. Brebner has moved from Quebec to Beamsville, Ont., where he is practising as a consulting engineer at 400 Mountain Street. Mr. Brebner was formerly maintenance engineer with the St. Lawrence Corporation Ltd., in East Angus, Que.

British Columbia

Engineers in the News

F. E. Fernyhough has been transferred from Spillimacheen to Campbell River where he is now working on the Lodore Falls development for the B.C. Power Commission.

R. N. Gordon is now division engineer for the Maritimes and Newfoundland with the Federal Department of Fisheries, and is responsible for all engineering work for the department in these areas. He is still located in Ottawa to be available for engineering advice to senior officers in the department.

R. C. Telford is now located at Prince Rupert instead of Terrace. He is woods manager for Columbia Cellulose Co. Ltd.

W. O. Richmond has just recently returned from a conference of engineering educators held in Detroit by the General Motors Co. The conference was attended by 24 educators from various parts of the United States and Canada and was to acquaint those responsible for engineering education in the universities with the work of the engineer in the automotive industry.

G. D. Sharon is now a superintendent with Northern Construction and J. W. Stewart Ltd. at Prince George.

Donn Wales has been transferred by the B.C. Power Commission to Smithers and is now assistant manager of the Commission's North Okanagan district. He has been replaced as district manager at Smithers by **T. M. Berger,** formerly in the distribution division at the head office of the Commission in Victoria. **C. T. Wale** has been transferred from assistant manager of the Comox Valley-Campbell River district to manager at Vanderhoof. He replaces **S. C. Burnell,** who now holds the post of assistant district manager, Kamloops. **C. D. Coomes** has been appointed manager at Terrace; he was formerly in the engineering branch at Victoria. **G. E. Fairbairn,** previously at Alert Bay, has been appointed district manager for the Commission at Quesnel.

H. T. Miard has been transferred by the Department of Highways to Victoria, where he will be assistant to the Deputy Minister of Highways. He was formerly divisional engineer at New Westminster.

B. E. Shevelyov is now with the B.C. Engineering Co. in Vancouver. Formerly, he was with the Greater Vancouver Water Board.

H. P. Burden has rejoined the R.C.A.F. as a flying officer and is now stationed at London, Ont.

H. M. Anderson is now located at Red Rock, B.C., where he is working on the Willow River Forest Development road for the B.C. Forest Service.

Dr. H. C. Gunning has been elected vice-president of the Society of Economic Geologists for 1956. Resident Canadians who have been previous holders of the position are: R. W. Brock, 1927; J. B. Tyrrell, 1940; and Wm. F. Jones, 1953.

H. C. Giegerich retired on August from his position as general superintendent of Exploration and Outside Mines with Consolidated Mining and Smelting Company of Canada Limited, and is now residing at Ganges, B.C.

A. R. Boal has accepted a position with the Trans-Canada Highway Division of the Department of Public Works of Canada at Banff, Alta. He used to be with the B.C. Department of Highways.

J. D. Hartley has been appointed superintendent of the zinc department at Trail by Consolidated Mining and Smelting Company of Canada Limited. He was formerly assistant superintendent in the same department.

J. D. Reid resigned from his position in the engineering department with the City of Trail, B.C., to accept the position of city engineer at North Bay, Ont.

J. G. Parr has accepted the position as associate professor of metallurgy at the University of Alberta. He was formerly research associate with the Department of Mining and Metallurgy at the University of B.C.

R. I. Jackson has been appointed executive director of the International North Pacific Fisheries Commission. He will be responsible for the co-ordination and administration of the joint fisheries conservation program set up by Canada, the U.S. and Japan. His headquarters will be at the University of British Columbia.

J. E. McMynn has been transferred by Consolidated Mining and Smelting Company of Canada Limited to Trail where he has been assigned to special duties in Administrative Controls. He was formerly district superintendent of Mines, North Central District, with headquarters at Yellowknife, N.W.T.

O. Niemela who has been employed by McMillan and Bloedel at Harmac, has recently taken a position with A. L. Swanson and Co. in Vancouver.

W. E. Foliett has left the Western Plywood Co. to join a new employer, Canadian Western Lumber Co. Ltd.

B. J. Carrigan of the Shell Oil Co., has recently been transferred to head office in Toronto.

S. J. Pedley has accepted a new position with Viola Mac Mines Ltd., New Denver, B.C. He was formerly with Carnegie Mines of B.C. at Sandon.

C. D. MacKintosh recently retired from the position of Consulting Engineer for the Canadian Pacific Railway.

C. A. Brockley has received a Canadian Government appointment to the staff of the Naval Research Laboratories in Halifax, N.S.

After graduating from U.B.C. in mechanical engineering in 1949, Mr. Brockley went to England as a design engineer and while employed by British Ropeway Engineering Co. of London, he came back to Canada for a special engineering assignment in Labrador. Back in Vancouver, he worked for his father's firm, C. W. Brockley and Co., and a year later in 1952, was awarded an Athlone Industrial Fellowship which took him to Sheffield University, England. Last year he won a Canadian Government scholarship which enabled him to complete his work towards a Ph.D. in mechanical engineering. He will be returning to Canada to take up his new position in September.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Eric Percival Muntz, M.E.I.C., consulting engineer of Toronto, Ont., died July 1st, 1955, at Nora Frances Henderson Hospital in Hamilton, Ont.

Mr. Muntz was born in Toronto on July 19, 1892. Matriculating from Upper Canada College with honors, he entered the University of Toronto and graduated in 1914 with a B.A.Sc. degree. For the following two years he was assistant engineer on the Welland Ship Canal construction of Lock 2 and Pond 2. In 1916 Mr. Muntz served as a captain with Canadian Railway Troops in France and Palestine and as transport officer and quartermaster with the 1st Battalion of the C.R.T. At the close of the war he was in charge of the erection of a deck span over the Orontes River in Syria and then returned to Canada in 1919.

For the next three years he was connected first with A. E. Rigby, railroad contractor, on the Grand River Railway Betterments at Galt, Ont., and then as construction manager for J. B. Nicholson Ltd. and J. B. Nicholson Inc., coal handling facilities in Canada and the United States. In 1923 Mr. Muntz established his own business and was president of E. P. Muntz Ltd. in Ontario and E. P. Muntz Inc. in New York until 1932. The engineering work executed during this period exceeded four million dollars and included work for seven railroads and many large industries. In 1937 he became vice-president of Canadian Engineering and Contracting Company (Quebec) Ltd., a company formed to build the plant for Abrasive Company of Canada Ltd. in Arvida, Que.

From 1940 to 1943 Mr. Muntz was engineer on special work for the Foundation Company of Canada Ltd. and subsidiaries. Since that time he had been a consulting engineer with offices in Montreal until 1946 and then in Toronto and Hamilton. He had been advising the Hydro-Electric Power Commission of Ontario on various bridge and building problems.

Mr. Muntz was a past-president and life member of the Association of Professional Engineers of Ontario; he was twice president of the National Construction Council; and was a member of the Corporation of Professional Engineers of Quebec and a licensed professional engineer of the State of New York.

He joined the Engineering Institute as a Student in 1913, transferred to Associate Member in 1919, and to Member in 1927. Mr. Muntz was vice-president of the Institute in 1940 and in 1948 he was awarded the Keefer Medal for a paper entitled "Steel Rail Piles Replace Concrete Piles." He was one of the country's pioneers in pre-stressed work and was the first chairman of a Canadian development group on pre-stressed concrete. He was a member of several committees of the Canadian Standards Association and held patents on a number of construction devices.

Eric P. Muntz, M.E.I.C.

Casimir S. G. Rogers, M.E.I.C., retired Canadian National Railways regional officer, died on June 26, 1955, at his home in Moncton, N.B.

He was born in Niagara Falls, Ont., on February 28, 1878, and received his secondary education at Niagara Falls Public School and Collegiate Institute Mr. Rogers graduated with honors from Queen's University in 1901 with a M.A. degree. He interrupted his engineering career to serve overseas during World War I with the English forces. He saw service in France and with Army headquarters. Transferred to the Canadian Army he returned home with the rank of major at the end of the war.

Prior to entering the railway service in 1923 he was associated with the Dominion Bridge Company as manager of their Ottawa branch. In 1923 he joined the Canadian National Railways first in Toronto and then in Moncton where he was bridge engineer until his retirement in 1944.

Mr. Rogers was a leader in Canadian Legion activities in Moncton for many years. He was a past-president of the Moncton branch and was made a life member of the branch several years ago. Mr. Rogers was a key figure in veterans' rehabilitation work after World War II. He was also a member of the Old Moncton Hospital Board for many years and served as chairman of the building committee.

Mr. Rogers joined the Engineering Institute in 1910 as Associate Member, transferred to Member in 1940. He attained life membership in 1947.

George E. Medlar, M.E.I.C., engineer for the water division of Windsor Utilities Commission, died on April 3, 1955, following a heart attack at his home in Windsor, Ont.

Mr. Medlar was born in Saltfleet Township, Ont., on September 24, 1892. He received his general education at Hamilton public and high school and then took a correspondence course in engineering and surveying. From 1908 to 1918 he was engaged in surveying work in Saskatchewan and Alberta. He joined the Royal Flying Corps in 1918 and served overseas for a time. Returning to Canada in 1919 he became associated with the Hamilton Harbour Commission as assistant on surveys and reports. He later became assistant on sewers, waterworks and power dam development surveys at Timmins, Ont. In 1920 Mr. Medlar joined the Utilities Commission as engineer in charge of field and office work. He became office engineer in 1938.

During his thirty-five years with the utilities commission Mr. Medlar had much to do with the development and engineering of water services for Windsor and the surrounding communities. In his capacity as engineer-in-charge of water service he was in charge of the construction of extensions to the services and with maintenance. Since 1938, when an extensive development of water services was made in Windsor, Mr. Medlar supervised the construction of more than three million dollars in new work.

He was a member of the American Waterworks Association and of the Association of Professional Engineers of Ontario.

Mr. Medlar joined the Engineering Institute as a Junior in 1922, transferring to Associate Member in 1930, and to Member in 1940. He served as secretary-treasurer of the Border Cities Branch of the Institute and was chairman of that branch in 1941 and in 1943.

Eric Hinton, M.E.I.C., manager of Bowater Power Company Limited, died suddenly at his home in Deer Lake, Newfoundland on May 7, 1955.

Mr. Hinton was born in Warwick, England, in 1901. He was educated and trained as a civil engineer in England before coming to Newfoundland to participate in the original construction of

Eric Hinton, M.E.I.C.

the power development for the Corner Brook Paper Mills. At the completion of the construction work Mr. Hinton was invited to join the Power Plant operating staff as hydraulic engineer. He continued at this post with the various operating companies until 1938 when he was appointed assistant manager of the hydro-electric department of the then operating company — Bowater's Newfoundland Pulp and Paper Mills Limited. In 1942 he was appointed manager of the hydro-electric department and held this position up to his death.

During the early stages of the 1947-48 extension of the Corner Brook Paper Mill, he was appointed engineer-in-charge of construction and saw this work to a successful conclusion. In 1949 Mr. Hinton received the appointment of assistant chief engineer for the Paper Company. He relinquished this post in 1953 when his services were made available to the British Newfoundland Corporation. He was responsible for setting up the hydro division of the Corporation and was actively engaged in the original and subsequent planning for the water power studies of the Hamilton River in Labrador.

He was a member of the Council of the Association of Professional Engineers of Newfoundland, a member of the snow and ice committee of the American Geophysical Union, and a member of the Community Planning Association of Canada.

Mr. Hinton's community activities in Deer Lake covered all phases of life. For the past twelve years he has been chairman of the Deer Lake Amalgamated School Board and last year was made a vice-president of the Association of Amalgamated School Boards. His engineering advice was always gratuitously available to the local Town Council as a consultant and member of the Town Planning Committee; and as chairman of the local Navy League Committee he was largely responsible for the formation of the Deer Lake Sea Cadet Corps.

G. H. Finch, M.E.I.C.

Mr. Hinton joined the Engineering Institute in 1932 as a Junior, transferring to Member in 1942. He had served as councillor for the Institute and as president of the Corner Brook Branch of the Institute.

Gordon H. Finch, M.E.I.C., district manager of the western district for Canadian Westinghouse Company, Ltd., apparatus division, died suddenly in Winnipeg, Man., on July 17, 1955.

Born in Cookshire, Que., Mr. Finch received his early education at Kelvin Technical School and graduated from the University of Manitoba in 1924 with a B.Sc. degree in electrical engineering. He then enrolled in the graduate student training course at Westinghouse, and later engaged in apparatus sales work and filled various positions at Winnipeg, Calgary and Ottawa, before being transferred to Montreal in 1946. The following year Mr. Finch was named manager of the Westinghouse apparatus division's Quebec district and in 1951 he was transferred to Edmonton, Alta., where he became sales manager for the district. In January of this year Mr. Finch was appointed western district manager at Winnipeg for the company, the position he held at the time of his death.

Mr. Finch was an active member of numerous engineering and business organizations, among them the American Institute of Electrical Engineers, the Canadian Electrical Association, and the Canadian Institute of Mining and Metallurgy. He was also a member of the Association of Professional Engineers of Alberta.

He became a Member of the Engineering Institute in 1943.

Arthur John Watson, Jr.E.I.C., junior engineer with Canadian Aviation Electronics Ltd. in Vancouver, B.C., died in a traffic accident on April 18, 1955, near Kenora, Ont.

Mr. Watson was born in Mission City, B.C., on July 21, 1931. He received his secondary education at Burnaby North High School and then graduated from the University of British Columbia in 1953 with a B.A.Sc. degree in electrical engineering. During the summer months of his university course he was employed with Pacific Co-operative Union and with Standard Oil Company Ltd. as warehouseman.

He became associated with Canadian Aviation Electronics Ltd. in Vancouver upon his graduation from university. He was transferred to the Winnipeg branch of the company in June, 1954, and was employed on radar work in British Columbia and Alberta until his death.

Mr. Watson joined the Engineering Institute as a Student in 1950 and transferred to Junior in 1955.

Personals

News of the Personal Activities of Members of the Institute

Drummond Giles, M.E.I.C., president and general manager of Courtaulds (Canada) Ltd., has also been appointed president of T.C.F. of Canada Ltd. Head offices of both companies are in Cornwall, Ont.

Mr. Giles became associated with Courtaulds in 1943 as executive vice-president. He had formerly been vice-president of Canadian SKF Company Ltd.

He graduated from McGill University in 1927 with a B.Sc. degree in metallurgical engineering.

Mr. Giles joined the Institute in 1929 as a Junior, transferring to Member in 1939 and has represented the Cornwall Branch of the Institute on the Council for two terms.

Drummond Giles, M.E.I.C.

Dr. C. R. Young, Hon.M.E.I.C.

Norman A. Eager, M.E.I.C., has been elected president and general manager of Burlington Steel Company Ltd. in Hamilton, Ont.

Mr. Eager has been associated with the company since 1940. He has held positions of sales manager, general manager and vice-president and is a director of the company. In 1952 Mr. Eager was appointed to the Hamilton Advisory Board of the Huron and Erie Mortgage Corporation and the Canada Trust Company.

He graduated from McGill University in 1922 with a degree in civil engineering and received his master's degree from Cornell University in 1923.

Ralph C. Flitton, M.E.I.C., who retired last year as general sales manager of Canadian Vickers Ltd. in Montreal, recently visited Los Angeles and while there was guest speaker at a luncheon of the Metropolitan Club. Mr. Flitton also visited Hoover and Parker Dams as the guest of the Metropolitan Water District of Southern California.

Mr. Flitton, a graduate of McGill University, had been with Canadian Vickers Ltd. since 1933 when he transferred from William Hamilton Company Ltd. in Peterborough, Ont., to Montreal. He was successively superintendent of industrial shops, chief estimator for the engineering division, sales manager and finally general sales manager for the company before his retirement.

Mr. Flitton became a life member of the Institute in 1953 having joined as a Junior in 1914.

Norman A. Eager, M.E.I.C.

L. Nadeau, M.E.I.C.

Leopold M. Nadeau, M.E.I.C., has been appointed to the position of assistant to the president (administrative) of Racey, MacCallum and Associates Ltd. in Montreal.

Mr. Nadeau was formerly general secretary of the Corporation of Professional Engineers of Quebec having joined the Corporation as assistant general secretary in 1946.

A civil engineering graduate of Ecole Polytechnique in 1936, Mr. Nadeau's early experience included employment as assistant plant engineer at the Port Alfred mill of Consolidated Paper Corporation, and as resident engineer for the Quebec Department of Highways. Mr. Nadeau then joined the technical staff of the Canadian Underwriters' Association as fire protection engineer.

During the war years Mr. Nadeau was mainly engaged in designing and supervising the fire protection equipment of war industries and other installations. He also contributed a number of articles to technical publications on the subject of fire protection and insurance.

He is a member of the Canadian Good Roads Association and the Canadian Committee on Guidance in Engineering and Science.

Dr. C. R. Young, HON. M.E.I.C., dean emeritus of the Faculty of Applied

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Established 1882

PLANTS AND OFFICES THROUGHOUT CANADA

• Personals

Science and Engineering at the University of Toronto, has been made a life member of the American Society for Engineering Education. He has been a member of A.S.E.E. since 1914.

Dr. Young retired as dean from the University of Toronto in 1949 after serving on the engineering staff for more than thirty years.

He joined the Institute as a Student in 1903, transferred to Member in 1908 and was made an Honorary Member in 1949. Dr. Young was president of the Institute in 1942 and received the Sir John Kennedy Medal in 1951.

W. Eric Phillips, C.B.E., M.E.I.C., has been elected a director and member of the executive committee of St. Lawrence Corporation Ltd. Mr. Phillips is chairman of the board of Angus Corporation Ltd. and of Canadian Pittsburgh Industries Ltd. He is also a director of Brazilian Traction, Light and Power Company Ltd., Crown Trust Company, the Royal Bank, and many other Canadian companies.

A. H. Ashworth, M.E.I.C., consulting engineer of North Vancouver, B.C., has returned from New Zealand where he was engaged on the seven million dollar eastern foreshore development scheme of the Auckland Harbour Board.

Mr. Ashworth has worked on civil engineering projects in the United Kingdom, South Africa, Rhodesia, New Zealand and Canada. Several professional engineers associated with Mr. Ashworth, in each location, now form the group known as the North Western Associated Engineering Consultants, covering a wide field of engineering service.

A. H. Ashworth, M.E.I.C.

He was municipal engineer for North Vancouver district during a two and a half year period of office from the fall of 1952, being associated with the waterworks modernization and expansion program on the North Shore linking up with Vancouver's new Cleveland Dam in Capilano Canyon.

Last year Mr. Ashworth helped prepare a Report on Burrard Inlet Crossings as a member of the special committee set up by surrounding municipalities to consider future bridges and other facilities to cross Vancouver Harbour.

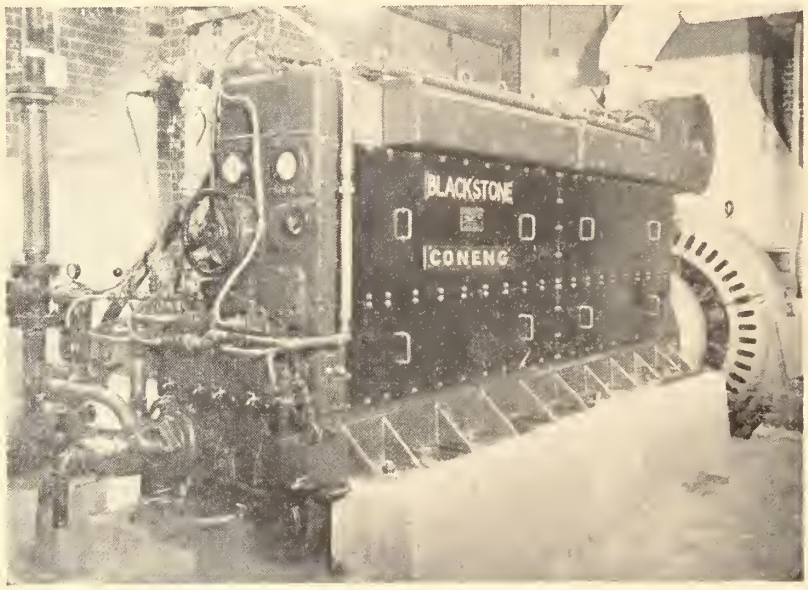
M. W. Huggins, M.E.I.C.

M. W. Huggins, M.E.I.C., associate professor of civil engineering at the University of Toronto, is chairman of the Toronto Branch of the Engineering Institute.

Mr. Huggins was born in Toronto Ont., and received his general education at Parkdale Collegiate there. He attended the University of Toronto and received his B.A.Sc. degree in 1932 and his M.A.Sc. degree the following year

EMERGENCY OPERATION

at Montreal General Hospital



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ALL' ACOUSTIC – 2" ROCK BLANKET	0.21	0.64	0.97	0.95	0.91	0.76	0.85

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• Personals

Immediately after his graduation Mr. Huggins became associated with E. P. Muntz Limited in Dundas, Ont. His work included research work on prestressed concrete and on formwork accessories. In 1936 he joined Vernon Construction Company as engineer in charge of design and erection of forms and falsework at Oakville, Ont. The following year he was with the Dominion Bridge Company in Toronto as detailer and designer until his appointment in 1938 to the staff of Queen's University as lecturer in civil engineering. Mr. Huggins joined the faculty of the University of Toronto in 1941. He is also a partner in the consulting firm of Morrison, Hershfield, Millman and Huggins in Toronto.

Mr. Huggins is a member of the Association of Professional Engineers of Ontario and is a past councillor of the Association.

He joined the Engineering Institute as a Junior in 1935, transferring to Associate Member in 1939, and to Member in 1940.

J. T. Turner, M.E.I.C.

J. T. Turner, M.E.I.C., manager of transportation maintenance for the B.C. Electric Railway Company, has been elected chairman of the Vancouver Section of the American Institute of Electrical Engineers.

Mr. Turner graduated from Tri-State College with a B.Sc. degree in electrical engineering in 1936 and a B.Sc. degree in mechanical engineering in 1937. He was associated with National Light and Power Company in Moose Jaw, Sask., before the war and served on the Directorate of Electrical and Communications Design of the Department of National Defence in Ottawa during World War II.

After some time as Canadian engineering representative in New York for the Copperweld Steel International Company, Mr. Turner became associated with B.C. Electric in Vancouver.

James S. Cameron, M.E.I.C., is the new president of the Canadian Standards Association. Mr. Cameron is on a year's leave of absence from his position as vice-president of the Northern Electric Company prior to his retirement.

He will be in office as president for two years, having been the association's vice-president for the past two years. Last June Mr. Cameron went to Sweden as Canadian representative to the International Standardization Organization.

Mr. Cameron graduated from McGill University in 1908 with a degree in mechanical engineering. He joined the motive power department of Canadian Pacific Railways directly after his graduation and then in 1910 he became associated with Northern Electric. He was named vice-president of the company in 1949.

He joined the Engineering Institute as a Student in 1906 and attained life membership in 1948.

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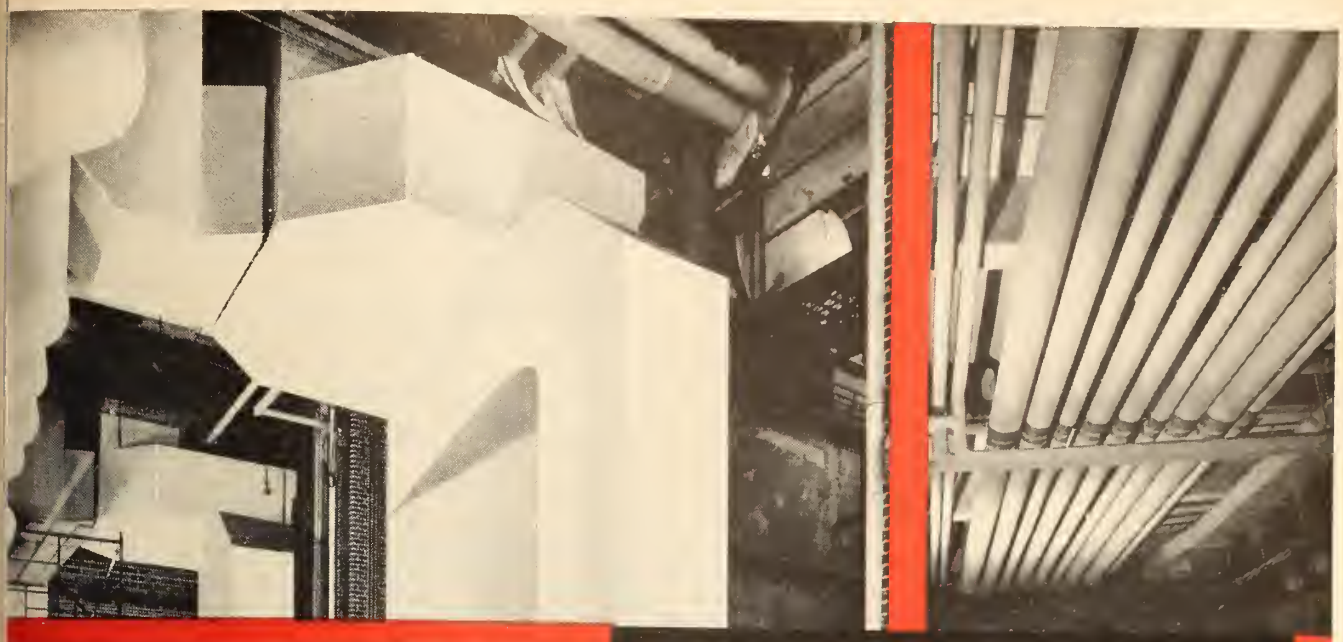

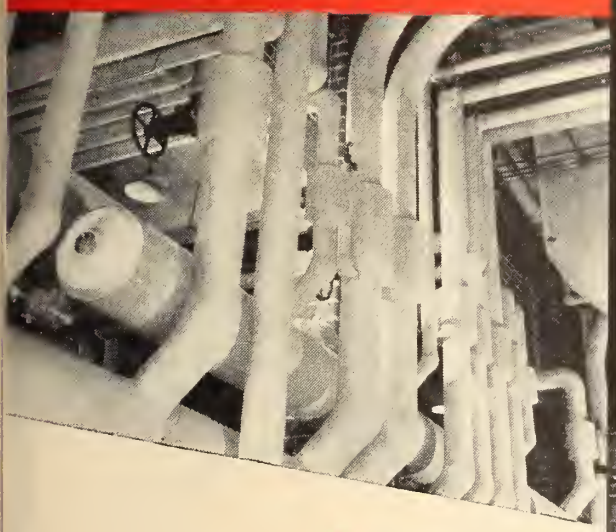

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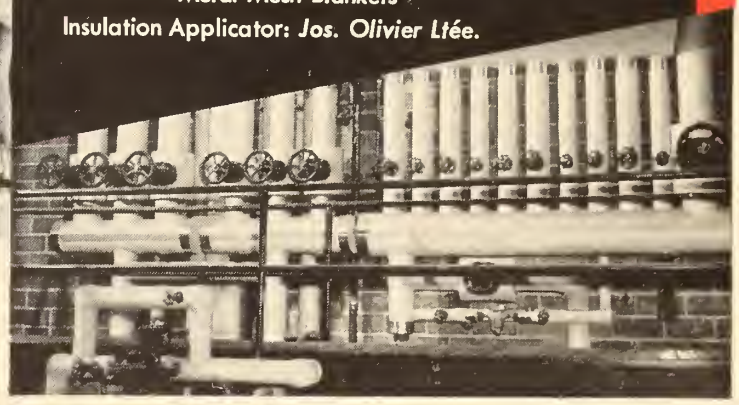

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*T.M. Reg'd

• Personals

G. M. Demarque, M.E.I.C., formerly chief engineer in Montreal for Royer, Lazarides, Lount and Partners, Toronto, has resigned from the firm, and established his own consulting practice in Montreal.

A native of France, Mr. Demarque received his B.A. degree from the University of Paris, and his civil engineering degree from Ecole Nationale des Ponts et Chaussées in 1929.

After experiences in Freneh Morocco and Algeria, he became director and general manager of a contracting firm in Paris. He served in the Freneh Engineers Corps during World War II and was for some time a prisoner of war in Germany.

Mr. Demarque came to Canada in 1947 and became associated with Mount Enterprises Limited in Montreal. Before joining Royer, Lazarides, Lount and Partners in 1953 he was chief engineer with Preload Company of Canada Limited.

Cmdr. C. L. Moffard, M.E.I.C., has been transferred from Esquimalt, B.C., to Ottawa where he will be deputy works officer-in-chief with the new rank of commander. He was formerly manager of civil engineering and maintenance on the Pacific coast with the rank of lieutenant commander.

Denis Temple, M.E.I.C.

Denis Temple, M.E.I.C., is acting as Toronto representative for the St. Lawrence Cement Company. He was previously in Quebec with the company.

Mr. Temple, who graduated from the Imperial College of Science and Technology in London, has also been connected with the architectural services department of Atomic Energy Limited at Deep River, Ont.

A. F. Ness, M.E.I.C., is now assistant plant engineer with the Crown Cork and Seal Company in Toronto.

Mr. Ness, a mechanical engineering graduate of Queen's University in 1942, was previously with Canadian Comstock Company Ltd. in Catharines, Ont., as domestic engineer in their frequency conversion division.

John L. Townley III, M.E.I.C., is now associated with Socony-Vacuum Oil Company Ltd., in Calgary, Alta., as development or exploration geologist.

Mr. Townley, a graduate in geology from the University of Minnesota, was previously in Swift Current, Sask., with the Socony Vacuum Exploration Company.

Alex T. Cairncross, M.E.I.C., has resigned from the staff of the Aluminum Company of Canada after nearly fifteen years with the company, to operate and manage his own firm, the Armstrong Foundry & Machine Shop in Orangeville, Ont.

Mr. Cairncross graduated from Queen's University in 1931. He spent several years in China as technical advisor, Department of Engineering of the Generalissimo's Staff, National Government of China, and with the Municipal Council of the Department of Finance at Shanghai. He joined the Aluminum Company in 1940 at Arvida, Que., and was transferred to Montreal in 1944 He was also with the company at Toronto.

Percy Codd, M.E.I.C., has been named plant manager of the Seaway Metals Corporation at Rochester, N.Y. Mr. Codd was formerly superintendent of the wrought products division of Dominion Magnesium Company Ltd. at Haley, Ont., having joined that company in 1947 as research chemist.

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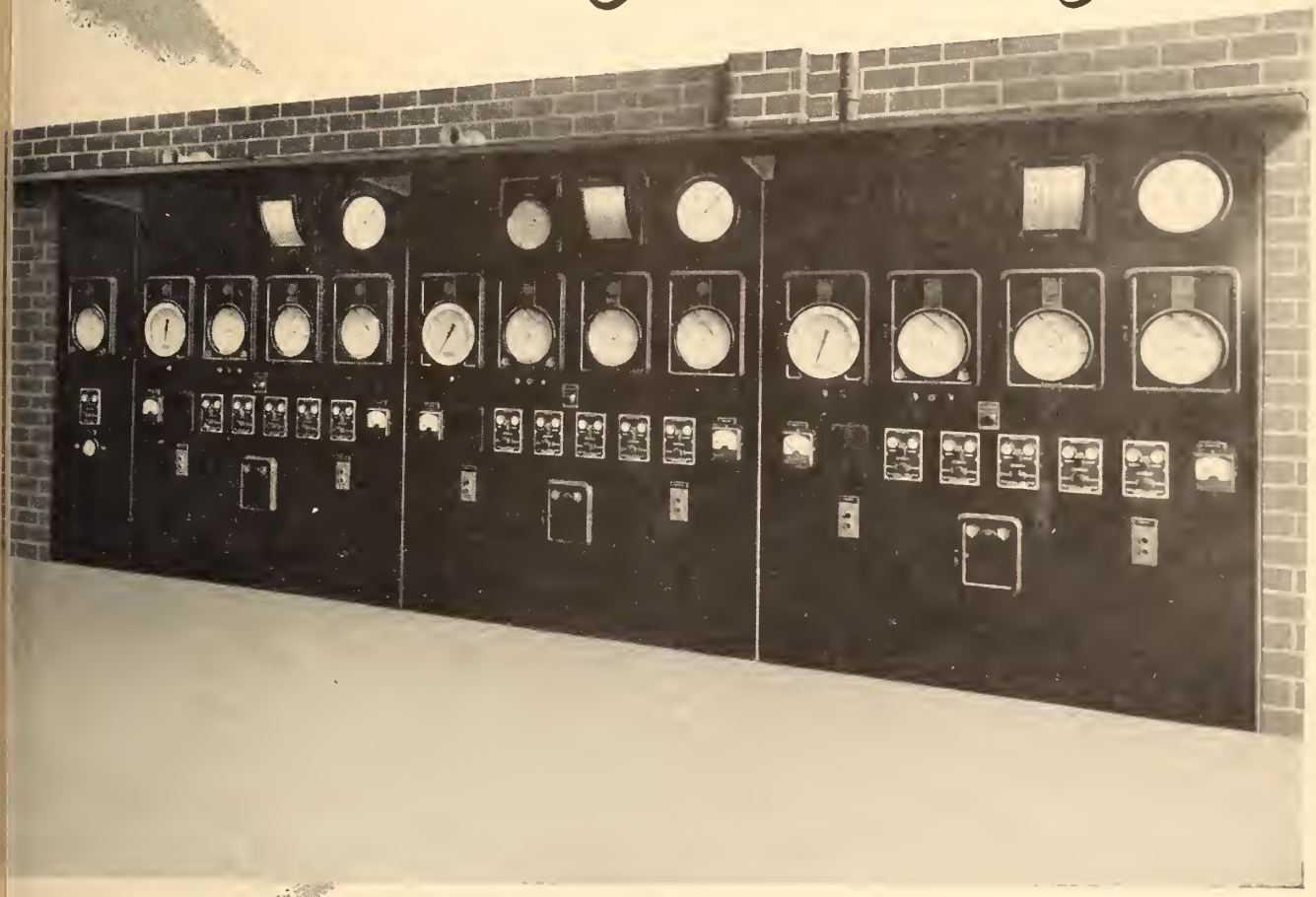

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katchewan in metallurgy, he served during World War II with the R.C.A.F. Mr. Codd has also been with Canadian Carborundum Company Ltd. at Shawinigan Falls, Que., and with Defence Industries Limited at Valleyfield, Que.

Alfred Payne Wiles, M.E.I.C., has joined the tool engineering department of the Ford Motor Company of Canada, Vancouver, B.C.

Mr. Wiles graduated from the University of Saskatchewan in 1946 with a B.Sc. degree in engineering and physics. He was previously superintendent of Public Works for the Corporation of the Township of Richmond, in British Columbia.

Howard W. McFarlane, M.E.I.C.

J. S. Michener, M.E.I.C.

Howard W. McFarlane, M.E.I.C., associate professor of soil mechanics at the University of New Brunswick, has been elected chairman of the Fredericton Branch of the Engineering Institute.

A native of Saint John, N.B., Mr. McFarlane received his secondary education in Saint John. He graduated from the University of New Brunswick in 1943 with B.Sc. degree in civil engineering, receiving the Ketchum Silver Medal for highest standing in the senior year. Following his graduation he served with the Royal Canadian Engineers until the end of World War II.

At the end of the war he became associated with D. O. Turnbull, consulting engineer in Saint John, N.B., until his appointment in 1946 to the staff of the University of New Brunswick as assistant professor of civil engineering. In 1948 he obtained a leave of absence from the university and spent a year at the University of London, England, on a Beaverbrook Scholarship, returning to his position as assistant professor in civil engineering in 1949. Mr. McFarlane is also a partner in the consulting firm of Associated Designers & Inspectors in Fredericton.

He joined the Engineering Institute as a Student in 1942, transferring to Junior in 1946, and to Member in 1950.

J. S. Michener, M.E.I.C., has moved to Edmonton and has become associated with the Trane Company of Canada there. He was previously district manager (Ontario) for National Heating Products Sales Ltd. with headquarters in Toronto.

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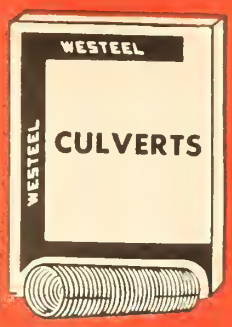

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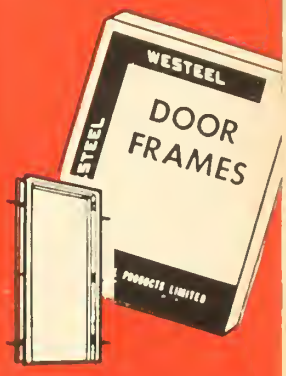


• Personals

Camille R. Godin, M.E.I.C., is now director of the assessment department of the City of Montreal.

Mr. Godin, who graduated from Ecole Polytechnique in 1935 with a degree in civil engineering, was formerly registrar and assistant to the dean at Ecole Polytechnique, having joined the staff in 1944 as assistant professor of mathematics.

Herbert L. Roblin, M.E.I.C., district engineer for Alberta for the Canadian National Railways at Edmonton, Alta., has been elected chairman of the Edmonton Branch of the Engineering Institute.

Mr. Roblin was born in London, Ont., and received his secondary education there. He graduated from the University of Toronto in 1913 with a B.A.Sc. degree and served with the Canadian Expeditionary Forces during the first World War, receiving the Military Cross.

He became associated with the Canadian National Railways in 1919 at Edmonton, Alta., as a resident engineer.

During World War II he was in command of the 13th Field Company of the R.C.E. at Regina. He retired in 1945 with the permanent rank of major.

Mr. Roblin joined the Engineering Institute as an Associate Member in 1919, transferring to Member in 1940. He attained life membership in 1955.

H. L. Roblin, M.E.I.C.

R. Albert de Villers, M.E.I.C., is now president of Lumber Products Manufacturing & Export Ltd. in Princeville, Que. He is also secretary and general manager of Paul de Villers and Sons Inc. in Princeville, having previously been manager of that company.

Mr de Villers, who graduated from Ecole Polytechnique in 1942 with a degree in civil engineering, worked for a time with Canadian Marconi Company in Montreal. In 1945 he joined the C.N.R. as assistant engineer at the Bureau of Research. He then became successively division engineer at Levis, Que., and assistant district engineer at Quebec City leaving the company in 1953 to join Paul de Villers and Sons Inc. as manager.

Ronald W. Evans, M.E.I.C., who was previously assistant chief engineer with Spruce Falls Power & Paper Company Ltd. in Kapuskasing, Ont., has moved to Neenah, Wisconsin, and is with the Kimberly-Clark Corporation there.

He graduated in mechanical engineering from the University of North Dakota in 1933.

D. J. McParland, M.E.I.C., has been named plant superintendent of Algom Uranium Mines Ltd. at Algoma Mills, Ont. He was previously master mechanic with Gaspe Copper Mines Ltd. in Murdochville, Que.

Mr. McParland graduated with a degree in mechanical engineering from the University of Toronto in 1952. He was also assistant master mechanic with Lamaque Mining Company in Bourlamaque, Que., for a time.

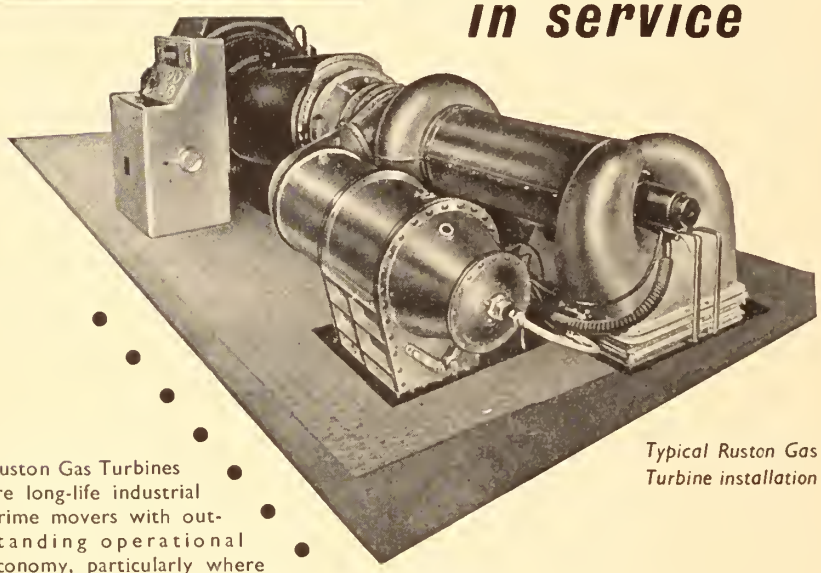
H. E. Hewitt, M.E.I.C., is now chief design engineer for Associated Engineering Services Ltd. in Edmonton, Alta.

Mr. Hewitt, a graduate of the University of Alberta in civil engineering was previously chief construction engineer with Coleman Collieries Ltd. in Coleman, Alta. He has also been chief engineer for International Coal & Coke Company Ltd. in Coleman, Alta.

E. G. Wyckoff, M.E.I.C., who was works manager of Elevadoes Otis S.A., in Sao Paulo, Brazil, is now in Bombay, India with Otis Elevator Company (India) Ltd. He went to Brazil in 1952 after spending four years in Warsaw, N.Y. with the Warsaw Elevator Company as chief engineer.

Mr. Wyckoff graduated from the Uni-

RUSTON gas turbines in service



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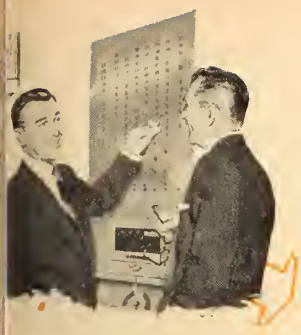

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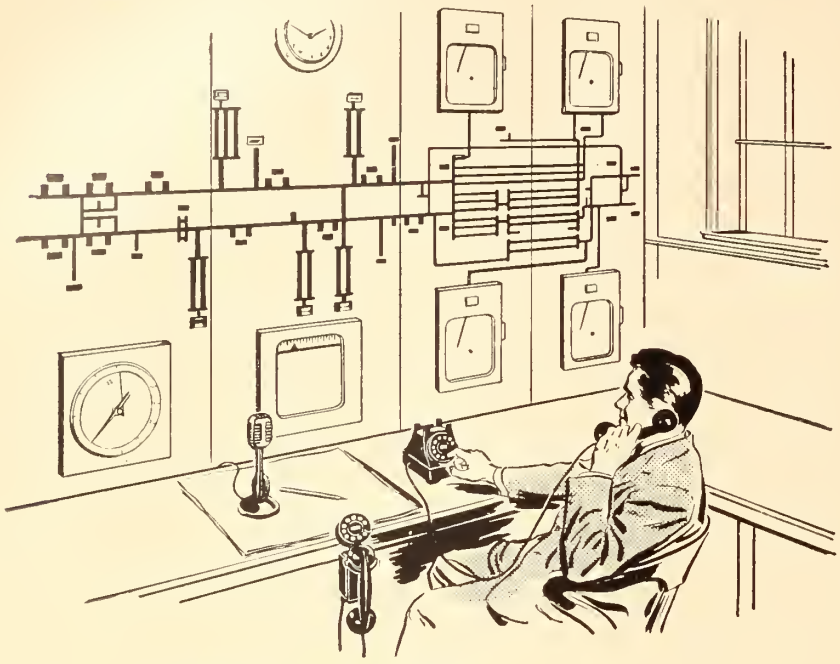

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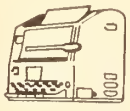

BELL TELETYPE

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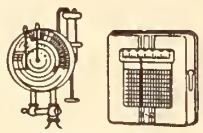

Channels for Telemetering and Supervisory Control

THE BELL TELEPHONE COMPANY OF CANADA

• Personals

versity of Toronto in 1930 and then b came associated with Otis Fensom El vator Company as an engineering st dent in the Hamilton, Ont., works. Su sequently he assumed charge of vario manufacturing departments and in 19 was administrative engineer of the co pany in Hamilton.

J. A. Sirdevan, M.E.I.C., has been tra ferred by Imperial Oil Limited fro Edmonton to Toronto where he is the manufacturing department. He h been technical superintendent of t Edmonton refinery of the company.

Mr. Sirdevan graduated from t University of Toronto in 1934 with degree in electrical engineering.

C. B. R. Macdonald, M.E.I.C., wr to Headquarters some months ago fr Lusaka, Northern Rhodesia. He acknow edged his election to life membersh in the Institute, recalling that he h become a student member while in l senior year at Royal Military Colle Canada.

Mr. Macdonald is general manager the John Howard & Co. (Africa) Lt building and civil engineering contra tors. He expressed interest in meeti in the Rhodesias any member of t Institute who might be traveling the

B. C. Van Hees, M.E.I.C., has join the staff of Haddin, Davis & Brown L in Calgary, Alta., as civil engineer. I was previously assistant chief engin with the Eastern Rockies Forest Co servation Board in Calgary.

He graduated from the University Alberta in 1949 with a degree in ci engineering.

R. E. Tweeddale, M.E.I.C., assistant ch engineer of the New Brunswick Pow Commission, has been named to he the Atlantic Economic Council comm tee on power. The appointment w made by **O. Nelson Mann,** M.E.I A.P.E.C.'s executive manager and o permanent officer.

F. C. Hamata, M.E.I.C., is now with t Construction Aggregates Corporation Chicago on their Caland Ore dredg project. He is shift superintendent f the project which involves the remov of some 180,000,000 cu. yds. of mater and the dewatering of a portion of Ste Rock by dredges.

Mr. Hamata graduated from the U versity of Manitoba in 1949 with degree in civil engineering and was f merly with the construction division Ensign Stores Limited in Calgary, Al

He has also been connected with M souri Valley Dredging as project en neer, and with Braid, LeBrun and M Kinnon as construction supervisor Bowidji, Minn.

Marcel LeBel, M.E.I.C., is now superv ing engineer in the soil mechanics s tion of the testing laboratories divisi of the Department of Public Works Ottawa, Ont. Mr. LeBel was previou in Rimouski, also working for the g ernment.

He graduated from Ecole Polyte nique in 1943 with a degree in civil en neering.

Ronald Marriott, M.E.I.C., has join Dominion Engineering Company Ltd. Montreal. He is applications and es mating engineer in the diesel division

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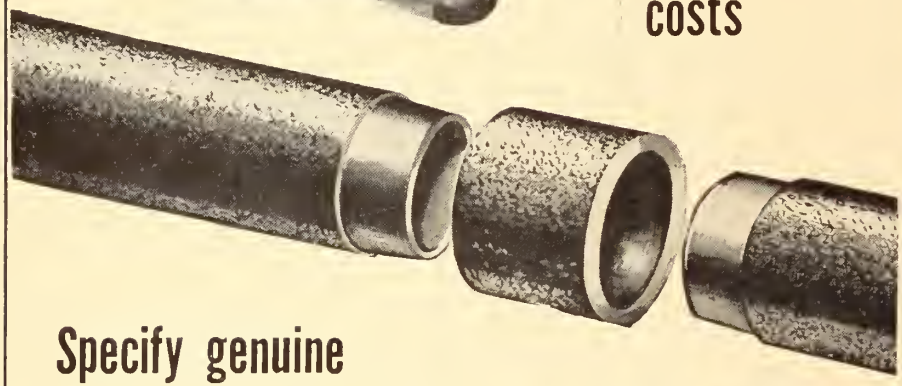

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• Personals

L. J. R. Sanders, M.E.I.C.
Chairman of the Kitchener Branch
The Engineering Institute of Canad

Mr. Marriott, who has a degree fr Cambridge University in mechanical gineering, was formerly chief engineer Knowles & Foster (Canada) Ltd. Montreal.

George Dawson, M.E.I.C., has be named technical assistant at the Pow River Company in Vancouver, B.C. was previously project engineer Northern Construction Company on Powell River Waterfront Developme

Mr. Dawson is a graduate of the U versity of Nevada with a B.Sc. deg in mining engineering, class of 1941.

Robert Lessard, M.E.I.C., is now as ciated with George Demers, consult engineer of Quebec City. He was f merly town engineer for the Town Port Alfred.

Mr. Lessard has also been connect with the Quebec North Shore and La rador Railway Company as resid engineer in Seven Islands, Que.

M. G. Elston, M.E.I.C., has joined staff of the T. H. Newton Engineer Company of Edmonton. He is resid engineer in Whitehorse, N.W.T.

Mr. Elston, a 1949 civil engineer graduate of Portsmouth Technical C lege, was formerly resident engin with the Department of Highways Edmonton, Alta.

R. L. Davies, M.E.I.C., has been nam manager of the building department Baynes Manning (Alberta) Ltd. in C gary, Alta. Mr. Davies has previou been associated with Carter Constr tion Company as construction supe tendent in Toronto and as project e neer in Point Anne, Ont.

Mr. Davies graduated from the U versity of Alberta in 1942 with a B degree in civil engineering and has b associated also with the Department Transport as testing engineer in Otta and resident engineer in Whitecou Alta. He also spent some time w Burns Packing Company as project en neer in Edmonton, Alta.

N. Perquin, M.E.I.C., is now sales e neer with Engineering Equipment Co pany Ltd. in Montreal. Mr. Perq

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• Personals

has previously been with Dominion Tar and Chemical Company Ltd. in Montreal as design engineer having joined the company in 1953.

He graduated from the Technical University of Delft with a B.Sc. degree in civil engineering in 1927 and a M.Sc. degree in mechanical engineering in 1930.

Len Fieldman, M.E.I.C., has joined the Polymar Corporation as mechanical engineer in Sarnia, Ont. He was previously an inspector with A. V. Roe (Canada) Ltd. at Malton, Ont.

James Bortolotto, M.E.I.C., has been appointed maintenance engineer with the department of highways and transportation by the Saskatchewan Public Service Commission. He has formerly held the positions of assistant construction engineer and district engineer with the department and has been located at Rosetown and Regina in Sask.

Mr. Bortolotto graduated from the University of Saskatchewan in 1947 with a degree in civil engineering.

A. V. Corlett, M.E.I.C.

A. V. Corlett, M.E.I.C., head of the department of mining engineering at Queen's University, has been elected chairman of the Kingston Branch of the Engineering Institute.

Born in Thamesville, Ont., Mr. Corlett received his general education there. After service with the Royal Canadian Engineers, he graduated from Queen's University with a degree in mining and metallurgy, in 1922. His early experience was gained in Canadian and West African mining camps. He was mine manager at several properties including Aldermac Copper Corporation and Normetal Mining Corporation. Mr. Corlett joined the faculty at Queen's University in September, 1948, as head of the department of mining engineering.

He is a member of the Association of Professional Engineers of Ontario and of the Corporation of Professional Engineers of Quebec.

Mr. Corlett became a Member of the Engineering Institute in 1953.

Captain W. J. Dickson, Jr.E.I.C., has been appointed assistant professor of civil engineering at the Royal Military College in Kingston, Ont.

Captain Dickson has been stationed in Chilliwack, B.C., with the R.C.S.M.E.

He graduated from McGill University in 1949 with a degree in civil engineering.

Frank Totino, Jr.E.I.C., has been appointed sales engineer for Rosco Metal Products (Alberta) Ltd. His appointment marks the opening of a sales engineering department for the company. Mr. Totino will be located in the offices of Ferguson Supply (Alberta) Ltd., an associate firm of Rosco Metal Products Ltd. in Edmonton.

Mr. Totino graduated from the University of Toronto in 1947 with a degree in civil engineering.

A. J. Benn, Jr.E.I.C., is resident engineer for the Lachine section of the St. Lawrence Seaway Authority. He was formerly with the Department of Transport working on the Atwater Ave. tunnel project in Montreal, Que.

Mr. Benn graduated from Queen's University in 1948 with a degree in civil engineering. He has also been associated with Macnamera, Manning, Morrison and Knudson as resident engineer in Mont Joli, Que.; and with W. A. Mackay Ltd. in Weston and Norland, Ont.

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Larry W. Blackman, Jr.E.I.C., has been named district highways engineer in Dauphin, Man., with the Department of Public Works.

Following his graduation in 1948 from the University of Manitoba he was resident engineer at Brandon, Man., and the following year he was transferred to Boissevain as assistant engineer. In 1950 he was appointed executive assistant to the deputy minister of public works at Winnipeg, and three years later was posted to Minnedosa as assistant district engineer.

Mr. Blackman served with the Royal Canadian Air Force for four years during World War II.

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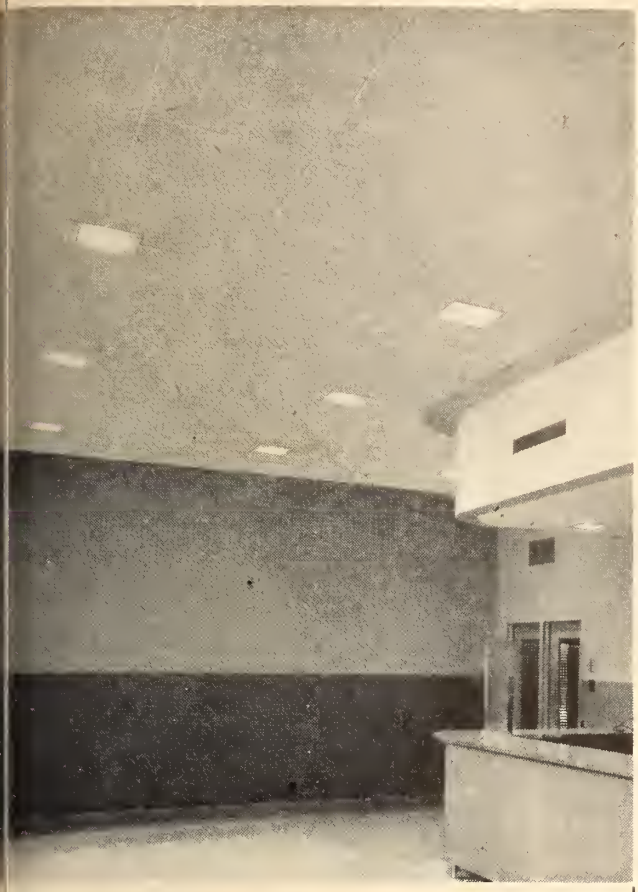

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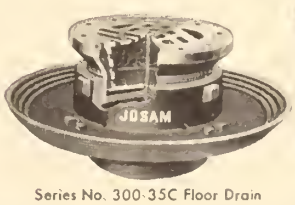

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• Personals

H. Anthony Dare, JR.E.I.C., has joined the staff of H. G. Acres & Company Ltd., as a field engineer. He has been sent to Pakistan on the Warsak hydro-electric scheme in Peshawar.

Mr. Dare was with the Aluminum Company of Canada since his graduation in 1951 from the University of British Columbia. After completing a training course in Montreal the company sent him to Sprostons (Jamaica) Ltd. in Shooters Hill, Jamaica. He then returned to the head office in Montreal where he was employed in cost estimating and cost analysis.

T. C. Hall, JR.E.I.C., is plant engineer with Fiberglas Canada Limited in Sarnia, Ont. He was formerly with the Renfrew Aircraft and Engineering Company in Renfrew, Ont.

Mr. Hall graduated from the University of British Columbia in 1951 with a B.A.Sc. degree in electrical engineering. He has also been associated with Cockshutt Aircraft Limited in Renfrew as electrical engineer, and as plant electrical and welding engineer.

G. R. Naylor, JR.E.I.C., is with Packard Electric Company Ltd. in Toronto. His position is that of sales engineer.

Mr. Naylor graduated from the University of Manitoba with a B.Sc. degree in electrical engineering in 1951, and was formerly on the staff of the British General Electric Company in Toronto as junior engineer and estimator.

F. P. Mascarin, JR.E.I.C., recently joined the staff of the plant engineering department of Hiram Walker & Sons Ltd. in Walkerville, Ont. He was previously with Giffels and Vallet of Canada Ltd. as mechanical engineer in Windsor, Ont.

Mr. Mascarin graduated from the University of Toronto in 1951 with a B.A.Sc. degree in engineering and business.

W. A. Trotter, JR.E.I.C., is now assistant commissioner of works for the Township of York in Toronto.

A 1948 graduate in civil engineering from Queen's University, Mr. Trotter was previously deputy city engineer with the Corporation of the City of Kingston, Ont.

K. S. Flitton, JR.E.I.C., who is with the St. Lawrence Seaway Authority, is presently employed as supervising engineer on dredging the approach to the Beauharnois Canal in Lake St. Francis at Coteau Landing, Que. Mr. Flitton had been in Churchill, Man., with the Foundation Company Ltd. as estimator for three years.

Mr. Flitton, who graduated from McGill University in 1949 with a degree in civil engineering, also spent some time with Asbestos Erectors of Canada Ltd.

W. J. Robinson, JR.E.I.C., has been transferred by Provincial Engineering Ltd. from Hamilton, Ont., to the head office of the company in Niagara Falls, Ont. He has been with the company since 1952.

A graduate of the University of Manitoba, class of 1949, in electrical engineering, he was formerly with Walker and Associates in Hamilton, Ont., as conversion engineer.

Dominion Bridge Appointments

Dominion Bridge Company recently announced the appointment of two sales engineers in their boiler division, **R. D. Davis,** JR.E.I.C., and **J. P. Dagenais,** JR.E.I.C.

Mr. Davis graduated from the University of Toronto with a M.A.Sc. degree in civil engineering in 1953. He joined the Dominion Bridge Company the same year and has held a number of positions in the company's design, estimating and drafting offices. He is now located in the boiler division of the Toronto plant.

Mr. Dagenais received his engineering education at Ecole Polytechnique, graduating with a B.A.Sc. degree in 1948. Prior to his appointment with Dominion Bridge he held the position of sales engineer with the Bailey Meter Company in Montreal. He will be located in the head office at Montreal as sales engineer in the boiler division.

J. P. Dagenais, Jr.E.I.C.

R. D. Davis, Jr.E.I.C.

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• Personals

R. R. Cheyne, JR.E.I.C., has rejoined the staff of the Aluminum Company of Canada at Arvida, Que., after successfully completing a M.B.A. course in business administration at the University of Western Ontario. He was previously in British Guiana on the staff of the Demerara Bauxite Company for the Aluminum Company for two years.

Mr. Cheyne graduated from the University of Saskatchewan in 1949 with a degree in mechanical engineering and has also been with General Steel Wares Ltd. in London, Ont.

Maurice Lajoie, JR.E.I.C., has been appointed sales manager of the precast division of Creaghan & Archibald Ltd. in Montreal. His position includes responsibility for sales, advertising and promotion for the precast division.

Mr. Lajoie graduated in civil engineering from Ecole Polytechnique in 1950.

Ferris J. Abbass, JR.E.I.C., has joined the New Brunswick Power Commission as engineer for power contracts and rates in Fredericton, N.B. He was previously installation engineer for Cossor (Canada) Limited in Halifax, N.S.

Mr. Abbass graduated from Nova Scotia Technical College in 1950 with a degree in electrical engineering. He has been with Canadian Westinghouse Company Ltd. in the lamp and tube division at Hamilton, Ont., and as quantity engineer in Three Rivers, Que.

S. Gauley, JR.E.I.C., is now mechanical test engineer with Avro Aircraft at Malton, Ont. He was previously in Montreal as liaison engineer with Canadair Limited.

Mr. Gauley graduated from the University of Saskatchewan in 1950 with a degree in mechanical engineering and joined the Ontario Hydro at Toronto, working in the construction department before coming to Montreal in 1952.

Thomas Fell, JR.E.I.C., has been appointed assistant city engineer of Port Arthur, Ont. Mr. Fell was previously with the Department of Public Works of Canada at Port Arthur, Ont.

He graduated from Queen's University with a degree in civil engineering in 1950, having spent the summers of his university course working with the Ontario Hydro Electric Power Commission on the Ottawa River and at Pine Portage, Ont.

In 1950 he joined Detroit Edison and was in charge of inspection and progress reports on a 2 million dollar foundation building project. Two years later he joined the staff of United Engineers and Constructors Inc. in Detroit, Mich. He returned to Canada in 1953 to join the Department of Public Works at Fort William, Ont.

Mr. Fell served during World War II with the R.C.A.F.

S. Oancia, JR.E.I.C., is in Jamaica, B.W.I., with Sprostons (Jamaica) Limited in Shooters Hill. He was formerly with George Mills & Sons Ltd., general contractors in Sydney, N.S., as project engineer and assistant superintendent on wharf and breakwater construction.

He graduated from the University of Alberta in 1950 with a degree in civil engineering and has also been with the Quebec North Shore Paper Company in Baie Comeau, Que.

N. W. Bunn, JR.E.I.C., has been transferred from plant engineer of the Calgary office of Precast Concrete Limited to manager of the Edmonton branch of the company. He joined the company in 1953.

Mr. Bunn graduated from the University of Alberta in 1950 with a B.Sc. degree in civil engineering. He has previously been associated with Alberta Transit Mix and Concrete Constructors Ltd. in Calgary, and with Truscott Products Limited in Edmonton, Alta., as sales manager.

Donald W. Gordon, JR.E.I.C., is now with Vulcan Iron Works Ltd. in Winnipeg, Man. He was previously with Bridge and Tank Company Ltd. in Winnipeg.

A 1950 graduate of the University of British Columbia in mechanical engineering, he has been on the staff of the Toronto Iron Works in Toronto, Ont.

H. A. Bowman, JR.E.I.C., has been named vice-president and chief engineer of Stein Struthers Ltd. in Edmonton, Alta.

Mr. Bowman, who graduated from the University of Alberta in 1950 with a degree in civil engineering, was formerly associated with the Calgary Power Company as production engineer in Calgary and in Wabanum, Alta.

Boris W. Petron, JR.E.I.C., has joined the staff of Cosmos Chemical Company Ltd. in Port Hope, Ont. He will represent the company as their official technical representative in the field.

Mr. Petron, who graduated from the University of Toronto in 1950 with a B.A.Sc. degree in chemical engineering, was formerly plant chemical engineer with Temus Products (Canada) Ltd. in Toronto.

E. R. Skanes, JR.E.I.C., is now an electrical engineer with the United States Air Force at headquarters of the Northeast Air Command at Pepperrell Air Force Base in St. John's, Nfld.

Mr. Skanes was formerly with the Canadian General Electric Company at St. John's, first in the test department and then as apparatus and supplies specialist.

He graduated from Nova Scotia Technical College in 1951 with a B.Eng. degree.

John Papanicolas, JR.E.I.C., has joined the staff of Walter Dow and Company Ltd. in Toronto, Ont.

Mr. Papanicolas is a graduate in engineering from Ecole Speciale des Travaux Publics, Paris, class of 1951. He was formerly with Dominion Bridge Company Ltd. in Lachine, Que., as electrical engineer.

Christopher A. Brockley, JR.E.I.C., has received a Canadian government appointment to the staff of the Naval Research Laboratories in Halifax, N.S., effective in September.

After graduating in 1949 from the University of British Columbia with the degrees of B.A. and B.Sc. Mr. Brockley went to England as design engineer with British Ropeway Engineering Company in London.

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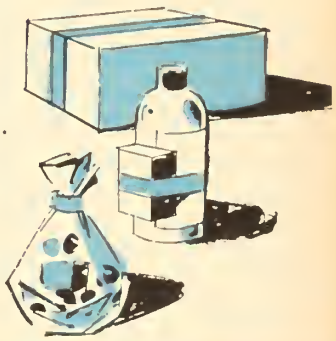

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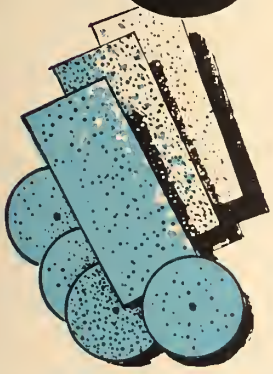

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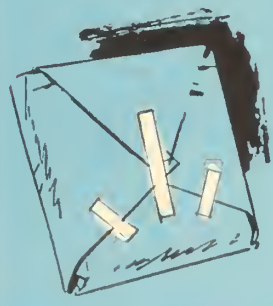

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Name .....

Position .....

Company .....

Address .....

• Personals

came design engineer with his father's firm. In 1952 he was awarded an Athlone Fellowship and went to Sheffield University in England. Last year he won a Canadian Government scholarship which enabled him to complete his work towards a Ph.D. degree in mechanical engineering.

Howard E. MacIntyre, JR.E.I.C., has joined the staff of Canadian Industrial Minerals Ltd. in Walton, N.S.

Mr. MacIntyre graduated from Nova Scotia Technical College in 1951 with a degree in mechanical engineering. He has also been associated with Dominion Iron & Steel Corporation as mechanical engineer in Sydney, N.S.

Dante De Pretis, JR.E.I.C., is employed as electrical engineer in the hydro-electric department of Price Brothers and Company Ltd. in Kenogami, Que. He was formerly an electro draughtsman with Canadian Vickers in Montreal.

Mr. De Pretis graduated from Padua University in electrical engineering, class of 1952.

Robert Burn, JR.E.I.C., has been transferred by the Canadian National Railways to Montreal, Que. His new position is that of supervisor of staff training.

Mr. Burns graduated from the University of Manitoba in 1951 with a degree in electrical engineering. He became associated with the C.N.R. as mechanical inspector in Toronto, Ont., upon his graduation. In 1953 he became assistant electrical engineer for the central region of the railway at Stratford, Ont.

T. Milne Dick, JR.E.I.C., is now employed by C. D. Howe Company Ltd. in Churchill, Man.

Mr. Dick, an honors graduate of the University of Glasgow in civil engineering, class of 1953, was formerly field engineer with the city engineer's office in Port Arthur, Ont.

John W. Smith, S.E.I.C., who graduated this year from Queen's University in civil engineering, has accepted a position in the building and structures division of the special contracts division of the Bell Telephone Company of Canada in Montreal.

G. J. Maguet, S.E.I.C., has joined the research and development branch of the Canadian National Railways in Montreal. Mr. Maguet graduated this spring from the University of Manitoba with a degree in mechanical engineering.

Kenneth W. Domier, S.E.I.C., a 1955 graduate of the University of Saskatchewan, has accepted a position as petroleum technician with Federated Co-operatives Ltd. in Regina, Sask.

H. Skogland, S.E.I.C., who graduated this spring from the University of Saskatchewan in mechanical engineering, is now maintenance project engineer at the R.C.A.F.'s Central Experimental and Proving Establishment in Ottawa, Ont.

L. E. Parker, S.E.I.C., is on the engineering staff of the British American Oil Company at the Clarkston refinery in Toronto, Ont.

Mr. Parker graduated this year from the University of Saskatchewan in mechanical engineering.

B. R. Pinder, S.E.I.C., a 1955 civil engineering graduate of McGill University, is now employed as design engineer with Dominion Structural Steel Ltd. in Montreal.

F. X. MacDonald, S.E.I.C., is presently employed as an electrical engineer with R.C.A. Victor Company Ltd. in Montreal.

Mr. MacDonald graduated this year from Nova Scotia Technical College with a degree in electrical engineering.

Gordon P. Luke, S.E.I.C., graduated from the Royal Military College in Kingston, Ont., in May and since then has been on the engineering staff of the Department of Highways of Ontario, located on a bridge project near Pembroke, Ont. He will enter Queen's University in the fall to complete his degree course in civil engineering.

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NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS WANTED

PRODUCTION ENGINEER — M.E.I.C., P.Eng. (Que.) McGill, diversified experience includes business administration, plant operation. Sales, purchasing, product control. Project engineering, labor negotiations. Manufacturing cost estimates and analyses. Plant layout, methods studies. Production planning and scheduling, material handling. Age 45. Married. Desires challenging and demanding position. Available on reasonable notice. Full resume on request. File No. 1186-W.

ELECTRICAL ENGINEER, P.Eng. Ont. with post-graduate training in business administration seeks responsible position leading to sales management. 8 years sales and manufacturing experience at supervisory level. Presently in sales administration, functions including supervision of sales, product promotion, technical projects, top level customer contact in industrial market. File No. 2975-W.

CIVIL ENGINEER Jr.E.I.C., B.Eng. 1949, age 28, married. Six years varied experience in public utility field mainly on design and fabrication of steel structures both light and heavy. Some experience in concrete construction as well as general supervisory, administrative and correspondence duties connected with design office. Seeking responsible position with opportunity for advancement anywhere in Canada. Available on 15-30 days notice to present employer. File No. 3845-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng. (Ont.) graduated (Univ. Vienna) 1944 (Hons.) age 39, married, left home country 1947, in Canada since 1951. Ten years experience in manufacturing methods, production engineering of high precision components and heavy machinery; design and engineering of heavy machinery, precision parts, steam engines, boiler, heating and ventilating, piping, structures, material handling equipment. Good organizer. Excellent scientific worker. Desires responsible and challenging position. File No. 3990-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng., 1949, graduate. Married, 2 children. Experience as follows — 1 year electronics, 2 years on inspection of electrical equipment, 2 years on construction, operation and maintenance of power houses, transmission lines, substations, 1½ years with consulting engineers on design of power and lighting systems for industrial and commercial buildings. Desire position with heavy industrial power or consulting company. File No. 4124-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C., B.Eng., McGill '51. Single, 30. Completed graduate student training course with large electrical equipment manufacturer. Presently engaged as industrial engineer responsible for productivity of a power products line. Post graduate courses. Interested in position with greater responsibility, challenge and opportunity to demonstrate ability. File No. 4217-W.

INDUSTRIAL MANAGER M.E.I.C. Mechanical engineer with twenty year's experience all phases of engineering, production and management at both factory and general management level. Background covers sheet-metal manufacturing in both aircraft and commercial products. Successful record in organizing, leadership, and labor relations. Seeking career appointment, preferably in moderate sized company with opportunity for participation. File No. 4219-W.

MECHANICAL ENGINEER, Jr. E.I.C., P.Eng., Jr.A.S.M.E., B.A.Sc., Toronto 1950, age 32, married and family of one, 5 years experience in petro-chemical plant in pressure vessel inspection, maintenance and capital project development, field engineering on maintenance and project installation. Familiar with all phases of plant operation. Considerable practical pre-engineering experience. Desire general plant engineering, mechanical test and/or development, or maintenance or process supervisional work. Prefer Ontario or the West. Will welcome and answer all inquiries or proposals. File No. 4329-W.

ELECTRICAL ENGINEER, P.Eng., University of Alberta 1950, bilingual, experience in maintenance and plant engineering in heavy industry, statistical engineering and switchgear engineering. Seek responsible position in manufacturing. File No. 4427-W.

ELECTRICAL ENGINEER, Jr.E.I.C., B.Eng. (Hons.), McGill U. (1950), P.Eng. (Ont.), age 32, recently married desires technical work with consulting engineering firm, plant engineering department or utility. Four years with plant engineering department in design, layout and drawing up of distribution and lighting systems, plant electrical services, automatic sequencing controls for process equipment; and in application of adjustable speed drives. One year with architectural firm in designing distribution lighting and services for commercial and institutional buildings. Practical experience includes construction or rural distribution lines and operating diesel power house. File No. 4448-W.

CIVIL ENGINEER, Jr.E.I.C., Sask. '49. Married. Age 27. Desirous of employment in Alberta. Experience chiefly in the field of heavy industrial equipment. Would like sales, plant engineering, application engineering. Presently located in Montreal. File No. 4517-W.

CIVIL ENGINEER GRADUATE McGill University, wishes to find employment with a medium sized construction company or smaller consulting firm. Over five years experience in all phases of the building field: engineering studies, sight and soil investigation, design, construction, maintenance, inspection, and costing. Have worked for some of the best construction firms and engineers. File No. 4588-W.

INDUSTRIAL - METALLURGICAL ENGINEER, master of science degree in metallurgical engineering, B.Sc. (Hons.) in chemistry, P.Eng., Jr.E.I.C., national foundry college diploma in foundry management and technology. Applied experience includes cost savings development, work study and time standards, heat treatment, foundry work, ferrous and non-ferrous, steel melting and rolling, machining, specifications and standards writing. Particular background was specifically obtained for a supervisory or managerial position in the manufacturing or engineering field, or with a consulting firm. Location and size of company is not important. File No. 4648-W.

ELECTRICAL Jr.E.I.C., McGill '52, presently employed, experience includes utility and power project work, switchgear and control design, and contracts, industrial rectifier sales, and control work on D.C. drives. Interested in consulting or manufacturing in or around Montreal and would be available on one month's notice. File No. 4694-W.

INDUSTRIAL SALES ENGINEER, 30, graduate chemical engineer Jr.E.I.C., McGill 1951, P.Eng. (Que.), bilingual, married with family. Production and sales experience in building materials field and mechanical engineering field. Desires sales position with progressive firm having opportunities for advancement. File No. 4704-W.

CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.), A.M.I.C.E. (Britain). Age 35, married, desires responsible position with well established engineering firm or municipal authority, preferably in British Columbia or Ontario. Experience includes approximately 10 years with highways and bridges authorities in U.K., 3 years as executive engineer in the Public Works Dept. East Africa, and 2 years in government engineering and construction service in Canada. Good administrative ability with considerable experience in design specification writing, and supervision of construction of highway projects, reinforced concrete bridges, domestic and public building works, airfields, water supply, sewage disposal, and drainage schemes. File No. 4707-W.

CIVIL ENGINEER, Jr.E.I.C., P.Eng. (Man.), 1952 graduate. Experience in both field and office work in municipal engineering. Will consider any offer of employment for qualified civil engineer. 1 year experience with engineering department of railway, 2 years experience with consulting municipal engineers, 1 year as assistant city engineer. Single. Age 25. Location of work no object. Available on one month's notice to present employer. File No. 4747-W.

CIVIL ENGINEER, D.R.T.C., A.R.T.C. (Glasgow) 1949 P.Eng. (Alberta) M.E.I.C., age 32, eight years experience in municipal engineering. Heavy and light construction work, reinforced concrete and steel construction and design, hydraulic design, bridges, irrigation, drainage and roads. Wishes job of some responsibility in structural design with varied interest and good future prospects. Precis of experience and qualifications can be supplied on request. File No. 4748-W.

CHEMICAL ENGINEER, B.Sc., Alberta 1951, Athlone Fellow, Jr.E.I.C., now completing research for Ph.D., University of London, desire position in chemical industry, preferably in Western Canada. File No. 4749-W.

ELECTRICAL ENGINEER, 27, married, two children, 1949 honors graduate masters degree,

Westinghouse training course, four years with Montreal consultant, desires to relocate. Experience includes distribution, relaying, generation and system studies. Foreign service acceptable. File No. 4750-W.

MECHANICAL ENGINEER, P.Eng. (Alta.), M.E.I.C., graduate 1950. 30 years old, married, two children. Experience: 2 years as works manager of steel fabricating and machine shop, 3 years as estimator, project engineer and superintendent on construction of bridges, buildings, water lines, sewer lines, and road. Desires employment with opportunities for advancement. File No. 4752-W.

CHEMICAL ENGINEER patents, B.A.Sc., Toronto 1954, P.Eng., S.E.I.C., age 28, married, 2 children. Experience includes some plant experience, a year's experience in patent department of U.S. chemical manufacturing firm, patent office organization, search reports, validity investigation, preparation of patent applications and amendments. Desires position in small patent department of a chemical manufacturer or as liaison engineer with outside patent firm, offering responsibility, scope and future. File No. 4753-W.

MECHANICAL AND INDUSTRIAL ENGINEER, P.Eng., Jr.E.I.C., Physics degree, honors degree in mechanical engineering from Canadian University, 1951. Master's degree upon completion of thesis. Test course, industrial engineering course. Age 28, married. Captain, Army Reserve. Desires responsible position in junior management, industrial engineering, design, development, or production control. Particularly interested in cost reduction. Good experience in above fields, also some plant engineering and heating experience before graduation. Prefers Toronto-Hamilton area but will take right position anywhere. File No. 4755-W.

MECHANICAL-ELECTRICAL ENGINEER, with B.Sc., in Electrical Engineering, M.E.I.C., P.Eng. and Associate Member A.I.E.E., with seven years experience desires supervisory or management level position with an industrial organization. Experience includes one year manufacturer's test course, one and one half years Sales Engineer and four and one half years as Co-ordinating Engineer on large scale projects co-ordinating design, drawings, shop contact, engineering tests and field applications. Have completed Executive Evaluation Tests and results are available to prospective employer. Travel not objectionable and will locate anywhere in Canada or the Eastern United States. File No. 4759-W.

CIVIL ENGINEER, Toronto, B.A.Sc., M.A.Sc., Jr.E.I.C., P.Eng., age 27, married. Graduating in October. Seeks employment in structural design or fabrication in or around Toronto. Varied experience, including two years draughting, two years work in welding field. Special interest in metallurgy and welding during post graduate studies. File No. 4761-W.

MECHANICAL ENGINEER, P.Eng. (Ont.), age 35, graduated 1949 from Hannover University, Germany, diploma-ingenieur. Married, one child. In Canada two years. Experience in machine design, inspection, sales engineer. In Germany, six years experience in plant maintenance, vibration research, with continental rubber industries. Consulting Engineer for vibration problems. Desires employment preferably in Ontario or Quebec. Available immediately. File No. 4762-W.

ELECTRICAL ENGINEER, B.Sc. (Queens, Belfast) 1953, Grad.I.E.E. Age 28, single, seeks contacts offering position soon after arrival Montreal October 4th, 1955. Experience: 3 years fleet air arm; completed two years graduate apprenticeship with B.T.H. Coy. Rugby, including four months industrial electronics; 8½ months with world renowned electrical consultants as an Assistant Resident Engineer; vacation work in power station in Germany, paper mill in Sweden, and distribution in Reykjavik, Iceland. Details and credentials upon request. File No. 4764-W.

MECHANICAL-ELECTRICAL ENGINEER, B.Sc. (Mechanical), Sask. 1952, Jr. E.I.C. Age 25, married. Have 3 years experience with large electrical manufacturer including their training course. Capable public speaker and lecturer. Experienced in the problems involved in producing and marketing a quality product at customers price. Capable of contacting and negotiating effectively at management or executive level. Desire a plant managers position or sales position with scope for initiative. Preferred location in Western Canada. File No. 4765-W.

CIVIL ENGINEER National University of Ireland with eight years good general construction experience, including tunnels, roads and piling. Seeks position with good construction company. Free to travel. File No. 4770-W.

AGRICULTURAL ENGINEER, P.Eng., Jr.E.I.C., B.E. (Sask. 1951). Canadian citizen, 26 married, farm background, Canadian experience: 2½ years design drawing office. British experience under Athlone Fellowship: one year machine shop training, one year divided between process planning, time and motion study, and design drawing departments. Desires position in design or development field, preferably connected with the farm equipment industry. Available Nov. 1st. Location open. Resume sent on request. File No. 4772-W.

FIRMS OR INDIVIDUALS IN CANADA or the U.S. desiring consultations or representation in Mexico, or other parts of Latin America may contact a professional engineer (Member Corp. of Professional Engineers of Quebec) with broad and lengthy experience and travel, knowledge of Spanish, permanent resident status in Mexico, and numerous important contacts in Canada, the U.S., Mexico, Venezuela, and the West Indies. Correspondence invited. File No. 4773-W.

MECHANICAL ELECTRICAL ENGINEER. P.Eng., Jr.E.I.C., high standing graduate from Polytechnique, 1953, bilingual, single. Two years experience in administrative work with large municipality. Actually in charge of two engineers, one technician and two foremen. Two years evening studies in general electricity at McGill University. Seeks challenging position with advancement and incentive for consulting engineers or contractors located in Montreal area, not necessarily in electricity or mechanics. File No. 4774-W.

MECHANICAL ENGINEER, Jr.E.I.C., B.Sc., P.Eng. Six years varied experience in estimating, incentive systems, plant layout and product inspection. Supervisory and administrative experience as a departmental head responsible for high daily productive output of forged and machined products. Seeking responsible position with greater opportunity for advancement. File No. 4775-W.

METALLURGICAL ENGINEER, P.Eng., M.E.I.C., M.C.I.M.M. Canadian born. Married, age 37. Graduate McGill University. Course in management administration. Twelve years diversified experience in ferrous metallurgy. Development and supervision of chemical and metallurgical laboratories, inspection, specification and technical service divisions in steel finishing mill. Presently employed but seeks more responsible position. File No. 4782-W.

MECHANICAL ENGINEER, S.E.I.C., N.S.T.C. 1952, age 26 married, 2 children. Experienced in newsprint mill process and development. Excellent knowledge of process instrumentation. Desires permanent responsible position in development, production or instrumentation. Has done considerable supervising. Detailed resume on request. File No. 4783-W.

SITUATIONS VACANT

CHEMICAL

SENIOR PROCESS ENGINEER is required by large petrochemical cellulose acetate and synthetic yarn plant near Edmonton. Minimum of five years experience since graduation is required. Experience in field of petro-chemicals is preferred. This is a permanent staff position and the opening is immediate. Write stating personal information, experience in full detail, salary required, and date available to File No. 5246-V.

TWO GRADUATE CHEMICAL ENGINEERS, required with 2 to 5 years experience in the petro-chemical or rubber industries. The type of work which these men will do will be process control, raw material and product control process modification and design work. Location Ontario. File No. 5254-V.

CHEMICAL ENGINEER, required for large cement plant in Toronto area, for running the chemical and physical test laboratories. Analytical background and some industrial experience desired. A training of one year will be given at the Quebec Plant. File No. 5285-V.

SALES ENGINEER required to sell and service the application of specialized chemicals to industrial accounts. Largest and most progressive company in its field. Applicants may be graduates of any field with 1 or 2 years experience in industry or sales. Applicants will probably travel Quebec area but should be willing to work across Canada. File No. 5287-V.

CHEMICAL ENGINEER OR CHEMIST, required for position as Technical Assistant to the Plant Manager of new caustic-chlorine plant in Alberta. Preferably a young man with one to three years experience in control and development work in an industrial plant. Position affords an excellent opportunity for a man with initiative who is willing to assume responsibility. File No. 5310-V.

CHEMICAL ENGINEERING GRADUATE, required for oil refinery in Winnipeg, as a technical assistant. One or two years experience in technical and economic studies and process design preferred. Write giving full particulars of training and experience. File No. 5316-V.

VACANCIES EXIST in a large specialty pulp and paper mill in the Eastern Townships, Province of Quebec. We require one chemical engineer and one chemist. The successful applicants will be employed in the Technical Department. Initially work will consist of technical investigations throughout the mill aimed at increased production and higher quality. The positions offer interesting work with good opportunities for advancement. Candidates must be recent graduates of a recognized university. Previous experience in the industry is not necessary. Essential qualities are initiative, self confidence and ability to work with a minimum of supervision. Apply in writing giving full details of education, experience and career. All applicants will be handled in strict confidence. File No. 5321-V.

CHEMICAL ENGINEER, required by large oil company located in Toronto to work into sales. Applicant will start in Toronto area, but must be willing to move elsewhere in Canada. Canadian graduate preferred. Salary commensurate with ability, etc. File No. 5324-V.

CHEMICAL ENGINEER or chemist required for training to manage a new department in an established chemical manufacturing concern in Montreal. Practical industrial experience in chemical operations helpful, but not essential. Apply giving training, experience and salary expected. File No. 5331-V.

CHEMICAL ENGINEER required to fill the position of junior research engineer. Interested in young engineers recently graduated and who are interested in research work. The position is available immediately. Good starting salary. File No. 5334-V.

CHEMICAL ENGINEER OR CHEMIST to be responsible for production in small Montreal plant and to offer technical assistance to sales staff. Knowledge of chemical cleaning of metals desirable. Age 28 to 40 years. File No. 5340-V.

CHEMICAL ENGINEERS required by chemical works within 40 miles of Montreal. Successful applicants will be trained for production supervision. Two years experience preferred. File No. 5352-V.

RESEARCH CHEMICAL ENGINEER required in Montreal. A recent graduate, with good scholastic record for small, scale pilot-model research and development on cooking and recovery process in the manufacture of pulp and paper. Apply by resume to File No. 5362-V.

YOUNG CHEMICAL ENGINEER recent graduate or one with 1 to 4 years experience required by long established chemical manufacturer located 18 miles from centre of Montreal. Duties include part office and part plant. File No. 5371-V.

CHEMICAL ENGINEERS (3 years or less experience) required for research and development work in large chemical company situated in Niagara Falls, Ontario. File No. 5380-V.

PETROLEUM CHEMIST, wanted to work on research and manufacture of lubricating greases and oils. Must have experience in development and process plant, operational knowledge of manufacture of greases, motor oils, metal cutting oils and soluble oils. Education level, B.Sc. or B.A. minimum. Age 25-55. Salary commensurate with previous experience and ability to contribute to technical group work. Location of employment Montreal. File No. 5399-V.

CIVIL

FIELD ENGINEER required in Montreal who has preferably had experience in working on housing projects, relative to instrument work for elevations, etc., blue-print reading, etc. File No. 5263-V.

CITY OF WINNIPEG, engineers' department requires design engineer (civil). Applications are invited from engineers with pump or other hydraulic municipal services design experience. This is a permanent position. Salary in accordance with experience. File No. 5264-V.

ASSISTANT CIVIL ENGINEER required by an established public utility supervisory-consulting organization. Age 30-45, minimum 5 years experience on structural steel, reinforced concrete and foundation design of steam electric power plants. Location New York. Some travel field future. Reply stating age, education, experience, personal particulars. File No. 5271-V.

GRADUATE CIVIL ENGINEER for head office sales work with firm engaged in engineering

COMMUNICATIONS DEPARTMENT

Has immediate openings for electrical engineering graduates specializing in or with experience in Communications as Assistant Engineers in the transmission and equipment groups. Work involves application and special engineering of all types of carrier telephone, telegraph, program network transmission, television and broad band microwave systems. Offers wide range of experience in Communications field. Headquarters Montreal with field engineering throughout system. All replies will be held in strict confidence and will be acknowledged.

Canadian Pacific

RAILWAY COMPANY

Address replies to:
EMPLOYMENT OFFICE
1080 Drummond Street
Montreal, P.Q.

manufacturing and erection of industrial and commercial building products. Responsibilities to include administration, technical and structural calculations and product application engineering. Prefer applicant with minimum two or three years experience in structural steel design and potential for eventual position as field sales engineer. Location Niagara Peninsula. Salary open. File No. 5275-V.

SALES ENGNEERS recent graduate civil engineers required to train for positions as field sales engineers with firm engaged in engineering manufacturing and erection of industrial and commercial building products. Extensive training program provided. Immediate location, Niagara Peninsula. Salary open. File No. 5275-V.

CIVIL ENGINEER, 1955 or 1954 graduate for the position of planner with paper company located in Quebec. The applicant should be interested in detailed maintenance and construction of buildings. His duties would be to assist in planning work of building maintenance. File No. 5295-V.

MUNICIPAL ENGINEER, with one or two years experience, required by the Department of Municipal Affairs and Supply in Newfoundland. Man to be employed on topographic surveys, preparation of water and sewer design and road and bridge construction. Salary $4,600-$4,900. Replies should state qualifications, age and experience. File No. 5297-V.

APPLICATIONS ARE INVITED, from engineers with at least five years experience to act as assistant to City Engineer. Must have experience in design, planning, grading and paving roads and streets. Good permanent position for right person. Pension plan and other fringe benefits. Official application forms may be obtained at the Executive Director Office, City Hall, Saint John, N.B. File No. 5305-V.

STRUCTURAL STEEL DESIGNER. Outstanding opportunity for Ontario Professional Engineer with minimum of five years experience in the design of structural steel buildings. Excellent starting salary, modern office and good working conditions. Please state age, experience, references and salary required. File No. 5306-V.

GRADUATE ENGINEERS, for large structural steel plant in Ontario. Recent graduates from Canadian universities preferred. Excellent opportunities for two young men who are willing to train for positions in design, contracting and production. Salary is in line with 1955 schedules as recommended by Assoc. of Prof. Eng. File No. 5318-V.

STRUCTURAL ENGINEERS AND DRAUGHTSMEN. General industrial steel and concrete design, draughting. Salary commensurate with experience. Location Montreal. File No. 5326-V.

SENIOR PROJECT ENGINEER required by young municipal engineering firm to supervise both design and construction of complete water supply and sewage disposal systems, qualifications thirty to forty years of age with applicable experience in Canada. Please reply giving full details of academic training, professional experience, references and salary requirements. File No. 5332-V.

CIVIL ENGINEER, required by Canadian general contractor for position as resident engineer on hydro electric development in Pakistan. Married man preferred. Duration of job approximately three years. Good living conditions and excellent prospects for an experienced man. File No. 5335-V.

SENIOR STRUCTURAL DESIGNER required by firm of consulting engineers in Toronto. Salary negotiable. File No. 5342-V.

CIVIL ENGINEER required by firm of consulting engineers to act as resident engineer for large highway job. Location Ontario. Living quarters provided for wife and family. Well experienced man required. Duration of present work approximately 3 years, with possibility of permanent employment. Salary negotiable. File No. 5342-V.

MUNICIPAL ENGINEER OR DIRECTOR of Public Works for the Corporation of the District of Kitimat, B.C. Salary range $575-$690 per month plus housing bonus. Position entails development of public works department for fast growing planned municipality—population now 6,000, estimated 20,000 by 1960—and supervision of up to $8,000,000.00 of construction in next 5 years. Requirements: university degree in civil engineering or equivalent. At least 5 years responsible experience, preferably in municipal engineering and/or public works construction. Eventual registration with B.C. Association of Professional Engineers. Maximum age 50. File No. 5347-V.

CIVIL OR STRUCTURAL ENGINEER with administrative ability required for timber development engineering by Canadian Institute of Timber Construction. This Institute, representing the structural timber fabricating industry and the pressure-treating industry in Canada, has several projects under way requiring professional personnel with ability to develop and present design information for the use of designing engineers and architects. Experience in design, preferably with a consulting firm is desirable. Ability to administrate and to coordinate activities of others is essential. We visualize a man 30-40 who likes variety in his work and enjoys working with people. Location, Ottawa. Reply giving full details. File No. 5355-V.

STRUCTURAL ENGINEER for technical promotion work in connection with a major type of building construction. Applicant must be a Canadian citizen experienced in structural design and capable of meeting and assisting engineers, architects and public officials with structural problems. Office in Toronto, considerable travel in Ontario. Salary $6,000. Car allowance. Reply stating personal data, qualifications and references. File No. 5360-V.

WATERWORKS DESIGN ENGINEER, applicant must be a graduate professional engineer of a recognized university and preferably a member of the Association of Professional Engineers of Ontario or the equivalent. Should have a minimum of 7 to 10 years experience in the design of engineering structures re, watermains, pumping station, elevated tanks, etc. Excellent opportunity for advancement. Generous sick leave pension, vacation, and hospital and medical plan. Initial salary range $5,600 to $7,200. Starting salary commensurate with ability and experience. Municipality located in Southern Ontario. File No. 5369-V.

RECENT GRADUATE CIVIL ENGINEER required in the track section of the office of the chief engineer of a major railway company in Montreal. File No. 5377-V.

CIVIL ENGINEER required to manage and direct the expansion of Montreal company, specializing in the design and construction of prestressed concrete structures. Should be top executive, age 35 to 45 years, and have extensive experience in the field and office management. Excellent salary plus participation in company profits. File No. 5381-V.

CIVIL ENGINEER preferably not over 35 years of age required by structural steel firm in Montreal, to act as salesman for roof deck and wall panel construction. Salary open. Please reply to File No. 5393-V.

SOIL ENGINEERS, required by well known Engineering and Construction Company. Must be graduate Civil Engineers, preferably with post graduate studies in soil mechanics and foundation engineering. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

GRADUATE CIVIL ENGINEERS, required by well known Engineering and construction company for special work in the field of Soil Mechanics and Foundation Engineering. Post graduate studies in soil mechanics and structures desirable but not essential. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

SENIOR STRUCTURAL ENGINEER required for mining and concentrating plant design and layout. Please state full details of qualifications, experience and age in first letter to File No. 5398-V.

ELECTRICAL

ENGINEERS required for development in connection with telephony magnetic amplifiers, radar, transistor circuits, fire control systems and other servo operated instruments for both military and commercial application. The continuing expansion of work in our engineering department offers opportunities for both senior and intermediate engineers. Previous experience in fire control or electro-acoustical systems is desirable and supervisory ability would be an asset. Location Montreal. File No. 5244-V.

SALES ENGINEER, required to sell communications equipment in the Montreal area. Applicants must be bilingual and have an extensive electrical background. Above average remuneration on a base salary plus commission arrangement. Car, company benefits and excellent future with expanding company. File No. 5245-V.

TELEVISION BROADCAST ENGINEER required by Ontario manufacturer. Must be familiar with television transmission equipment including camera chains, transmitters, antennas, etc. Must be qualified to lay out television studio broadcast equipment and prepare technical briefs covering television station operation. Considerable customer contact will be involved. Position may develop into sales engineering in the television field. File No. 5256-V.

RADIO COMMUNICATIONS ENGINEERS for research and development on HF and UHF equipment required by Ontario manufacturer. Some practical experience in this field essential. This is a varied and interesting position with a small but rapidly expanding communications company with excellent opportunities for future progress. File No. 5256-V.

JUNIOR ELECTRICAL ENGINEER required by paper company located in Province of Quebec. Graduate engineer preferably 1950, interested in working in the engineering and operating fields. File No. 5269-V.

GRADUATE ELECTRICAL engineer with several years experience in plant mechanical work required by a prominent Montreal industrial engineering firm. Experience in air conditioning and plant mechanical design desirable. Position involves supervision of all mechanical and electrical design and offers possible participation in the firm for the

ENGINEERING OPPORTUNITIES IN VICTORIA, B.C.

with B.C. Power Commission, for senior and intermediate civil engineers in hydraulic design, both office and field, and senior electrical station designers. Excellent welfare provisions. Contact personnel supervisor, Box 500, Victoria, B.C., for further information, stating qualifications, experience and availability.

right man. Five day week with Blue Cross and pension plan. Reply should detail education, experience, personal qualifications and starting salary required. File No. 5286-V.

ELECTRICAL ENGINEER required by paper makers with at least two years experience in paper mill or other industrial work. Initially, his work will consist of design on specification of paper mill electrical equipment. Good starting salary. File No. 5295-V.

IMMEDIATE OPENINGS, for electronic engineers. General company expansion has created several opportunities for men with proven ability and experience for the design and development of complex electronic apparatus. There are openings for electrical and mechanical engineers in the following fields; electronic computors, microwave relay systems, test equipment design and development, systems engineering, transitors. If you are interested in improving your professional status and knowledge by joining a firm that offers the security and prestige of leadership send full details as to age, education and past experience by mail. All replies will be held in strict confidence and will be acknowledged. File No. 5299-V.

ELECTRICAL ENGINEER, 4 to 8 years experience in electronics, electrical or electromagnetic circuits. Capable of doing and directing development in these fields; interested in developing his own ideas with those of others in exchange for an opportunity to participate in a small progressive engineerng company. File No. 5304-V.

ASSISTANT SALES MANAGER, for electrical industry. Graduate electrical engincer preferred with experience of sales organization, in the switchgear and transformer field. Please state experience, age and salary expected. Application to be accompanied by a recent photograph. File No. 5308-V.

McGILL UNIVERSITY, requires demonstrators in Electrical Engineering, starting October first. Salary $300 a month, with time and free facilities for study and research. File No. 5315-V.

ELECTRICAL ENGINEERS AND DRAUGHTSMEN. Industrial, electrical light and power distribution. Salary commensurate with experience. Location, Montreal. File No. 5326-V.

ELECTRICAL ENGINEER up to $7,200.00 to supervise the installation and the design, preparation of plans, specifications and estimates of electrical systems for public buildings. For further information write to file No. 5330-V.

ELECTRICAL ENGINEER required by Canadian General contractor on construction of hydro-electric development in Pakistan. Married man preferred. Duration of job approximately three years. Good living conditions. Applicant must have a general experience in the electrical branch of construction work. File No. 5335-V.

ELECTRICAL ENGINEERS for the production department. This man to have a maximum of two years experience in production detailing and checking on low voltage distribution equipment of all kinds. Location S. Ontario. File No. 5346-V.

GRADUATE ELECTRICAL ENGINEERS. We require graduate elcctrical engineers for our Montreal Engineering department. We are looking for men with experience in power utility work or associated lines. Duties will consist of design of power stations, transmission systems, sub-stations, distribution and control systems and would include field supervision of installations. The salary offered will be based on ability and experience. The company has normal employee benefits. File No. 5354-V.

GRADUATE ELECTRICAL ENGINEER, required as assistant engincer rural department of power company in Alberta. Location in Edmonton. Duties involve design and estimation of single phase farm power lines with related engineering. Salary commensurate with qualifications. Excellent employee benefits provide pension, group life, sickness and accident coverage. File No. 5359-V.

TWO JUNIOR ELECTRICAL or engineering physicists for work in our research and development departments. The work involvcs research and development work in various

STRUCTURAL ENGINEER

for technical promotion work in connection with a major type of building construction. Applicant must be a Canadian citizen experienced in structural design and capable of meeting and assisting engineers, architects and public officials with structural problems. Office in Toronto, considerable travel in Ontario.

Salary $6,000. Car allowance.

Reply stating personal data, qualifications and references.

File No. 5360-V.

special antennae and related components. Location Ontario. File No. 5374-V.

GRADUATE ELECTRICAL ENGINEER WANTED as demonstrator in the electrical engineering department University of Toronto for the session 1955-56. Session commences on Sept. 19th, 1955, and extends seven months. File No. 5375-V.

ELECTRICAL ENGINEER, university graduate, required for electrical service of power and industrial equipment of a Canadian manufacturer. Applicant will be located in Montreal with possibility of limited amount of travel in Province of Quebec. Please state education, experience and starting salary expected. File No. 5384-V.

ELECTRICAL SALES ENGINEERING AND APPLICATION ENGINEERING positions in new and growing company making electrical, industrial control apparatus in S.W. Ontario. Prefer electrical, mechanical or engineering and business. File No. 5388-V.

ELECTRICAL MANUFACTURING ENGINEER, with experience in the design and manufacture of Air Break Switchgear required for Chief Engineers position with Western Manufacturer. Should be capable of leading a development program in a newly equipped laboratory on low voltage air break switchgear and circuit breakers up to 15 kv. Salary open. Replies from applicants with all or part of the required experience will be treated in strict confidence, and should contain full details of experience, age, and educational background. File No. 5395-V.

MECHANICAL

MECHANICAL ENGINEER required, and whose duties will include general mechanical design on a variety of projects associated with the commercial application of atomic energy. Applicants should have a minimum of 4 years experience, a small portion of which should be in the electrical field. Engineering graduates of Canadian or British universities preferred. Please reply in writing giving full details of education and experience to File No. 5259-V.

THOROUGHLY EXPERIENCED INDUSTRIAL engineer required by manufacturer of large range of heavy mechanical equipment. Applicant should be of department head calibre and capable of setting up and administering an industrial engineering group. A mechanical engineering degree and five years of applicable experience are preferable qualifications. File No. 5265-V.

SALES ENGINEERS required by Montreal manufacturer of a wide range of heavy mechanical equipment. Applicants should be graduate engineers, in the age bracket of 25 to 35, with a minimum of perhaps three years sales experience in mechanical equipment or allied lines. They must be mature and personable with strong sales or sales administration interests and aptitudes. File No. 5266-V.

GRADUATE Canadian engineers, preferably with manufacturing experience, required by financial institution to make surveys of and write reports on industries in Eastern Canada. Salary according to qualifications. File No. 5273-V.

MECHANICAL ENGINEER required in construction department of pulp and paper company located in Maritime Provinces. Engineer with experience in design and installation of power plant equipment. We are contemplating the installation of an 850 p.s.i. 200,000 lb hr. power boiler, oilfired. File No. 5277-V.

MECHANICAL ENGINEER, required for supervision of design for a variety of heavy machinery. Applicant must be an engineering graduate or have equivalent status, 35 to 45 years of age, capable of promoting design for both economy and practicability as well as control of quality consistent with design intent and facilities of manufacture. Please reply in detail, stating experience, education, etc. All replies will he kept in strict confidence. Salary commensurate with experience and qualifications. Office and shops in Montreal area. File No. 5282-V.

MECHANICAL ENGINEER to take charge of mechanical department of a prominent Montreal industrial engineering firm. Experience in air conditioning design, steam plant and plant mechanical services required. For an experienced man with good personality this position offers an unlimited future including participation in the firm. Five day week with blue cross and pension plan. Reply should

WANTED

BY THE CITY OF HAMILTON

WATERWORKS DESIGN ENGINEER

Applicant must be a graduate professional engineer of a recognized University and preferably a member of the Association of Professional Engineers of Ontario or the equivalent.

Should have a minimum of 7 to 10 years' experience in the design of engineering structures re watermains, pumping station, elevated tanks, etc.

Excellent opportunity for advancement. Generous sick leave, pension, vacation, and hospital and medical plan.

Initial salary range $5,600 to $7,200. Starting salary commensurate with ability and experience.

Apply
Stating all particulars to

Director of Personnel
City Hall
Hamilton

RESEARCH HYDRAULIC ENGINEER

For research team studying the forces involved in pulpwood holding grounds, at both model and full scale. Requirements: master's degree in hydraulic engineering, good academic record, and ability to work with woods personnel in the field. Apply by resume to

**Scientific Personnel Officer,
Pulp and Paper Research
Institute of Canada,
3420 University Street,
Montreal, Quebec**

detail education, experience, personal qualifications and starting salary required. File No. 5286-V.

MECHANICAL ENGINEER, experienced in plate fabrication work with some selling experience to assist in developing an industrial business. Location, Province of Quebec. File No. 5307-V.

MECHANICAL ENGINEER, to take complete charge of engineering department in medium sized, aggressive electrical manufacturing plant in Montreal. The right man must be a good draughtsman with some practical experience and be prepared to re-organize the present engineering department. There is an excellent opportunity that position would lead to executive level and company participation. File No. 5311-V.

MECHANICAL ENGINEER, required by architectural firm in Winnipeg. Heating, ventilating, plumbing design and layout experience preferred. To work with Chief Engineer. File No. 5314-V.

MACHINERY SALESMAN, required by leading manufacturer of machine tools in Southern Ontario. Applicants should have some practical machine shop experience, plus a proven sales record. Reply in writing, stating age, salary expected and experience, etc. File No. 5317-V.

MECHANICAL ENGINEER, with 3 to 5 years experience in the design and construction of materials handling equipment. Working knowledge of electricity and the strength of structures helpful. Position offers good salary and opportunity for advancement with full employee benefits. Location Niagara Peninsula. File No. 5322-V.

MECHANICAL ENGINEER required by pulp and paper company with all or some of the following qualifications. Experience in maintenance work, knowledge of the fundamentals of time and motion study. Ability to supervise a group of approximately ten persons. Some knowledge of production cost systems. Duties include work with consultants on the installation of a system of maintenance standards. Develop standard time values, supervise a crew of maintenance standard assessors. File No. 5382-V.

GRADUATE MECHANICAL ENGINEER with one or two years experience, to assist the plant engineer. Salary depending upon qualifications. File No. 5383-V.

MECHANICAL SALES ENGINEERING and application engineering positions in new and growing company making electrical, industrial control apparatus in S.W. Ontario. Prefer electrical, mechanical or engineering and business 1955 graduates. File No. 5388-V.

WELL KNOWN MACHINERY manufacturer requires a mechanical sales engineer to contact large industries in the Province of Quebec. Established clientele assuring substantial income for qualified man. Some knowledge of French desirable. This is in addition to the existing staff who are aware of this vacancy. If you believe you are the man for this position, please send complete details of qualifications and past experience which will be held in strict confidence. File No. 5389-V.

GRADUATE MECHANICAL ENGINEER for large industrial concern near Montreal required for development work and general project engineering. Permanent staff position and good prospects of promotion for young engineer with initiative and ability for original design work. Previous experience preferred but not necessary. We will pay travelling expenses for interview. Write stating personal information, experience in detail, salary required and date available. File No. 5390-V.

MISCELLANEOUS

A NATIONAL ORGANIZATION requires an engineering staff manager to coordinate departments supplying product engineering services for their very diversified lines. The man will have engineering training and experience but will also be strong in administrative ability and experience and able to build an outstanding organization. He will motivate his staffs to design in terms of sales appeal, manufacturing costs and production. He himself will be seriously concerned with the mutual impacts of market trends, sales forecasts, service and engineering. He will determine policy, guide and direct organization to provide information for order negotiation, manufacturing, quality control, production and industrial engineering, product development and design, selection and training of personnel. He will maintain close liaison with sales, manufacturing and purchasing. This position will be both demanding and challenging. If your experience and ambitions line up with our description send us all pertinent information as to training and experience. File No. 5255-V.

CHIEF ENGINEER, responsible to the president. Age 35 to 40. In charge of all product engineering activities. Duties through a group of four to five product engineers, to direct experimental engineering activities, conceive, develop and design new products supervise redesign of all regular line products for improvement and cost reduction. To supervise engineering department of fifty persons, through unit heads. To maintain adequate engineering records, including drafting and blue-printing sections. Engineering graduate in mechanical or electrical with experience in the direction of product engineering, preferably in the field of consumer durables. File No. 5255-V.

ATTRACTIVE OPPORTUNITIES

For

SENIOR ARCHITECTS AND ENGINEERS WITH THE FEDERAL GOVERNMENT IN OTTAWA

Salaries up to $7,900

Requirements include:

An assistant chief penitentiaries engineer with training in engineering or architecture; a telecommunications engineer; a communications engineer; an architect (Buildings); an electrical engineer (Power); a structurol engineer; and a construction engineer (Runways).

Opportunities for odvancement. Generous Fringe Benefits.

**For further information, write to:
CIVIL SERVICE COMMISSION
OTTAWA**

Ask for circular B341

SENIOR CHECKER to lay out and check details of aircraft installations. Applicant should have had at least 15 years experience in drawing offices of aircraft manufacturers or in drawing in connection with allied light engineering work. This is a position suitable for an engineer who is retired or nearing retirement age. Reply stating age, education, experience, personal particulars and salary expected. File No. 5257-V.

MECHANICAL DESIGNERS (engineers or draughtsmen) capable of doing the work of machine design including pulleys, gear, etc. Location, Ottawa and Montreal. Salary commensurate with experience. File No. 5326-V.

MECHANICAL ENGINEERS AND DRAUGHTSMEN, for industrial installation of equipment, piping, etc. Salary commensurate with experience. Location, Montreal. File No. 5326-V.

GRADUATE MECHANICAL ENGINEER required by a heavy industry with extensive mining and milling operations in the Eastern Townships (Quebec). Duties will include machine design, plant layout, work scheduling, etc. Preference will be given to applicant with one year's experience or recent graduates. Good opportunity. Interesting and permanent position with attractive salary. Numerous employee benefits. Replies should include complete record of education, also salary expectation should be mentioned. File No. 5338-V.

WORK EQUIPMENT MANAGER required by large transportation company headquarters in Montreal. Applicants must be graduate mechanical engineers, not over 40 years old, with at least 10 years experience in the selection, operation and repair of contractors' work equipment or mechanical equipment used in woodlands operations. Apply to the undersigned by letter, giving complete information in regard to person, education and experience. Personal interviews will be arranged if applications justify. Salary depends on capability of successful applicant. File No. 5343-V.

ASSISTANT MECHANICAL SUPERINTENDENT required for Southern Quebec pulp and paper mill. Recent mechanical engineering graduate preferred, to assist mechanical superintendent in all phases eventually taking over complete responsibility for mechanical maintenance. Position offers excellent opportunity for advancement. Hospitalization and life insurance, pension plan, etc. available. Please include in application all details regarding education and experience. File No. 5349-V.

GRADUATE MECHANICAL ENGINEER required by large manufacturing plant located in Montreal. A minimum of five years experience in heavy mechanical equipment essential. Some shop experience desirable. Applicant will be required to study, analyze and report on new product lines and develop specifications for cost estimating. Give details of age, education, experience, salary requirements and other relevant information to File No. 5357-V.

THE PLANT ENGINEERING SERVICES of the National Research Council, requires at Ottawa a graduate mechanical engineer preferably with some experience in plant work to design, prepare plans and specifications for heating, ventilating and air conditioning systems. Familiarity with various manufacturers equipment and control systems is essential. Initial salary up to $4,500 per annum depending on qualifications. Apply by letter giving full details of education and experience to The Employment Office, National Research Council, Sussex Drive, Ottawa, Ontario. Please quote file PE-236. File No. 5358-V.

MECHANICAL ENGINEER required for work in refinery at Sarnia as area maintenance engineer. Must have 3 to 5 years experience in oil refinery or related industry. Duties include general engineering and estimating. Permanent position, full employee benefits. Write giving full particulars of age, qualifications, experience, present salary. File No. 5364-V.

MECHANICAL ENGINEER required for product design by manufacturer of mining machinery in Southern Ontario. Registered or qualified professional engineer. Reply in detail stating

WANTED

PULP & PAPER ENGINEER

Graduate engineer capable of planning and developing complete pulp and paper projects. Must have not less than five years' experience in newsprint manufacturing. Summarize experience — Location about 100 miles from Montreal.

Address Reply to the Engineering Journal File No. 5363-V.

ATOMIC POWER PROJECT
PLATE AND VESSEL DESIGNER

We require an experienced professional mechanical engineer with 5 to 10 years' design experience in vessels, heat exchangers or allied equipment.

Will be required to work on pressure vessels and heat exchanger for the reactor, as well as plate and tube components for the reactor core.

Please reply by letter stating experience, qualifications etc. to

Canadian General Electric Company Ltd.,
212 King Street W.,
Toronto, Ontario
Attention: Mr. W. F. McMullen

personal history, education and experience. File No. 5368-V.

MECHANICAL ENGINEER for sales office required by manufacturer of hydraulic fittings and hoses, etc., located in Ontario. Salary open with excellent future prospects. Age group approximately 23 to 30 years. File No. 5370-V.

LARGE MONTREAL MANUFACTURER requires specialist in welding and brazing techniques for mass produced apparatus. Applicant should be mechanical engineering graduate or equivalent with minimum of five years experience in welding processes. Salary open. Your confidence will be respected. File No. 5376-V.

TECHNICAL ASSISTANT to director of maintenance and operations required by Sask. department of public works. Salary range $382-$464 per month. Competition No. c/c 3582. Applicants require considerable experience in building construction repair and maintenance preferably including electrical and mechanical design and installation; supplemented by engineering degree or equivalent in training. Incumbent is expected to provide professional advice to the director on repairs and maintenance of government buildings and to assist the director in formulating repair and maintenance programs and to administer these programs. Competition will close when suitable applicant is obtained. File No. 5258-V.

ENGINEERING - PHYSICIST required, and whose duties will consist of development engineering in group engaged in the commercial application of radioactivity to the medical and industrial fields. Minimum of 3-4 years experience in the field of nuclear physics, or alternately in the electronics field with some knowledge of radiation physics. Graduates of Canadian or British universities preferred. Please reply in writing giving full details of education and experience to file No. 5259-V.

PULP AND PAPER SALES ENGINEER required by manufacturer of a wide range of mechanical equipment with head office in Montreal, to work out of their Vancouver office. This man should have a minimum of five years experience in the pulp and paper business, be thoroughly familiar with the industry and have strong sales interests or potential. He should be a graduate mechanical or chemical engineer with a good knowledge of instrumentation and controls. File No. 5265-V.

GRADUATE ENGINEER required for heavy clay products plant in southeastern Alberta. Duties will consist of plant layout re plant expansion, equipment replacement, materials handling, and related matters. Please reply in own handwriting. All replies will be held in strict confidence. File No. 5270-V.

PROCESS ENGINEER required for heavy clay products plant in south eastern Alberta. Duties will consist of quality control, specifications, laboratory and field work, process studies, and related matters. Please reply in own handwriting. All replies will be held in strict confidence. File No. 5270-V.

PRODUCTION MAN REQUIRED for heavy clay products plant in Southeast Alberta to understudy plant superintendent. Engineering training desirable but not essential. Please reply in own handwriting. All replies will be held in strict confidence. File No. 5270-V.

ASSISTANT PLANT ENGINEER required for heavy clay products plant located on the lower mainland of British Columbia. Duties will consist of plant layout, equipment [illegible] placement and installation, time studies, [illegible] terials handling and related matters. [illegible] replies will be held in strict confidence. F[illegible] No. 5270-V.

WANTED 1 SENIOR MECHANICAL ENG[illegible] NEER, 1 senior civil engineer, 3 jun[illegible] mechanical or civil engineers for mining a[illegible] concentrating plant for design and layo[illegible] Please state full details of qualificatio[illegible] experience and age in first letter to File N[illegible] 5272-V.

GRADUATE Canadian engineers, preferal[illegible] with manufacturing experience, required [illegible] financial institution to make surveys of a[illegible] write reports on industries in Eastern C[illegible] ada. Salary according to qualifications. F[illegible] No. 5273-V.

TWO GRADUATE ENGINEERS wanted [illegible] permanent position, one civil and one mecha[illegible] cal with 2 or 3 years experience, pulp a[illegible] paper preferred but not essential. Location [illegible] Northern Ontario Lakehead, with progressi[illegible] expanding company, having all employee be[illegible] fits. Furnish qualifications, salary expect[illegible] and availability for interview with appli[illegible] tion. File No. 5274-V.

THE QUEEN'S COMMISSION in the Regul[illegible] Army offers a career of unusual importanc[illegible] challenge and opportunities. It offers ma[illegible] rewards. The financial returns, the pensi[illegible] plan, the opportunities for advanceme[illegible] match, and in some ways, exceed those [illegible] any civilian profession or career. Howev[illegible] no one can measure the many intangible [illegible] wards of a leadership career in the serv[illegible] of Queen and Country. There are spec[illegible] opportunities and need for graduate engine[illegible] in The Royal Canadian Engineers, The Ro[illegible] Canadian Corps of Signals, The Royal Ca[illegible] dian Electrical and Mechanical Enginee[illegible] File No. 5276-V.

TWENTY-FIVE OPPORTUNITIES, for elect[illegible] cal and mechanical engineers to under[illegible] training as patent examiners with the F[illegible] eral Government at Ottawa. Good caree[illegible] numerous benefits. Starting salaries up [illegible] $4,620. For additional information write [illegible] Civil Service Commission of Canada, Ottav[illegible] Ask for circular B297. File No. 5278-V.

SALES ENGINEER required by water tre[illegible] ment engineers located in Ontario for [illegible] Hamilton and Niagara Peninsula area. Pre[illegible] man with engineering degree. File No. 5281[illegible]

INDUSTRIAL ENGINEER required by la[illegible] manufacturer Toronto. Applicant should be[illegible] recent graduate with one to two years [illegible] perience in time-study, budgetary control, c[illegible] reduction, preferably in the metal indust[illegible] File No. 5289-V.

PLANT MANAGER AND TWO production sup[illegible] intendents for new plant operation to [illegible]

MECHANICAL DESIGN ENGINEER

We require an experienced professional mechanical engineer with 10 to 15 years' experience in design of mechanical equipment particularly cranes or materials handling machinery. Experience in design of radioactive material handling valuable.

Will be required to design layout of fuel rod handling system and equipment.

Please reply by letter stating experience, qualifications etc. to:

Canadian General Electric Company Limited,
212 King Street West,
Toronto, Ontario
Attention: Mr. W. F. McMullen

YEAR'S TRAINING IN ENGLAND WITH PAY

Passage Paid

On behalf of British Insulated Callender's Cables Limited we have been asked to select outstanding Engineering Graduates in Canada to be the guests of B.I.C.C. in England for a year, leaving Canada about January 1st, 1956.

The details, briefly:

Several Engineering graduates in Canada will be given an opportunity to work in B.I.C.C. Laboratories and Factories in England.

Applicants selected will receive a salary of $3900.00 per annum, half to be paid in pounds sterling for living expenses while in England, the remaining half to be retained in Canada for payment as a lump sum in dollars on their return.

Travelling expenses from present location to destination in England will be paid in addition to the above salary.

Married applicants may take their families at their own expense, in which case all or part of the dollar half of the salary will be paid in pounds sterling while in England.

Those selected will be under no obligation to join either B.I.C.C. or Phillips Electrical Company Limited upon completion of their year in England.

Applicants are requested to forward full details of their education, experience, age, future plans, etc., in writing, by October 15th, 1955, to:

Mr. T. A. Lindsay, President,
Phillips Electrical Company Limited,
P.O. Box 100,
Brockville, Ontario.

PHILLIPS ELECTRICAL COMPANY LIMITED

the Canadian affiliate of the world-wide B.I.C.C. Group

ocated north of Toronto. Established multi-plant manufacturing organization.. Successful applicants will have practical experience background in ground wood pulp or paper mill. May be superintendents or senior production supervisors who have reached a standstill through lack of scope. Chemical or mechanical engineering background desirable. Ages 32 to 45. Sound salary plan and full benefit program. These are permanent challenging positions for men of proven production ability, drive and vision. Excellent opportunity for growth in international expanding organization. Reply giving full details of industrial experience, age, educational background, etc. All serious applications will be acknowledged and treated on a strictly confidential basis. File No. 5291-V.

LES ENGINEER in industrial water treatment department to work in the city of Montreal. We would prefer to have a bilingual man if at all possible, but it is not absolutely necessary that he be able to speak French. File No. 5294-V.

ECHANICAL ENGINEER or engineering physics graduates of 1953, 1954 or 1955. We have an opportunity for an engineer with a desire for a future in sales engineering work in heating, ventilating, air conditioning and power plant equipment. You would take a training program which includes a five months graduate engineering course in sales, research, design, and product engineering in United States, after which you would return to a Branch office of our company in Canada. Your inquiry for further information will be treated as highly confidential. File No. 5298-V.

AINTENANCE SUPERINTENDENT, required in Montreal for large chain of supermarkets. Position requires a qualified mechanical engineer with strong administrative ability and background including refrigeration and electrical installation. File No. 5300-V.

GINEERING REPRESENTATIVE, required by new progressive organization handling a variety of specialized building materials. Company is well represented in Ontario, the Western Provinces and British Columbia. The opening is for the Quebec territory. File No. 5301-V.

VIL OR MECHANICAL ENGINEER, for the engineering staff of a two machine high speed newsprint mill. Applicants should preferably but not necessarily have had some experience in engineering work in the paper industry. Salary commensurate with experience and qualifications. Reply stating age, education, experience, personal particulars, and salary expected to File No. 5302-V.

PLICATIONS ARE INVITED, for the position of Director of The Saskatchewan Research Council. The Director will be responsible for the initiation and supervision of the activities of the Council, including overall direction of a program of laboratory and pilot plant research, and for co-ordination and liaison with research carried on by the University of Saskatchewan, the National Research Council and other agencies. He will be expected to take an active part in the design and planning of a proposed new laboratory which will be located on the campus of the University of Saskatchewan. This laboratory is to operate as a centre of knowledge covering current developments in the utilization of provincial resources and conduct research into methods for their more effective utilization. It will contain within it the present industrial minerals research branch of the department of mineral resources of the Province of Saskatchewan, the office of the Technical Information Service, and administration of research grants-in-aid provided by the Council. File No. 5309-V.

YOUNG ENGINEERS, required for training in the Industrial Engineering Department of a progressive Ontario firm. The men we are looking for have some engineering training and are willing to accept responsibility. There are excellent chances for advancement for men who can develop the ability to deal effectively with all levels of management. Starting salary $4,000 to $5,000, depending on experience and ability. Reply giving full particulars on experience, education and interests. File No. 5312-V.

SALES ENGINEER for vitrified sewer pipe (Western Provinces). Write stating experience and references. Excellent opportunity. File No. 5313-V.

SALES ENGINEER, required, age 25-32, with about 3 years experience, to handle fairly large accounts for company selling industrial finishes to manufacturers such as enamels, lacquers used by paper industry, to work out of Ottawa. File No. 5319-V.

TWO YOUNG GRADUATE ENGINEERS, required in the production study and methods department. Age 23 to 27 years. Applicant should possess a desire to learn new methods, the ability to work with a minimum of supervision, and practical industrial experience. The first nine months of employment would consist of training in the Production Study Section learning labour controls before being transferred to the Production Methods Section. The salary would be based on the experience and qualifications of the applicant. File No. 5320-V.

SALES ENGINEER, chemical, mining, metallurgical or mechanical graduate with some experience. Will be based in Toronto, Ontario. References and reputation most important. This is a large foundry and the position has an excellent future with best possible salary and benefits. File No. 5323-V.

A CANADIAN UNIVERSITY, wishes to receive applications from engineering graduates, preferably civil, mechanical or electrical, under thirty-five years of age, to teach engineering problems and drawing. Applications should give applicants age, university and experience. The salary offered is $2,200 and up for the session depending on qualifications. Might lead to permanent appointment. File No. 5325-V.

OPPORTUNITIES
for
Electrical Engineers and Engineering Physicists
with the
DEFENCE RESEARCH BOARD
at
Valcartier, Quebec; Ottawa, Ontario;
Dartmouth, Nova Scotia

The challenging programme, which offers excellent chance for advancement, includes research on missile control systems, servo-mechanisms, temperature and vibration problems, fire control systems, instrumentation, low frequency and high frequency propogation, radio communication circuits, radar, microwave techniques, and underwater acoustics.

Applications are invited from university graduates (or the equivalent) who are Canadian citizens or British subjects.

Initial salaries range from $3750 to $6400 depending on qualifications and experience.

Modern laboratory facilities and generous employment benefits available.

Write to: Director of Research Personnel,
Defence Research Board,
Daly Bldg., Annex, Mackenzie Ave.,
Ottawa, Ontario.

PLEASE REFER TO 55-DRP-7.

MECHANICAL, CIVIL OR ELECTRICAL ENGINEER, for work in mechanical goods sales division. Company located in Montreal. The job deals with the larger industrial concerns and involves many individual problems that require originality and imagination, together with technical know-how and selling ability. Applicant should be 25 to 35 years of age and anxious to show his ability. File No. 5327-V.

PROVINCE OF NOVA SCOTIA, requires an architect for Department of Public Works. Applicant should be registered or qualified for registration with Nova Scotia Association of Architects. Forms may be obtained by applying to the Civil Service Commission, P.O. Box 943, Halifax, N.S. File No. 5328-V.

CHEMICAL ENGINEER or mechanical engineer with chemical plant experience required for plant development and process improvement in a chemical plant in Toronto. Must have 5-10 years experience in chemical plant operation or maintenance some design or engineering experience desirable. Salary commensurate with ability, pension, health and hospitalization benefits provided. File No. 5329-V.

FACTORY MANAGER REQUIRED to be responsible for all manufacturing and related service activities. He is to be accountable to the President and general manager for quality and economy of the following activities: direction and coordination of all direct manufacturing operations, through a superintendent, including departments as: machine shop, tool room, welding (principally electric), press—for light and medium sheet and plate, assembly, finishing and painting. To direct through a chief engineer, service and modification engineering and product design as required. Applicant should be a graduate mechanical engineer with practical experience in similar manufacturing operations. Age 38-45 years preferred. Should be a leader and co-ordinator with a good cost-consciousness and demonstrated ability in methods improvement. File No. 5336-V.

SALES MANAGER FOR SCIENTIFIC instrument division of international company. Instruments include spectro-photometers, PH meters, goniometers, precision electronic instruments and nucleonic instruments. A general knowledge of application of above equipment plus some experience in sales to industry or research establishments preferred but not essential. Remuneration on salary, bonus and expense arrangement. Location Toronto, periodic travelling throughout Canada necessary. File No. 5337-V.

ENGINEERS REQUIRED for expanding clay products industry in British Columbia and Alberta. Opportunities available in plant engineering, process engineering, production engineering and sales engineering. Please reply stating personal information, experience and qualifications, etc., to File No. 5341-V.

THE UNITED NATIONS TECHNICAL ASSISTANT ADMINISTRATION require candidates for assignments in Turkey, Pakistan and Israel.

1) Petroleum Geologist required October, 1955, for a period of one year. To assist in the organization of the Exploration Department of the Turkish Petroleum Corporation; to direct the exploration of new oil fields; to evaluate previous geological surveys; and to train local geologists. Sound theoretical training in petroleum geology and 10-15 years of field and executive experience with particular emphasis on evaluation of underdeveloped oil fields; experience with limestone reservoirs is also required.

2) Coal miner required for a period of one year, to carry out a detailed survey of the coal mining areas in West Pakistan, to determine the total available reserves of coal and particularly of Deghari and related coal fields in Baluchistan. An expert with extensive practical experience in all phases of soft coal mining, including planning and mechanization of underground surface operations.

3) Phosphate miner required in Israel. Duties to commence October 1st, 1955. The expert will advise on the following matters pertaining to phosphate mining: improvement in size reduction and classification methods, study of gravity separation and flotation possibilities. Training of available chemical engineers in setting up and running of laboratory and pilot equipment on various mineral dressing methods, research on some of the difficulties encountered followed by application of results of such research. The expert should have wide experience in beneficiating phosphate mines of similar constitution. File No. 5344-V.

A MAJOR INDUSTRIAL ORGANIZATION WITH CANADA-wide distribution facilities requires applicants who have all or more of the following classifications. Degree in Engineering, statistics, mathematics or physics; post graduate degree in business administration, statistics or economics; experience in distribution and profit-ability studies or operations research; ability to work efficiently on projects with minimum supervision. Age 25-35, with thorough knowledge of Canadian and U.S. business practices. File No. 5345-V.

PULP AND PAPER MILL executive engineer wanted for full partnership established Pacific Coast Consulting Engineering Firm. No investment required—submit complete qualifications to File No. 5348-V.

CHIEF OPERATOR required for hydro electric power plant. Must have experience, ability to direct and be responsible for operation and maintenance of power plants, dams and equipment. Location Northern Quebec. Full company benefit plan. In reply state age, education, experience, marital status, date available and salary expected to File No. 5353-V.

APPLICATIONS ARE INVITED for a position of assistant professor of engineering at Mount Allison University. Particulars regarding the position may be obtained from the Dean of Science, Mount Allison University, Sackville, N.B. File No. 5356-V.

SENIOR ESTIMATING ENGINEER required in a large manufacturing plant located in Montreal. Applicant must have general experience in heavy mechanical equipment, a broad knowledge of product costs, be energetic and have administrative abilities. Give details of age, education, experience, salary requirements and other relevant information to File No. 5357-V.

RESEARCH HYDRAULIC ENGINEER required for research team studying the forces involved in pulpwood holding grounds, at both model and full scale. Requirements: master's degree in hydraulics engineering, good academic record and ability to work with woods personnel in the field. Apply by resume to File No. 5361-V.

PULP AND PAPER ENGINEER required. Graduate engineer capable of planning and developing complete pulp and paper projects. Must have not less than five years experience in newsprint manufacturing. Summarize experience. Location about 100 miles from Montreal. File No. 5363-V.

SOILS ENGINEER, required by rapidly expanding consulting firm located in Western Canada. Must have a post graduate degree majoring in soils and a minimum of five years experience in related work. State full particulars as to age, experience and salary expected in first letter. File No. 5365-V.

SALES ENGINEER REQUIRED by Canadian transformer manufacturer. Preferably professional engineer with test course training. To be responsible for sales in the Maritime Provinces, reporting to the Montreal office. Drawing account and car mileage allowance provided for business travelling. State age, experience, etc. File No. 5366-V.

(Continued on page 1335)

Required Immediately by a Montreal Firm A PRESIDENT

Thoroughly experienced in the contracting industry, especiolly in the monogement and public relations' ends. Successful candidote should be o man of ability and vision. Preferred age 35-45; must be o Civil Engineering graduate. Solary in five figures plus bonus. File No. 5417-V.

YOUR OPPORTUNITY TO INCREASE EXPERIENCE RESPONSIBILITY SALARY

Continuing progress ond expansion of Dow-Canada's operations have created interesting permonent career opportunities for:

PROCESS ENGINEERS

Initially these two young Chemical Engineers will be assigned process evoluation and/or development problems and will do trouble shooting in the process plants*. This on-the-job training will lead to Production Supervision, Technicol Sales or Service or Technicol Administration, etc. (Locoted in Sornia)

*Ethylene, Chlorine, Caustic, Styrene, Polystyrene, Latex, Glycol, Solvents or Ammonio.

SALES ENGINEERS

Two Engineers with a floir for selling and with some sales experience in a process industry will be given the opportunity to combine technical training with interesting customer contoct. (Initially located in Toronto or Montreol)

One young Metallurgicol, Mechanical or Chemicol Engineer with the aggressiveness to develop o national market in the light metal industry. (Located in Toronto)

PROJECT ENGINEER

With 2 to 5 years mechanical design experience in o process industry. This position would provide the opportunities to handle major prospects in oll aspects and to see the project actually built in the field. (Locoted in Sarnia)

ELECTRICAL ENGINEER

A recent graduate now in a norrow field but who wonts broad experience in the design, instollation and operation of heavy power distributing equipment.

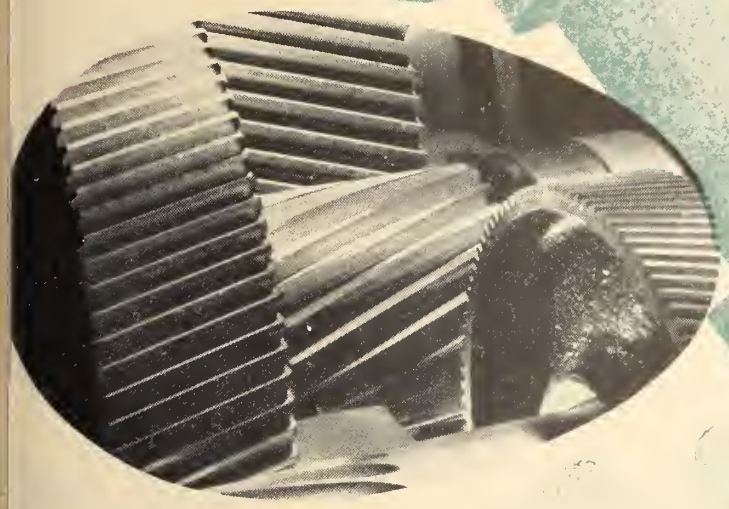
SALES TRAINEE

After extensive training in Canado ond U.S. these two trainees will be given permanent assignments as field representatives. (Initially locoted in Toronto)

To arrange on interview, write to our Generol Soles Service Manager in Toronto (Mr. T. Chombers, 600 University Ave.) or our Personnel Supervisor in Sornio (Mr. L. Pressnail, P.O. Box 1012, Sornio)

DOW CHEMICAL OF CANADA, LIMITED

Atlas alloy production steels



are born in the electric furnace

That's important, because it means more reliable products than similar steels produced by other methods. Where pennies mean profit, wise Canadian buyers insist on Atlas high quality SAE, AISI, MILS, ANQQS, AMS and other alloy production steels of these types.

The reasons: close tolerance bars, uniform hardenability, good machinability, fewer rejected pieces or parts, and—of course—prompt delivery.

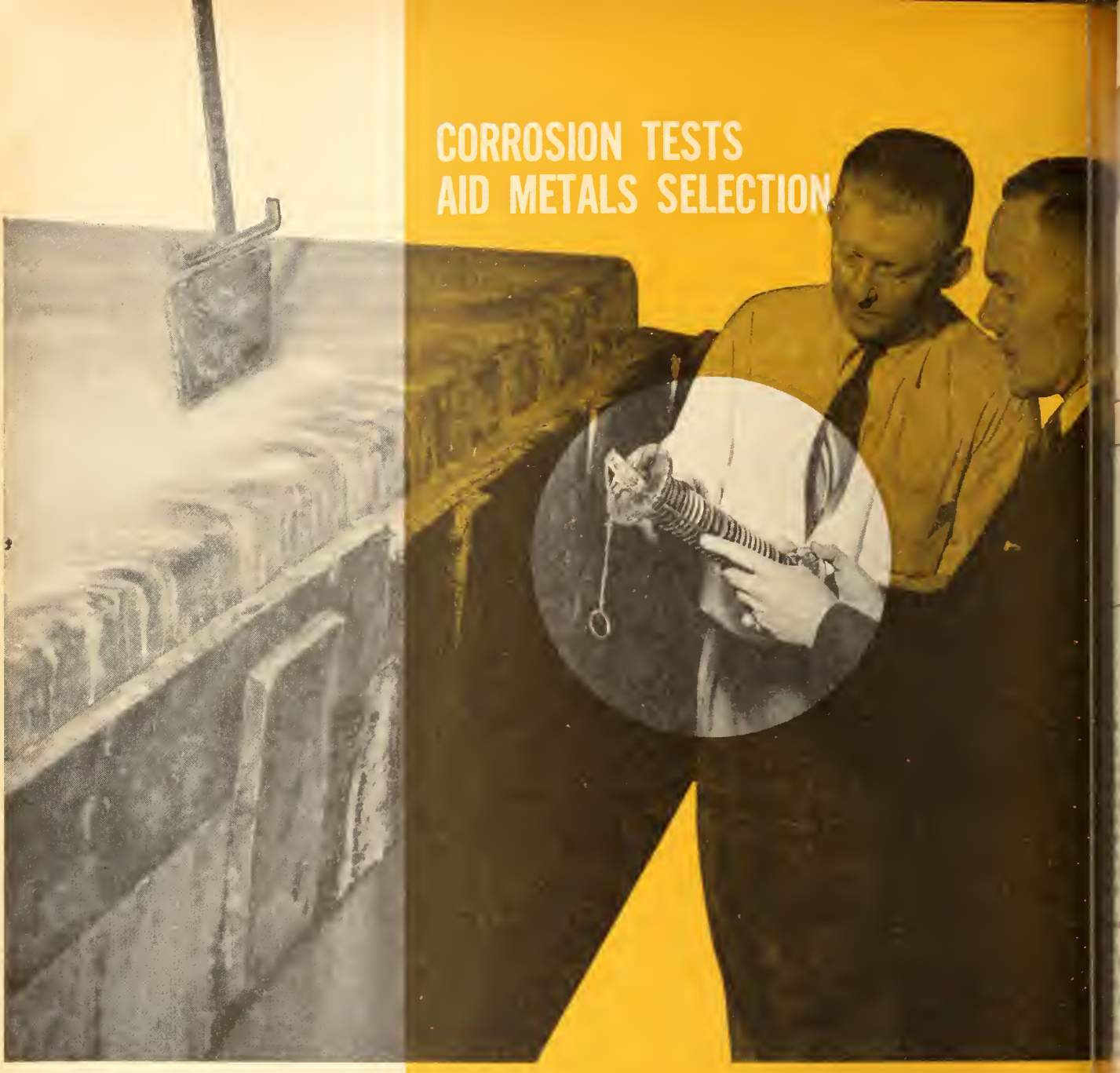
Just one of the extras you get when you buy

ATLAS STEELS LIMITED—WELLAND, ONTARIO

Warehouses: Montreal • Toronto • Hamilton • Windsor • Winnipeg • Vancouver
Agents Throughout The World

TS 10-55

CORROSION TESTS AID METALS SELECTION



Corrosian test spool is examined by plant supervisar and INCO Research Engineer ot Ontario Paper Campany, Thorold, Ontario.

Let INCO be of service* to yo

The above picture shows an INCO test spool which contains a variety of metals and alloys for testing under actual conditions of projected use. Over many years, INCO has made thousands of "on the job" corrosion tests to determine which alloy or metal is best suited for the particular job. This type of close co-operation enables INCO to put its facilities, personnel and experience to the best use in helping Canadian industry. If you have a met problem . . . let the information and experience available at INCO be of service to you.

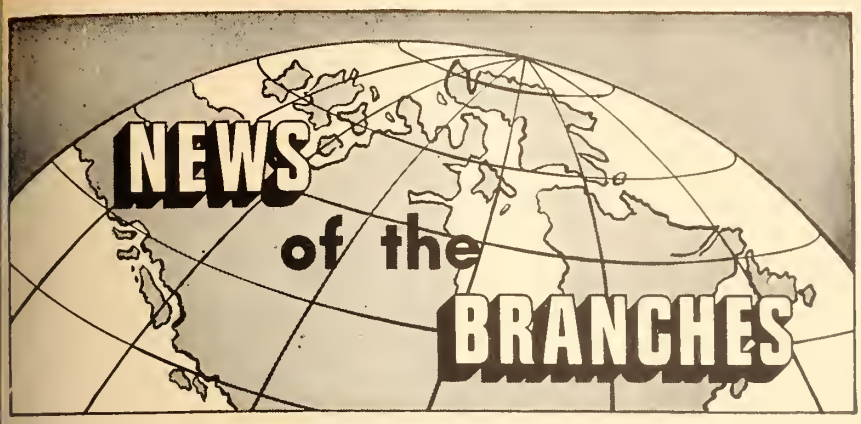
**Information involving corrosion, fabrication, fou problems, high and low temperature service and me selection.*

EMBLEM OF INCO SERVICE TRADE MARK

INCO SERVICE GOES WITH INCO NICKEL

DEVELOPMENT AND RESEARCH DIVISION

THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED, 25 KING ST. W., TOR



Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Saguenay

C. C. Louttit, Jr.E.I.C.,
Secretary-Treasurer

Joint Annual Meeting

The annual meetings of the Saguenay Branch, its Junior Section, and the Corporation of Professional Engineers of Quebec, were held jointly on May 31 in the Saguenay Inn, Arvida, with 40 members present. F. A. Dagg, chairman of the Saguenay Branch of the Institute and the Saguenay Chapter of the Corporation, presided.

Junior Section

Mr. Dagg turned the chair over to W. W. Robertson, chairman of the Junior Section. R. V. Norman presented the Junior Section's secretary's report after which H. Baker presented the treasurer's report. The reading of these reports was followed by the election of officers for the season 1955-56 who were: M. Gilbert, chairman; R. N. Norman, vice chairman; H. J. Baker, secretary; R. A. Alexander, treasurer; and J. Furlong, committee member.

Mr. Robertson said that it was becoming increasingly more difficult to find Juniors willing to address a meeting. Consequently, more emphasis would be placed on the study groups as a means of developing the young engineer. The past year's courses were successful and it was hoped that a greater number of groups could be started in the coming season.

Saguenay Branch

Mr. Dagg resumed the chair for the transaction of Saguenay Branch business. After the reading of the secretary's and treasurer's reports by C. C. Louttit, H. R. Fee, past Branch councillor, reported on the activities of Council during the year. He summed up briefly what action had been taken on all the major issues before Council. Mr. Fee's term as Branch councillor expired in May and he expressed his appreciaton for having been given the privilege of serving in this capacity. The membership showed their appreciation of Mr. Fee's work by a hearty round of applause.

A. C. MacNab, chairman of the Nominating Committee, read the scrutineer's report covering the election ballot as follows: A. H. Johnston, chairman; C. C. Louttit, vice chairman; F. A. Brown, L. D. Laventure and D. Stairs, committee members for a two-year term; and H. C. Perreault, committee member for a one-year term. Remaining on the executive with one year to serve as committee members are J. S. Taylor and O. S. Gislason.

C.P.E.Q.

The meeting then proceeded to the business of the Corporation. The secretary's and treasurer's reports were read by C. C. Louttit after which he was thanked by Mr. Fee for his work as secretary-treasurer of both organizations. The chairman of the Nominating Committee, Mr. MacNab, then read the scrutineer's report covering the election ballots as listed above.

In his remarks Chairman F. A. Dagg mentioned that this was the close of one season's joint activites and the start of the second such year. He was proud to be associated with such an endeavour which was so well supported by the majority of the membership. Under the chairmanship of A. H. Johnston there had been a good number of meetings, mostly non-technical in nature. These were very successful with attendances ranging between 35 and 70. The Membership Committee of Messrs. Bilodeau and Gislason did very good work which was not reflected in the figures for membership due to the number of transfers from the area. The field Trip Committee of Messrs. Campbell and Boisvert organized a visit to the small industries in the Chicoutimi area last fall. A second trip scheduled for May had to be postponed until fall. The Entertainment Committee of Messrs. Taylor and Laventure organized two successful dances, and attended as well to the details of supplying the refreshments at the regular meetings.

Mr. Dagg thanked H. R. Fee, E.I.C. Branch councillor, and L. Simard, C.P.E.Q. regional representative, for the great amount of work they had done for the parent organizations and the local sections. He expressed his own appreciation for the privilege of serving as chairman of the local section, and turned the meeting over to A. H. Johnston, who moved a vote of thanks to Mr. Dagg which the membership seconded by a round of applause. The meeting was then adjourned and coffee and sandwiches were served.

Sarnia

K. E. Bentley, M.E.I.C.,
Secretary-Treasurer
J. H. Douglas, M.E.I.C.,
Branch News Editor

International Day with Michigan Engineers

The Michigan Society of Professional Engineers held their annual meetings

(*Continued on page 1335*)

Second Annual

PROFESSIONAL ENGINEERS' BALL

sponsored by

Niagara Peninsula Branch of the E.I.C.,
Niagara Chapter of the Association of Professional Engineers of the Province of Ontario

FRIDAY, OCTOBER 7th, 1955

at the

Hotel Sheraton-Brock, Niagara Falls, Ontario

DINNER 7:00 p.m. — **DANCE 9:00 p.m. to 1:00 a.m.**

Dress Optional — **Music by "The Solidaires"**

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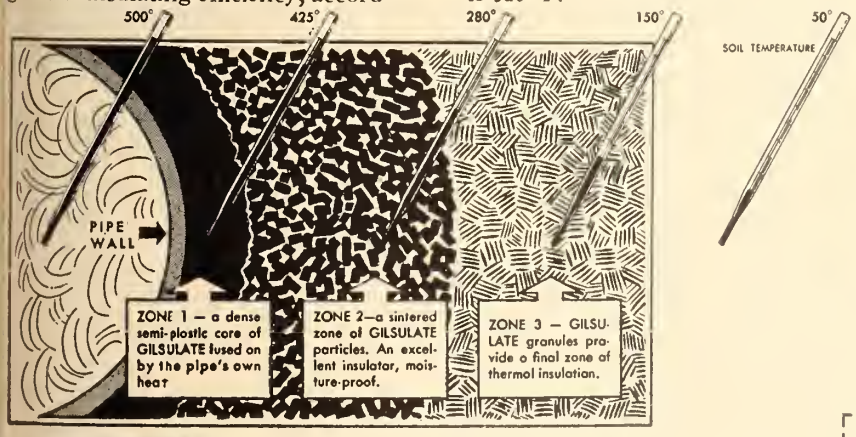

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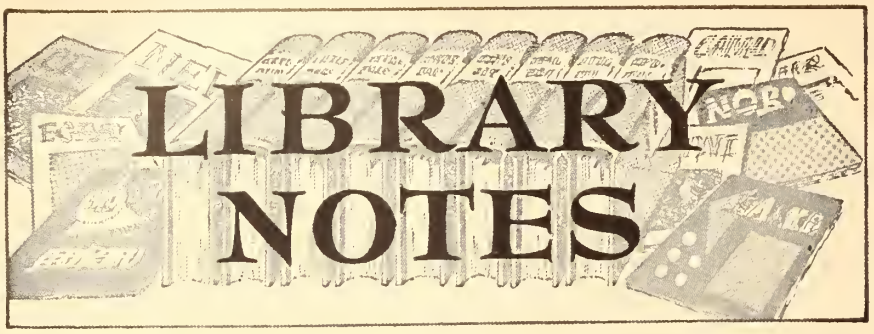

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Canadian trade index, 1955. Toronto, Canadian manufacturers' assoc., 1955. 1119 pp., $7.50.

Fraser's Canadian trade directory, 1955. Montreal, Fraser, 1955. 2 vols., $6.00.

Both the Canadian Trade Index and Fraser's Canadian Trade Directory contain the same type of material, and in both the largest part of the book is devoted to a classified directory of products manufactured in Canada, and the firms manufacturing them. They also both contain an aphabetical list of manufacturers in Canada.

In the classified section all types of product are included, except that Fraser's does not include textile or leather products as these are covered in separate directories. Strangely enough, the firms listed under the different products vary considerably, and Fraser's includes not only manufacturers but also wholesalers and agents in some cases, and foreign firms advertising in the Directory.

In the alphabetical list of manufacturers, the Canadian Trade Index includes foreign representatives, if any, and the trade names of each firm. Fraser's devotes a complete section to trade names, listing them alphabetically.

Both directories contain a considerable amount of advertising, and in both cases this is indexed.

In addition to the above material both contain lists of Canadian trade commissioners and foreign commercial representatives in Canada. Fraser's has an additional section listing such things as Canadian chambers of commerce, banks, power stations, transportation companies, etc., and towns and cities having a population of over fifteen hundred. This same directory also lists foreign manufacturers represented in Canada.

These two trade directories supplement each other, and both are essential on the reference shelf of any library.

S. C.

LIBRARY REGULATIONS

Hours

Mon.-Fri.	9 a.m.-5 p.m.
Saturday	9 a.m.-12 noon

Bibliography and Reference Service

Short subject bibliographies are compiled on request. When placing these requests, please give as much detail and background information as possible.

Borrowing

Books, periodicals, pamphlets and films may be borrowed for two weeks at a time. All books included in the Library Notes Section of *The Engineering Journal* are available for loan. **A fine of 25c per day is charged for each day borrowed items are retained beyond the two-week period.**

A library deposit of $5.00 at par in Montreal is required, for which two items may be borrowed at a time. Temporary deposits (30 days or less) $10.00. Books are sent anywhere in Canada, and carrying charges are payable by the member concerned.

Ordering

Any book or pamphlet may be ordered through the library. All publications of affiliated societies, whether books, pamphlets, or periodicals, should be ordered through the library, as reduced rates are applicable on these to all members. Except in the case of library deposits **please make no payments in advance.** Non-members may consult the library, but may not borrow material. Please address all requests to **The Library.**

BOOK NOTES*

Prepared by the Library The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

***Air conditioning, refrigerating data book, applications volume,** 5th ed., New York, American Society of Refrigerating Engineers, 1955. Various paging, $7.50.

Sixty-one chapters on the art and science of refrigeration are grouped in eight divisions covering frozen foods; food industries; warehouse practice; food distribution; low temperature applications; industrial applications; comfort air conditioning; and industrial air conditioning. The chapters on fishing boats, precooling, and passenger automobiles are new, and a number of chapters have been extensively revised.

American radio relay league antenna book, 7th ed. West Hartford, The League, 1955. 306 pp., illus., $2.25 (U.S.)

The seventh edition contains the latest accurate information on antenna theory, design and construction, and is intended for the amateur. There are many diagrams and illustrations, and a bibliography of further reading on antennas and transmission lines is included.

Atomic energy research at Harwell. K. E. B. Jay. Ottawa, United Kingdom Information Office, 1955. 144 pp. illus., $1.25.

This report continues the story of the Atomic Energy Research Establishment from 1952 to the formation of the United Kingdom Atomic Energy Authority in August, 1954. The earlier report covering 1946-1951 is also available in the library.

The first section of the report is written primarily for the non-technical reader and covers the main programmes of the Establishment, whilst the second, more technical section deals with research in the physics, metallurgy chemistry and chemical engineering sections. A short glossary of technical terms is also included.

Basic theory in electrical engineering. R. G. Kloeffler and E. L. Sitz. Toronto, Macmillan, 1955. 334 pp., illus., $5.50.

Written for the student at the sophomore level this text covers the basic material in the electric and magnetic circuits and in electrostatics, but gives only brief reference to electronics and alternating-current circuits. The mks system is used throughout the book except in the section on magnetic circuits where both the mks and the English systems are covered. Among the theories discussed are the latest on semi-conductors and ferromagnetism and in the final chapter on electromagnetic waves an introduction is given to Maxwell's equations and wave theory. Other chapters cover generated and induced voltages and miscellaneous voltage sources and electrolysis.

Britain; an official handbook, 1955. Ottawa, United Kingdom Information Office, 1955. 438 pp., illus., $2.00 cloth $1.40 paper.

This 1955 edition has been enlarged

How many bottlenecks do you have?

HOW MANY valves are involved in your plant operation? How many are really dependable? Actually it's here in the piping where many a production bottleneck hides. And it isn't just the major breakdowns that affect your production. Those little but frequent shut-downs for maintenance mean a down machine here, a slowed-up operation there—important losses when you add them up.

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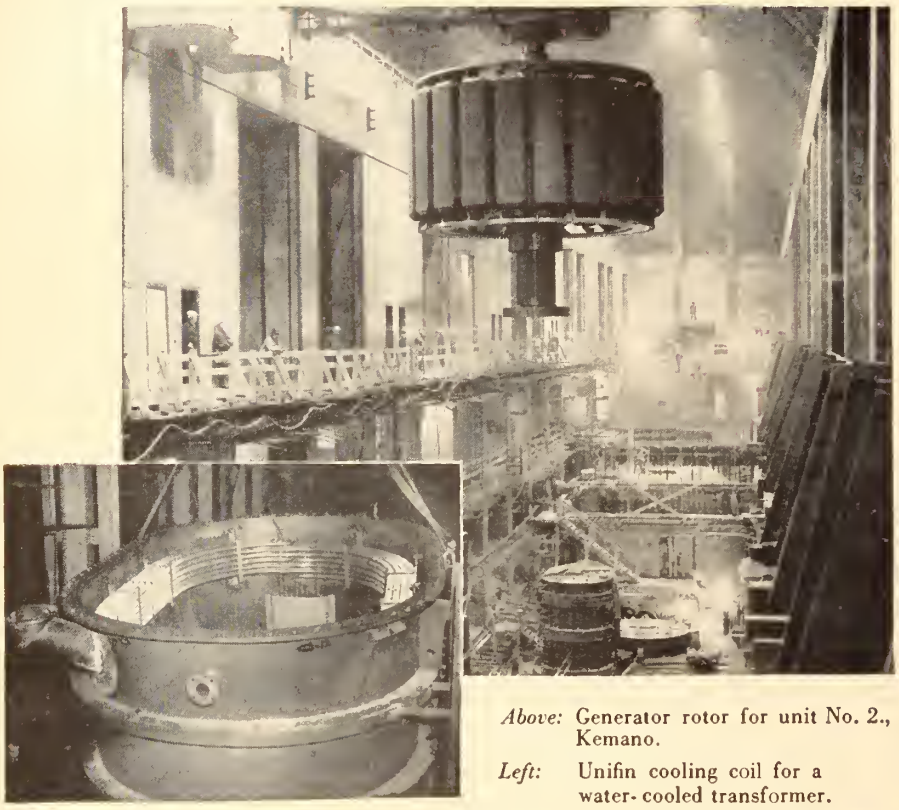

Above: Generator rotor for unit No. 2., Kemano.

Left: Unifin cooling coil for a water-cooled transformer.

To a major extent, the heat transfer equipment at Alcan's Kitimat-Kemano project incorporates Unifin integral finned tubing.

Heavy duty air cooling units built with Unifin "Copperline" — the aluminum integral finned tube with a seamless copper liner — have been installed in the two 140,000 h.p. Canadian-made water wheel hydro-electric generators, to remove 7,500,000 btu/hr. from each. In the majority of the 71,000 KVA transformers, the shell and tube heat exchangers employ Unifin Type S/T ("Lo-Fin") all copper tubing . . . to produce greatest cooling efficiency, in the most compact manner, at the lowest cost.

In the original preparation of the site, numerous portable compressors fitted with Unifin "Copperline" inter-stage coolers gave long, reliable service in conditions of extreme vibration — and in addition, Unifin Blast Heating Coils are installed in various heating and ventilating systems throughout the project.

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• Library Notes

and revised, and now contains illustrations and more maps and diagrams than previously. It has also been reset in more legible type.

The handbook covers such topics as government, defence, national economy, trade and industry, transport, social welfare, housing and religion. It is a valuable source of information on Britain, and also contains a thirty page list of material for further reading.

British engineers' association. Classified handbook of members and their manufactures, 1955. London, The Association, 1955. 737 pp.

This latest edition of the B.E.A. handbook includes the same types of valuable information as in previous years. The first section contains an alphabetical list of members, their manufactures and overseas representatives. Another large section is a classified list of manufactures, with French, German, Portuguese and Spanish keys.

The Handbook will prove very useful to all those concerned with trade with Britain.

Causalités et accidents de la découverte scientifique. R. Taton. Paris, Masson, 1955. 171 pp., illus., 980 fr.

One of a series on the evolution of science, this book discusses the different fields of scientific discovery, its principal factors and various aspects.

The author covers three fields, mathematics, theoretical sciences, and sciences involving observation and experimentation. In the section on the factors involved in discovery the author considers methodical research, inspiration and the roles of chance and error. Later he discusses originality, incomplete discoveries, and unorthodox methods.

His examples are drawn from all epochs, ranging from Archimedes to the present. There are name and subject indices, and many illustrations.

Coastal engineering. Proceedings of the fifth conference on coastal engineering, September 1954. J. W. Johnson, ed. Berkeley, Council on wave research. 1955. 669 pp., illus. $7.50 (U.S.)

Many problems of coastal engineering are dealt with in this compilation of papers. The topics are grouped under four main subjects which are: Theoretical and observed wave characteristics; Field and laboratory instruments and equipment; Coastal sediment problems and Design and construction of coastal works. Some of the titles of individual papers include Harmonics of a wave, Le régime de la rade de Tanger, Fundamentals of coast erosion and defence, Reconstruction de la digue de l'est à Dunkerque and Bitumen in coastal engineering.

Papers are written in either English or French with resumes provided in the second language as the case may be. There is no index to supplement the table of contents.

***Depreciation.** E. L. Grant and P. T. Norton, Jr. New York, Ronald Press, 1955. 504 pp., $7.50 (U.S.)

This comprehensive manual for engineers, accountants, and industrial managers deals with depreciation from the

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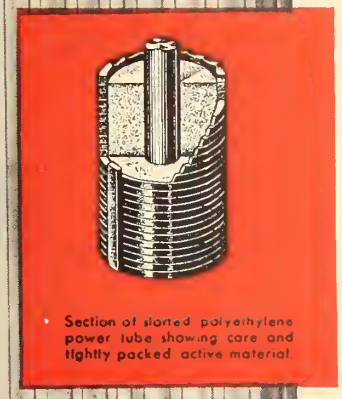

Section of slotted polyethylene power tube showing core and tightly packed active material

Polyethylene end-sealers hold active material in power tubes permanently

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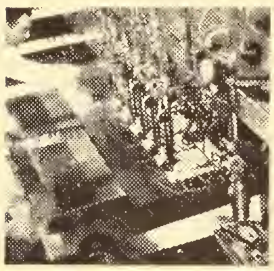

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• Library Notes

point of view of accounting and income taxes, and with the uses and limitations of depreciation account figures as a guide to decisions on business problems. The revised printing includes a new chapter on the U.S. Internal Revenue Act of 1954 as it affects the rules governing depreciation tax practice.

Electrical characteristics of overhead lines. S. Butterworth. Leatherhead, Surrey, British electrical and allied industries research association, 1954. 238 pp., figs., £2-2-0 (abridged version: 20 pp., 15/-.)

Both the full length text and the abridged version are now in this library, the latter consisting mainly of alignment charts with a minimum of explanation or expansion. From these charts magnitudes can quickly be read from a straight edge. The book refers to British practice in this field. Essentially the report is a presentation of the theoretical considerations which decide the electrical characteristics of overhead power lines, and of the practical estimation and application of these characteristics. Among the subjects dealt with are resistance of transmission lines, inductance and reactance of single-phase transmission lines, characteristics of three-phase transmission lines with balanced currents and voltages, corona and corona losses, multiple conductor systems, and voltage regulation.

Elementary engineering mechanics. J. B. Thirlwell. London, Macdonald, 1955. 126 pp., diagrs., 10/6.

While primarily a textbook of mechanics, this work is directed towards students of instruments and horology and is intended to give an introduction to the subject without resort to complicated mathematics.

Chapters are supplemented by problems. Since these are intended to supplement the text in a field familiar to the reader, special effort has been made to include examples where dimensions are small and some are chosen directly from the domain of clocks and watches.

Elementary volumetric analysis. Arthur Atkinson. Toronto, Longmans, Green, 1955. 56 pp., 40c.

This is an elementary treatment of the subject which assumes no previous knowledge of the principles and practice of volumetric analysis.

F-M limiters and detectors. Alexander Schure. New York, Rider, 1955. 4 pp., illus., 90c (U.S.)

This book presents a discussion of the f-m detector beginning with a vectorial explanation of the discriminator and gives a thorough treatment of limiters.

Fishing boats of the world. Jan-Olof Traung, ed. London, A. J. Heighway; Rome, Food and agriculture organization of the United Nations, 1955. 575 pp., illus., $12.50.

The papers in this book were originally given at the 1953 FAO International Fishing Boat Congress. The authors, drawn from all over the world, are all experts in various aspects of fishing boat design, construction, powering and equipment.

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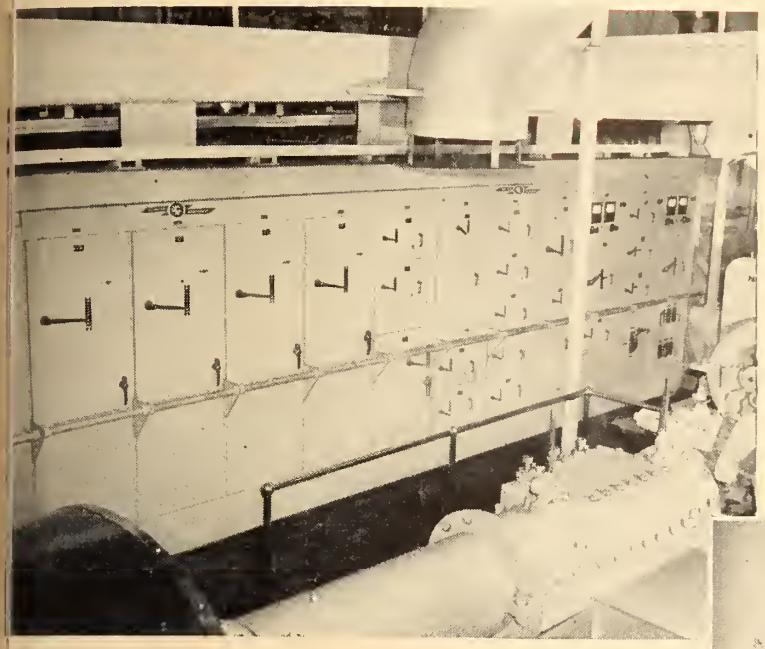

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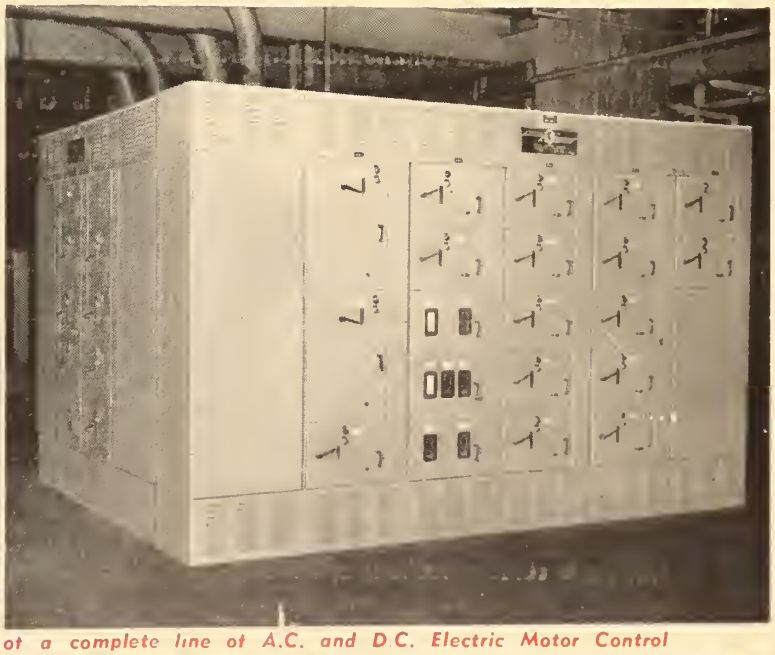

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The FAO has edited the papers for publication, and has included the discussions which were provoked, and which in fact take up a good part of the book.

The material is divided into four sections; boat types, naval architecture, engineering ,and factory ships. There are many illustrations, and a list of references and an index add to the value of this comprehensive work which will be of interest to all connected in any way with the fishing industry.

***Gas turbine principles and practice.** H. R. Cox, ed. Toronto, British Book Service, 1955. Various paging, illus. $18.00.

A comprehensive survey of thermodynamic principles, constructional features, and operating characteristics of the important types of gas turbines. The thirty sections, prepared by twenty-four specialists, cover a wide range of subjects including compressors, axial and radial turbines, materials, fuels, heat exchangers, and special problems encountered in the use of gas turbines in aircraft, marine engineering, transport, and industry. The book is intended for engineers, designers, and students specializing in gas turbine engineering.

Grundbau-Taschenbuch. W. Bernatzik and others. Berlin, Ernst, 1955. 2 vols. illus., DM85.

Written by some twenty-five experts in the field, this handbook on foundations and underpinning is divided into two volumes.

The first section of volume one deals with soil mechanics and calculations for foundations, the second part covers the materials and forms used in foundations while the third discusses actual construction. There are diagrams, tables and worked examples included in the text as well as references, mostly German, for further reading at the ends of the chapters.

Volume two contains all the German standards applicable to foundation work.

Handbook of 630-type TV receivers. S. S. Miller and Howard Bierman. New York, Rider, 1955. 194 pp., diagrs., $3.50 (U.S.).

This handbook, designed primarily for service technicians working on receivers, sets forth the "whys" and "hows" of each of the original 630-type receiver sections and their modifications and improvements to date.

***How to estimate for the building trades,** 2nd ed. Gilbert Townsend, A. R. Dalzell and James McKinney. Chicago, American technical society; Toronto, General, 1955. 699 pp., illus. $6.75 (U.S.).

This practical manual for the estimator, contractor, and builder deals with techniques used in estimating material and labor for residences and small buildings. To provide the necessary background, the practices of each of the various building trades are described and information on plan reading, relevant mathematics, specifications, and contracts is included.

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• Library Notes

Hydraulic operation and control of machines. Ian McNeil, London, Thames and Hudson, 1954. 324 pp., illus., 35/-.

Mechanical engineers, in particular, will be interested in this new volume which is concerned mainly with the practical applications of hydraulic equipment to machinery. This practical treatment of hydraulics and the frequent reference to actual machines and devices are welcome departures from the usual text on the subject. The book is comprehensive and up-to-date and stresses future trends.

Among the subjects which are fully treated are hydraulic packing, fluid media and the care and maintenance of hydraulic plant. The author includes valuable information on the relative merits and operating costs of the various types of hydraulic drives. He also discusses pumps and motors, valves and circuits, accumulators, intensifiers, and power saving devices, and hydrokinetic power transmission, as well as forging presses, extrusion machines, machine tools, and use of hydraulic power in mining, agriculture, aeronautics, and marine engineering.

* **International association for bridge and structural engineering, publications.** v. 14, 1954. Zurich, Verlag Leeman, 1954. 318 pp., paper. Sw. Frs. 38.00.

Seven English, three French, and fou German papers covering a variety topics in the theory and practice bridge and structural engineering. Son representative subjects treated are th following: effects of variable repeate loads in structures designed by the pla tic theory; statistical calculations of th strength of reinforced concrete beam suspension bridges — the aerodynam problem; and the theory of fatigu strength. Summaries are given in th three languages. None of the papers h previously been published.

Introduction to nuclear engineerin Richard Stephenson. Toronto, M Graw-Hill, 1954. 387 pp., illus., $9.7

The field of nuclear engineering h reached the stage where further develo ment of nuclear energy will fall mo within the province of the engine Because of this fact the present te is an introductory survey of the nucle energy field for engineers who ha taken conventional engineering cours and are familiar with elementary nucl physics.

The ten chapters include a brief v view of nuclear physics then go on discuss nuclear fission, the nuclear cha reactor, reactor theory, radiation shiel ing, materials of construction, react instrumentation and control, the separ tion of stable isotopes, chemical separ tions and processing and special tec niques of nuclear engineering.

While the book contains only u classified material most of the fund mental engineering principles have be released.

Lake Superior milling practice: technical history of a century copper milling. C. H. Benedi Houghton, Mich., Michigan college mining & technology press, 1955. 1 pp., illus., $3.00 (U.S.).

More than a century of copper milli practice in this section of the Unit States is here described by a man w played a leading role in the last h of the period. In his book he descrit the technical advances in copper pr duction, the way milling problems w met and solved, and how scienti methods replaced trial and error. Begi ning with the treatment of mass copp it follows the development of the stea stamp, fine grinding processes, reclam tion, flotation, and leaching. Significa Lake Superior mills and machinery a described and illustrated.

Lignes électriques t.h.t.; études méc nique et construction des lign aeriennes. H. Carpentier. Par Eyrolles, 1955. 250 pp., illus., 4,800

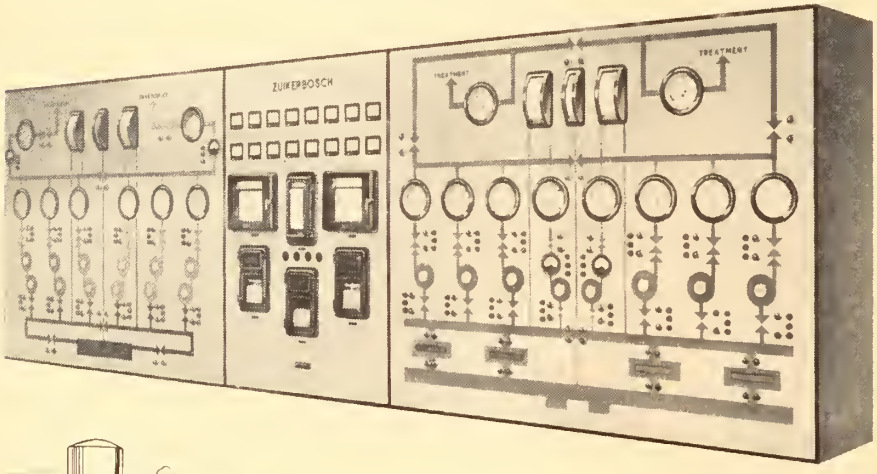
Awarded the first prize for a tec nical book by the Fédération nationa des Travaux Publics, this book is c cerned with very high voltage pow transmission lines, including both t actual construction of the lines, a the background knowledge required.

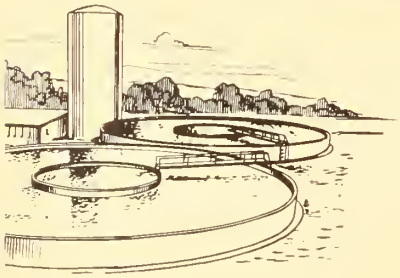
Amongst the topics covered are ro ing, foundations, cost estimates, act construction, and site supervision.

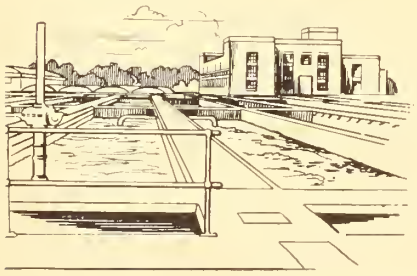
The author includes many numeric worked examples, and there are ma photographs and folded charts and d grams. There is a twenty-page bibl graphy listing French, English and G man periodical articles and books.

This well-written and well-produc book will be of interest to many our members.

From a Drop of Water to a Central Power Station







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Magnetic materials in the electrical industry. P. R. Bardell. London, Macdonald, 1955. 288 pp., illus., 32/6.

This book has been issued to help electrical engineers and others to a better understanding of the properties of the large number of magnetic materials now available. A glossary of terms and units has been included and a note explaining magnetic terminology and units added in order to assist the reader in the comprehension of complex details. Trade names are given in italics in the index and references are conveniently listed at the ends of chapters.

There are discussions of the historical development, application and testing of permanent magnets and of soft magnetic materials. Chapters are devoted to special devices such as sound recorders, non-destructive testers, transductors and transducers.

Metal industry handbook and directory, 1955. London, Cassier, 1955. 472 pp., 15/-.

This standard reference work is divided into four sections: the general properties of metals and alloys; general data and tables, covering temperatures, weights, hardness, and prices of metals, etc.; electroplating; and a directory of metal trade associations, scientific and technical institutions, directory for buyers, list of addresses, and trade names.

This list of trade names is a new feature with this edition. Another addition is the standard classification of non-ferrous scrap.

Newfoundland year book and business directory, 2nd ed. St. John's, Guardian, 1955. 176 pp., $3.50.

A good many of the questions anyone might ask about Newfoundland could be answered by this year book.

How many people live at Joe Batt's Arm? What types of stores are there in Corner Brook? Who runs taxis in St. John's? How many goats in the province? Who is the Chairman of the Newfoundland Fisheries Board? What labour unions are there?

All this information, and much more, is contained in this very interesting year book and business directory.

Pluie, évaporation, filtration et écoulement. Société hydrotechnique de France. Grenoble, La Houille Blanche, 1955. 316 pp., illus., 4,000 fr.

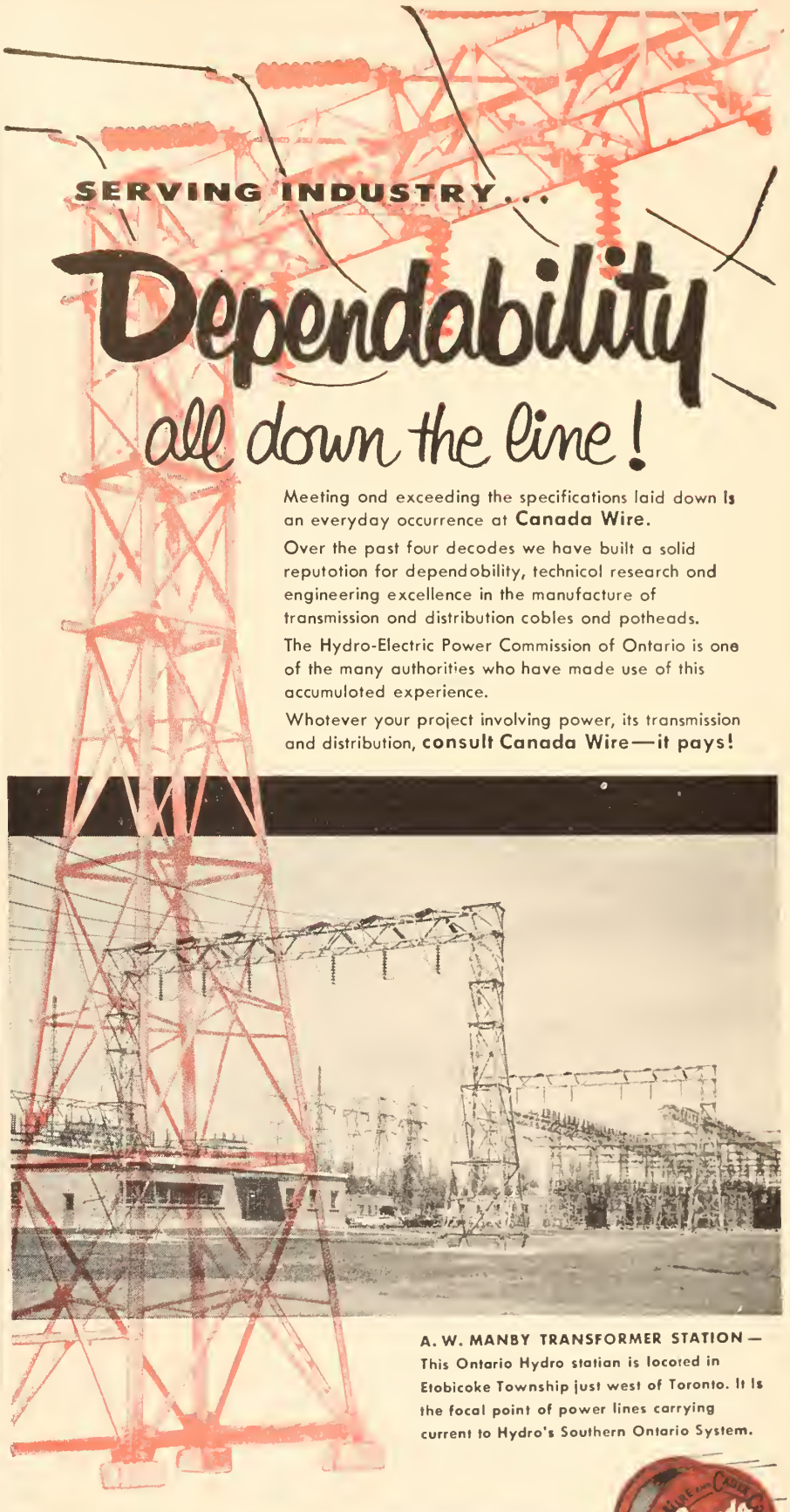
The papers reproduced in this volume were originally presented at a hydraulics conference held in Algiers in 1954.

Subjects covered include rainfall measurement, stream gauging stations, water evaporation, underground watercourses, water tables, soil permeability, and characteristics. Some of the papers relate to specific areas and locations, whilst others are of a more general nature.

English summaries are given of all the papers, the majority of which are illustrated with diagrams, tables, charts, maps, etc.

Practical electroacoustics. Michael Rettinger. New York, Chemical publishing, 1955. 271 pp., illus., $10.00 (U.S.)

In this book engineering information on electroacoustics is presented in the light of recent developments. The mod-



• Library Notes

ern methods and devices discussed are those in use in radio, sound-film recording, and allied arts.

This work gives a detailed analysis and description of audio-communication equipment, such as microphones, moving-coil loudspeakers, mixers, magnetic recording devices, and their construction and testing. It also deals with related subjects, such as crossover networks, attenuators, magnets, vibration isolation, studio construction, home acoustics, measurement of sound-absorbing materials, etc.

Principles of management. Harold Koontz and Cyril O'Donnell. Toronto, McGraw-Hill, 1955. 664 pp., $7.95.

Intended for both students and those actively engaged in all areas of management, this text analyzes and explains the principles and techniques of management, and presents the general theory of management.

The five sections of the book correspond to the authors' conception of the five functions of managers; organization, staffing, direction and planning and controlling. The authors stress that these functions are the same at all levels of management, from the top executive to the lowest supervisor.

The authors have drawn on their own experience and that of others, and the book should prove a useful addition to the literature on the field of management.

Process control. A. J. Young. Pittsburgh, Instruments publishing company, 1954. 132 pp., illus., $2.00 (U.S.)

Since the greater part of this book first appeared in the British publication, Industrial Chemist, the terminology used is that recommended in the British standard covering this subject. In order to clarify explanations the frequency-response approach was adopted.

The book explains the basic principles, without using advanced mathematics, of the plant control problem, the operation of closed-loop control systems, the modes of control, the types of controller available, and the causes and effects of the time lag. It also covers such commercially available controllers as pneumatic, electrical, electronic, electro-pneumatic, and mechanical types, including those of American, British, and German manufacture.

***Protective coatings for metals,** 2nd ed. R. M. Burns and W. W. Bradley. New York, Reinhold, 1955. 643 pp., illus., $12.00 (U.S.)

The composition, properties, and performance of both metallic and organic coatings are treated in relation to the solution of protection problems, with only brief consideration given to the production of coatings. The eighteen chapters provide comprehensive coverage of the entire field of coating technology, including surface preparation, sprayed metal coatings, methods of test, corrosion and inhibitors, and a wide range of materials and applications. This edition has been largely rewritten. An author index to the extensive bibliographical footnotes is provided.

Radio and television engineers' reference book. E. Molloy and W. E. Pannett, eds. Toronto, British Book Service, 1954. Various paging, illus. $12.00.

SUBSCRIPTIONS

Members are reminded that they can obtain reduced subscription rates to publications of certain other engineering societies only if their order is placed through the library. Orders should not be sent directly to the publishers.

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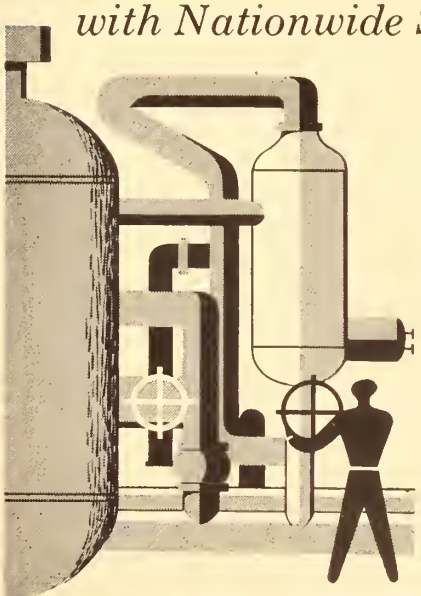

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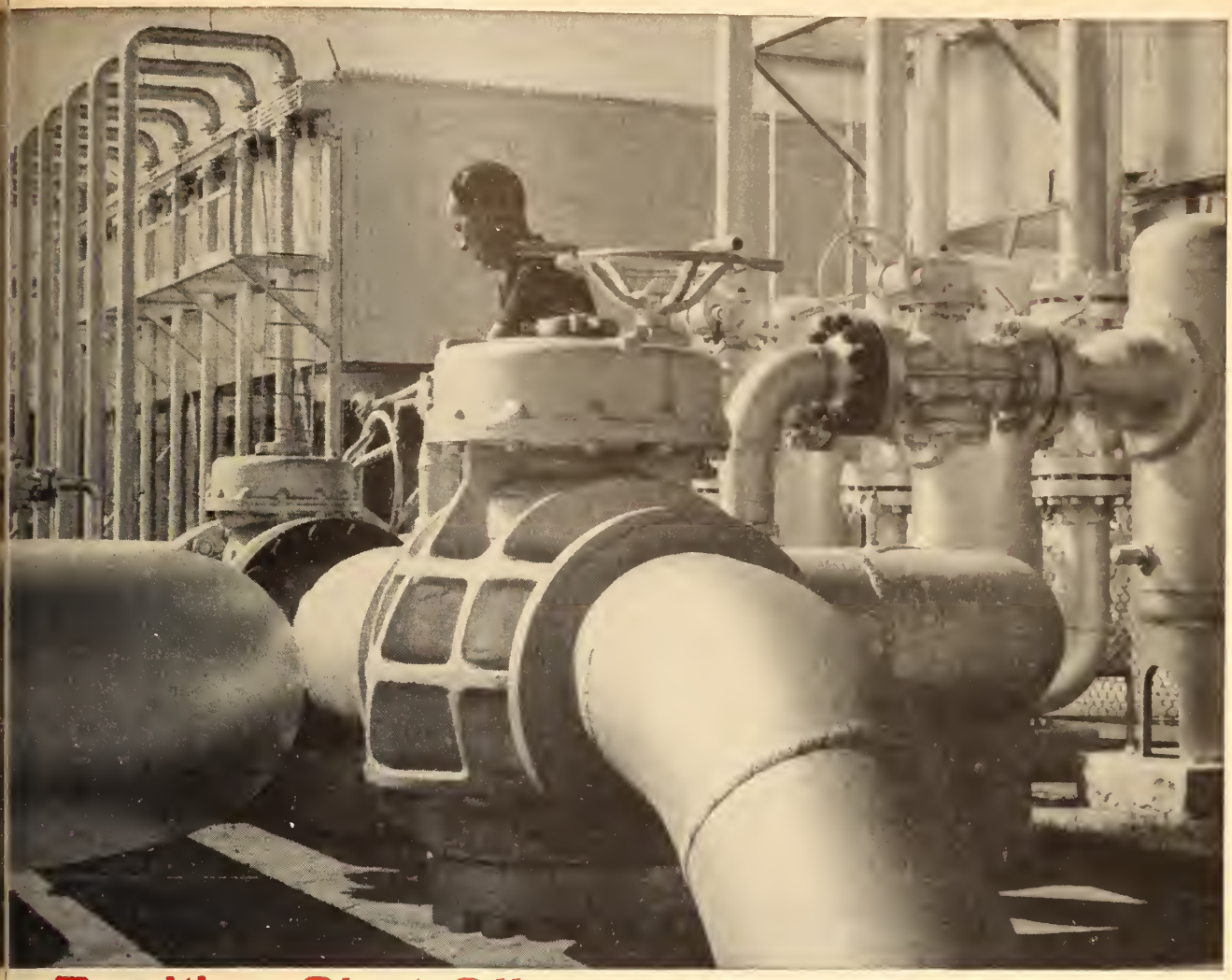

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This reference book has been written for engineers, technicians and amateurs who design, operate, maintain, service or sell radio and television equipment. It is divided into forty-five sections, each written by a specialist, with the emphasis on practical information.

Some of the topics covered include optics and electron optics, studios, transmitters, receivers, radar, microphones, etc. There is a detailed table of contents and a comprehensive index.

***Reinforced concrete arch design,** 2nd ed. G. P. Manning. Toronto, Pitman, 1954. 192 pp., 30/-.

This presentation of a method for calculating the most economical shape and thickness of an arch gives values for influence lines for a wide range of arches of different shapes and thicknesses. In general, the slope deflection method is used, but piled abutments and continuous beams are treated by the displacement method, and the flexible arch by an energy method. Examples and figures are based on small and medium span bridges.

***The testing and inspection of engineering materials,** 2nd ed. H. E. Davis, G. E. Troxell and C. T. Wiskocil. Toronto, McGraw-Hill, 1955. 431 pp., illus., $7.80.

The first section of this book, a general treatment of principles with special reference to mechanical properties of materials, covers measurement of loads, length, and deformation, inspection, and the following tests: static tension and compression; shear and bending; hardness and impact; fatigue and creep of metals; and non-destructive testing. The second section describes methods of conducting tests using the most ordinary apparatus. Among the new subjects treated in this edition are ultrasonic testing, low-temperature impact tests, and developments in testing equipment.

Toronto Hydro recollections. E. M. Ashworth. Toronto, University Press, 1955. 224 pp., illus., $5.00.

In the three years prior to his death in 1954, Mr. Ashworth drew on his recollections of forty years with the Toronto Hydro-Electric System to write this book. It is, therefore, not only a history of the system but is also a collection of personal reminiscences.

Mr. Ashworth traces the fortunes of the Toronto Hydro from 1910 when Toronto's new street-lighting system was being installed to the present. His account of its growth is interesting, human and often amusing. There are several "before" and "after" photographs and many little pen and ink sketches, which add to the interest of the book.

Vapor-plating; the formation of coatings by vapor-deposition techniques. C. F. Powell, I. E. Campbell, and B. W. Gonser. New York, Wiley, 1955. 158 pp., $5.50.

Since the term "vapor-plating" ha been used to describe purely physica processes, it should be noted at ono that this book deals only with chemica processes, such as hydrogen reductio or thermal decomposition of meta halides at heated surfaces. It is the firs single source of references for data an information on these processes.

The general techniques used in vapor plating are reviewed and discussions ar given of the conditions required for th deposition of pure metals, carbides nitrides, borides, silicides, and oxide from gaseous mixtures of their vapor ized compounds. Because of the lack o specific information little or no treat ment is given to the deposition of sul fides, selenides, and phosphides.

Some information is included on th properties of vapor-plated material while other data indicates the genera fields of utility of the coatings and many unusual characteristics of vapor-deposite materials. New applications for the pro cesses are also suggested.

Les vernis; caractéristiques et emplo dans la construction électrique, 2 éd. Fritz Raskop. Paris, Dunod, Mont real, Fonac, 1955. 199 pp., illus., $7.7

This work has been published t acquaint workers in the field with th characteristics and uses of electrical in sulating varnishes. It is not a chemica treatise, but rather an outline of th practical applications of such substance in electrical engineering. The introduc tion of the silicone varnishes has marke a turning point in this domain, for thes

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and other newer materials exhibit a greater resistance to heat and humidity, both problems to be overcome in electrical work.

Subjects covered include: Principal substances in the fabrication of isolating varnishes; Choice of isolating varnishes; Ovens and drying installations for impregnated windings; Present status of the fabrication of enamelled wires — improvement of the machines used; etc.

While there is no index, an elaborate table of contents is provided in this book.

***Water supply engineering,** 5th ed. H. E. Babbitt and J. J. Doland. Toronto, McGraw-Hill, 1955. 608 pp., illus., $10.50.

This standard textbook has been revised to include information on the latest accepted practices, and has been broadened in scope by the inclusion of material on industrial water supplies. Emphasizing design throughout, the coverage includes estimation of water usage; determination of water availability; fundamentals of hydraulics; materials of construction; design and maintenance of pumping stations and distribution systems; and methods of water purification. Numerous references to source material are given in order to make the book useful to practicing engineers and advanced students.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Aircraft Industries Association of America, Inc.:

Background information on sound abatement by the aircraft industry (Published by Hill and Knowlton, Inc.).

American management association:

Universals in management planning and controlling, by J. M. Juran.

American society for testing materials. Special technical publications:

No. 166—Symposium on methods of testing building constructions.

American welding society:

A5.4 — 55T (ASTM A298 — 55T) — Tentative specifications for corrosion-resisting chromium and chromium-nickel steel covered welding electrodes. A5.5 — 55T (ASTM A316 — 54T) — Tentative specifications for low alloy steel arc-welding electrodes.

British electrical and allied industries research association. Technical reports:

No. B/T117—The influence of phase number of a convertor on harmonics, by F. Busemann. No. L/T283 — A pressure chamber for micro-optical observations, by C. Turner. No. L/T285 — On the theory of dielectric breakdown in ionic crystals — II, by B. V. Paranjape. No. L/T290 — The variation with temperature of the electric strength of polyisobutylene subjected to discharges, by E. M. Hawley. No. V/T121 — The dispersion meter, design and development, by G. Mole. No. V/T124 — Dispersion meter, model 2, instruction manual. No. Y/T16 — The effect of surface material, surface finish, temperature of operation and water composition on the deposition of carbonate scale on electrical immersion heaters of high specific loading, by M. V. Griffith and H. M. Browning.

Canada. Department of mines and technical surveys. Geographical branch. Bibliographical series:

No. 14 — Selected bibliography of Canadian geography with imprint 1953

Canada. Department of mines and technical surveys. Mines branch. Technical papers:

No. 10. — Electronic concentration of low grade ores with the Lapointe Picker, by A. H. Bettens and C. M. Lapointe

Canada. Dominion bureau of statistics:

Construction in Canada, 1953-1955.

Canada: National research council. Division of building research:

Bibliography on cold weather construction, compiled by D. C. Tibbets. The blistering of paint in the presence of water, by J. M. Kuzmak and P. J. Sereda (Research paper No. 13) Devices for the measurement of settlements of buildings and dikes, by A. Scheidig and H. Leussink (TT-500). New results obtained from dynamic foundation soil tests, by H. Lorenz (TT-521). Study of ground pressures, by R. Fenner (TT-515).

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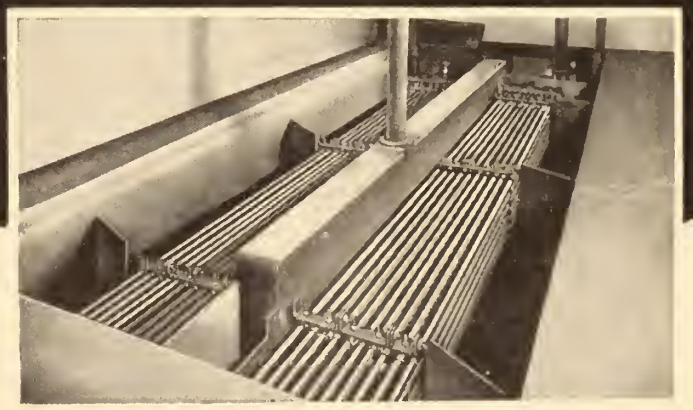

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United States. Highway research board. Bulletins:

No. 103 — Training highway-department personnel. No. 105 — Bituminous paving mixtures — fundamentals for design.

STANDARDS REVIEWED

A.S.M.E. standards, American society of mechanical engineers, 29 West 39th Street, New York 18, N.Y.

A.S.M.E. standard No. 106—Industrial engineering terminology. $1.50 (U.S.).

This is a compendium of 500 industrial engineering terms arranged in alphabetical order. Subjects range from elementary definitions, such as those for industrial engineering or for a standard itself, to an entire series of complex production terms. There are concise descriptions of the flow process chart and the simo chart, the Gantt chart, the Gantt task and bonus plan, job classification and evaluation, process layout and work station. Various instrument such as the marstochron and the kymograph are also included.

Gas transmission and distribution piping systems (ASA B31.1.8—1955) $2.50 (U.S.)

This 1955 Code covers the design, construction, operation, and maintenance of gas transmission and distribution facilities. It deals with materials and equipment; welding; piping system components and fabrication details; design installation and testing; and operating and maintenance procedures affecting the safety of gas transmission and distribution facilities.

The code also makes provisions for odorization of gases; suggests precautions to be taken when gas pipelines parallel overhead electric transmission lines on the same right of way; designates the dimensional standards and material specifications; and includes sketches of welding ends, attachment details of flanges, and welding details of openings.

A.S.T.M. standards, American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.T.M. standards in building codes. $6.00 (U.S.)

This compendium contains 250 ASTM specifications, methods of test, and definitions of materials included by reference in the major building codes of the United States and Canada. The compilation is designed for the use of building code authorities and for architects, engineers, and contractors in the building construction field.

A.S.T.M. standards on electrical insulating materials. $5.50 (U.S.).

Thirty-three of the designations in this compilation are either new or have been revised since publication of the previous edition in 1953. The standards included are of interest to manufacturers, suppliers, and consumers of insulating materials and electrical machinery and devices ranging from the heaviest generating equipment to the lightest of electronic components.

British standards, British standards institution, 2 Park Street, London, W.1. British standards are available from the Canadian standards association, National research building, Ottawa, Canada.

B.S. 661: 1955 — Glossary of acoustical terms. 6/-.

This is a revision of the glossary first issued in 1936, and about eighty new terms have been added. The major changes cover the enlargement of the section on recording and reproduction to keep abreast of techniques, especially that of using magnetic tape and wire, which are finding applications in many fields, and the inclusion of a section on ultrasonics. A section on underwater sound has also been included.

B.S. 938:1955—General requirements for the metal-arc welding of weldable structural steel tubes. 4/-.

This revised standard specifies the general requirements for metal-arc welding of weldable structural steel tubes under normal conditions of manufacture and service. It is a companion to B.S. 1856, General requirements for the metal-arc welding of mild steel. It is not applicable to certain forms of construction and does not specify the allowable stresses in welds or methods for their testing.

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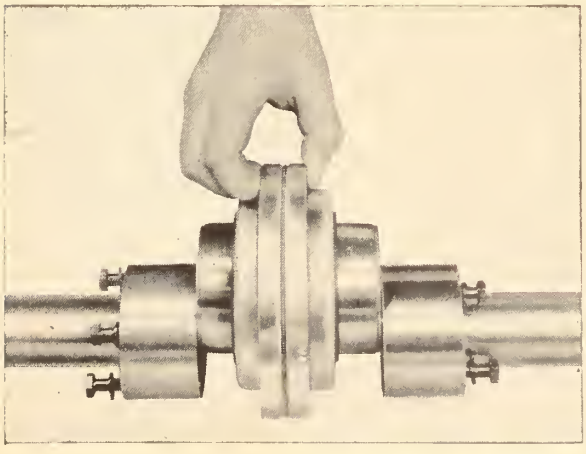

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B.S. 2G. 111:1955 — Specifications for the rate of climb indicators for aircraft. 2/6.

This standard has been prepared to provide an up-to-date specification for aircraft rate of climb indicators in the light of experience gained in the application of the first edition, published in 1949. Information has been added relating to the incidence of testing, and recommendations included in respect of tests to verify the serviceability of instruments.

B.S. G.150: 1955—Tachometer indicators (synchronous type) for aircraft. 2/6.

This standard specifies requirements for low range and high range synchronous type tachometer indicators for indicating the speed of aircraft engines.

It contains details of constructional requirements and of suitable type and production tests. An appendix deals with tests for verifying the reliability of instruments manufactured in accordance with the specification.

B.S. 1000 (622/623): 1955 — Universal Decimal Classification — 622 Mining and mineral dressing — 623 Military and naval engineering. 15/-.

This new section of the English Edition of the Universal Decimal Classification contains full classification schedules for the two major fields of mining and mineral dressing and military and naval engineering.

These schedules will serve as a useful tool for all workers in these fields with any substantial technical literature to classify.

B.S. 1003-4: 1955 — High purity zinc, zinc alloys for die casting and zinc alloy die castings. 3/-.

The presence in zinc alloys of certain impurities which are found in zinc ores may cause liability to intercrystalline corrosion with resultant dimensional instability and loss of strength. Thus, these impurities are strictly limited in the basic zinc used for the manufacture of these alloys. Limits have also been included for other elements which were included in the previous edition (1942) under the heading 'traces' and the same limits are included for the alloys.

B.S. 2590: 1955—Acceptance tests for sintered metal powder components. 3/-.

This standard makes recommendations with regard to the sampling and testing of the finished sintered component as distinct from the metallic powder from which it is made. It also makes recommendations with regard to the test pieces to be used for mechanical testing.

B.S. 2591: Part 1: 1955 — Glossary for valves and valve parts (for fluids) Part 1. Screw-down stop, check and gate valves. 10/-.

This illustrated standard defines types of, and parts for, three main types of valves. These are:

Screw-down stop valve: Globe, oblique. angle and needle valves.

Check valve: Horizontal, vertical and angle patterns of swing type and lift (disk, piston and ball) type, screw-down stop and check valves and foot valves.

Gate valve: Wedge gate, sluice, double disk gate and parallel slide valves, both inside and outside screw.

B.S. 2594: 1955 — Horizontal mild steel welded storage tanks. 4/-.

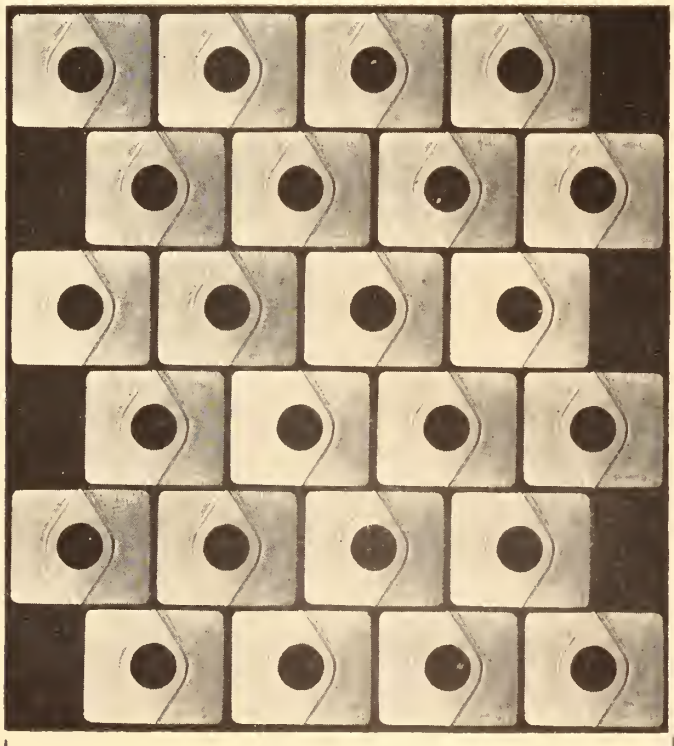
This standard relates to the design and construction of mild steel fusion welded horizontal storage tanks with dished and flanged ends and cover sizes of tanks ranging from 3 ft. 6 in. diameter by 4 ft. nominal length up to 9 ft. diameter by 30 ft. nominal length.

The tanks are classified by dimension instead of by capacities which has hitherto been the practice. As a guide to the user the gross capacities of these tanks are given in the tables.

The standard does not relate to tanks on transport vehicles or to lined storage tanks.

B.S. 2597:1955—Glossary of terms used in radiology. 10/-.

This standard covers over 750 terms and definitions. Its four main sections are, 'General terms and physics', 'Sources of ionizing radiation'; 'Radiology and fluoroscopy' and 'Radiotherapy and radiation protection'; among these sections are terms relating to such subjects as: atomic physics, high voltage generating equipment, X-ray tubes and their accessories, particle accelerators, diffraction analysis, and isotopes in medicine.



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Section through typical bank of diamond flow-tubes. Available for all pressures.

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See page 3 Douglas fir plywood Concrete Form Work Book.

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• Library Notes

Where appropriate, quantitative values and symbols are given for various terms. A complete alphabetical index is included.

B.S. 2600: 1955 — General recommendations for the radiographic examinations of fusion welded joints in thicknesses of steel up to 2 inches. 4/-.

The increasing use of X-rays and gamma rays for the examination of welded joints in a wide variety of constructions has led to the issuing of some recommendations of a general character giving guidance on the application of these methods.

This standard is divided into four sections which cover the general recommendations for all types of radiography within the scope of the standard, X-ray techniques for general and special applications and gamma-ray techniques.

B.S. 2614: 1955—Aluminium alloy sections for marine purposes. 3/6.

This standard defines three series of structural sections designed mainly for marine use. The three types of sections are tabulated; and for the 4 inch size and upwards alternate thicker webs are listed for use where necessary.

The sections are: bulb angles for riveting; tee bars for welding; and bulb plates for welding. Both the welding series of sections have a small root bead or table for welding, the dimensions of which have been so fixed that they can be used as backing bars for butt joints.

CP 3001: 1955 — Code of practice for zinc alloy pressure die casting for engineering. 5/-.

This code has as its objective the establishment of recognized practices in the design, production and inspection of zinc alloy die castings, in order to ensure that the material used, the procedure followed, and the design of the castings, will provide a reliable product.

Zinc alloy die castings will perform satisfactorily only if they are free from contamination by certain elements harmful to the mechanical properties and corrosion resistance. The code, therefore, states that it is essential that these elements should not be present in higher proportions than those indicated in B.S. 1004 'Zinc alloys for die casting'.

SP. 114: 1955 — Eye bolts (unified threads) for aircraft. 2/6.

This latest addition to the aircraft series specifies the materials, dimensions and finish of eye bolts manufactured in 35/45 ton carbon steel and having unified threads. Information concerning the loadings of the fittings, and the suitable sizes of cable, is given in the appendix to the standard.

Canadian standards, Canadian standards association, National research building, Ottawa, Canada.

C.S.A. A126—1955 — Specification for vinyl asbestos floor tile (semi-flexible-homogeneous) $1.00.

The specification applies to vinyl asbestos floor tile in sizes 9 by 9 inches and 12 by 12 inches in standard thicknesses of ⅛ inch.

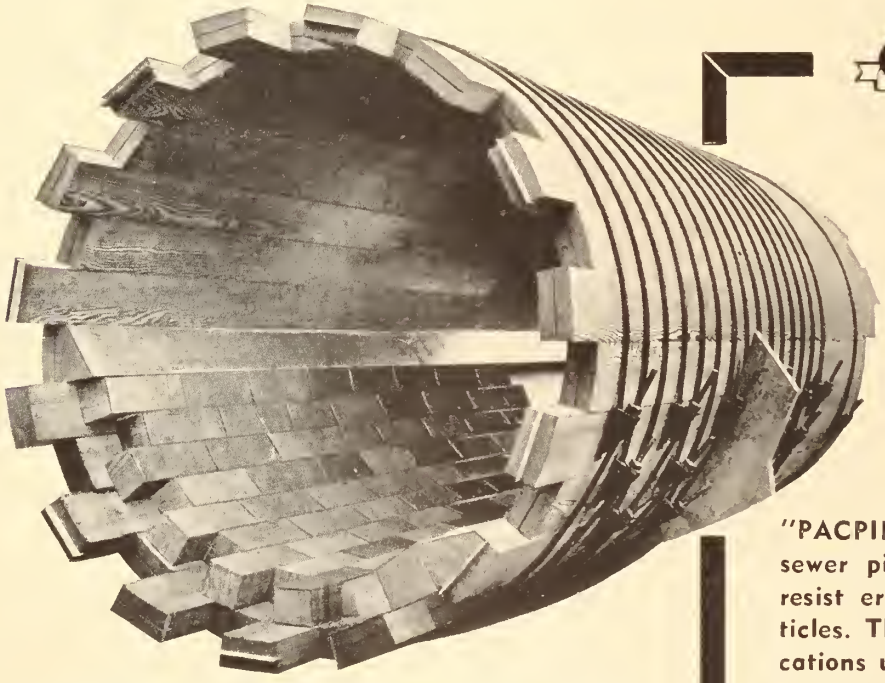
The standard specifies the physical properties of the tile and the methods of testing. The tests check not only the physical size, colour, finish and surface characteristics but also indentation at 77F and 115F, residential indentation, impact, flexure, dimensional stability, volatile material, resistance to reagents and curling. Packing and marking instructions are also included.

C.S.A. C83.1—1954 — Specification for communication line hardware, 3rd. ed. With drawings $4.00; without drawings 75 cents.

This is the 1950 Specification modified editorially and provided with a paragraph which draws attention to the fact that the stock used on items having rolled threads is smaller than that used when cut threads are provided.

C.S.A. C83.2—1954 — Specification for power line hardware, 3rd ed. With drawings $3.00; without drawings 75 cents.

Like its companion Specification C83.1, this specification has undergone similar changes modifying the 1950 edition.



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1

2

3 **Phillips** Shaped Magnet Wire offers . . .

six big advantages

With a battery of *new magnet wire machines* of the latest and most improved design, just installed; and using a *specially treated* copper conductor; Phillips now offer *quick delivery* of a superb product.

4

1. Soft Temper—The new annealing furnace gives an extra soft temper to the copper, making it easy to handle and wind.

2. High Surface Finish—Phillips copper has always been noted for its high finish. Now an additional process adds a special smoothness. (Good finish is essential for an insulation base.)

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4. Secure Source of Supply—Phillips greatly increased manufacturing capacity assures the reliability of your source of supply.

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6. Reliability—For years the quality of Phillips Magnet Wire has been a by-word in the trade. Sixty-five years of experience and reputation stand back of this product.

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5522

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5

6

BUSINESS & INDUSTRIAL BRIEFS

A Digest of Information

received by

The Editor

Appointments and Transfers

Magcoa General Manager.—L. A. Sutton has been appointed general manager of Magcoa Limited, magnesium fabricators and materials handling equipment manufacturers, it was announced by Miles L. Abel, executive vice president of the new Toronto firm.

●

Racey, MacCallum Appointment. — J. G. Baillot, B.A., B.A.SC., P. ENG., has recently joined the staff of Racey, MacCallum and Associates Limited, as a specialist in metallurgical engineering and ultrasonic testing.

●

Westinghouse Supply Company.—Appointments to managerial posts in the Canadian Westinghouse Supply Company's consumer products division recently announced were A. McGruther, sales manager for the Alberta District, and J. A. Comeau, sales manager for the Calgary branch.

●

Applied Research Ltd. — Donald S. Ross, R.C.A.F. photographic officer for 15 years, has joined PSC Applied Research Limited in Toronto as projects manager in charge of photographic and optics projects, according to an announcement by J. M. Bridgman, general manager of the company.

●

Powertronic Equipment Executives. - Brad W. Richardson and David E. Bawden have been appointed treasurer and secretary, respectively, of Powertronic Equipment Ltd., J. C. Burkholder, president, has announced.

●

Power Shovel Sales Appointment. —As a part of a major expansion in parts and service facilities in Canada, Marion Power Shovel Company of Marion, Ohio, has announced the appointment of P. Ralph Helm, Jr., as its Eastern Canada sales manager.

●

John Bertram Appointment. — The John Bertram and Sons Co. Ltd., Dundas, Ont., announces the appointment of George M. Brydon as general manager of their tool and gauge division.

●

Dow Corning Transfer. — Bruce F. Smith, manager of technical service in the international department of Dow Corning Corporation, has been transferred to the Company's Canadian affiliate, Dow Corning Silicones, Limited, of Toronto, as manager of the Canadian company's newly established branch office in Montreal, Que.

●

Peacock Executive Appointment—The following appointments have been announced by Peacock Brothers Limited. F. H. Hunt is made executive assistant to the vice-president and L. N. Harlock is made general sales manager. Both are directors of the company.

●

Canada Iron Appointment. — Canada Iron Foundries, Limited announces the appointment of R. K. Carty as controller. Mr. Carty, a graduate of Queen's University, has had extensive experience in the Canadian corporate financial and accounting fields.

●

Canadian Helicopters (1954). — New officers and key operations' personnel of Canadian Helicopters (1954) Limited, (now a wholly-owned subsidiary of Okanagan Helicopters Ltd., of Vancouver) have been announced. Named chairman of the board of Canadian Helicopters is Clark B. Davis, who is vice-president of Woodlands Division, Abitibi Power & Paper Co. G. W. McPherson is president of Canadian Helicopters; Carl Agar, vice-president of operations; and Alfred Stringer, vice-president of engineering. J. C. Charleson, of Ottawa, has been appointed managing director.

●

Raymond Concrete Pile. — Wesley C. Pietz, president and managing director, Raymond Concrete Pile Company Ltd., foundation and heavy construction company, Toronto, has announced the appointment of Walter T. Clarke as Montreal district manager. Mr. Clarke succeeds Edgar F. Thwing who resigned in July.

●

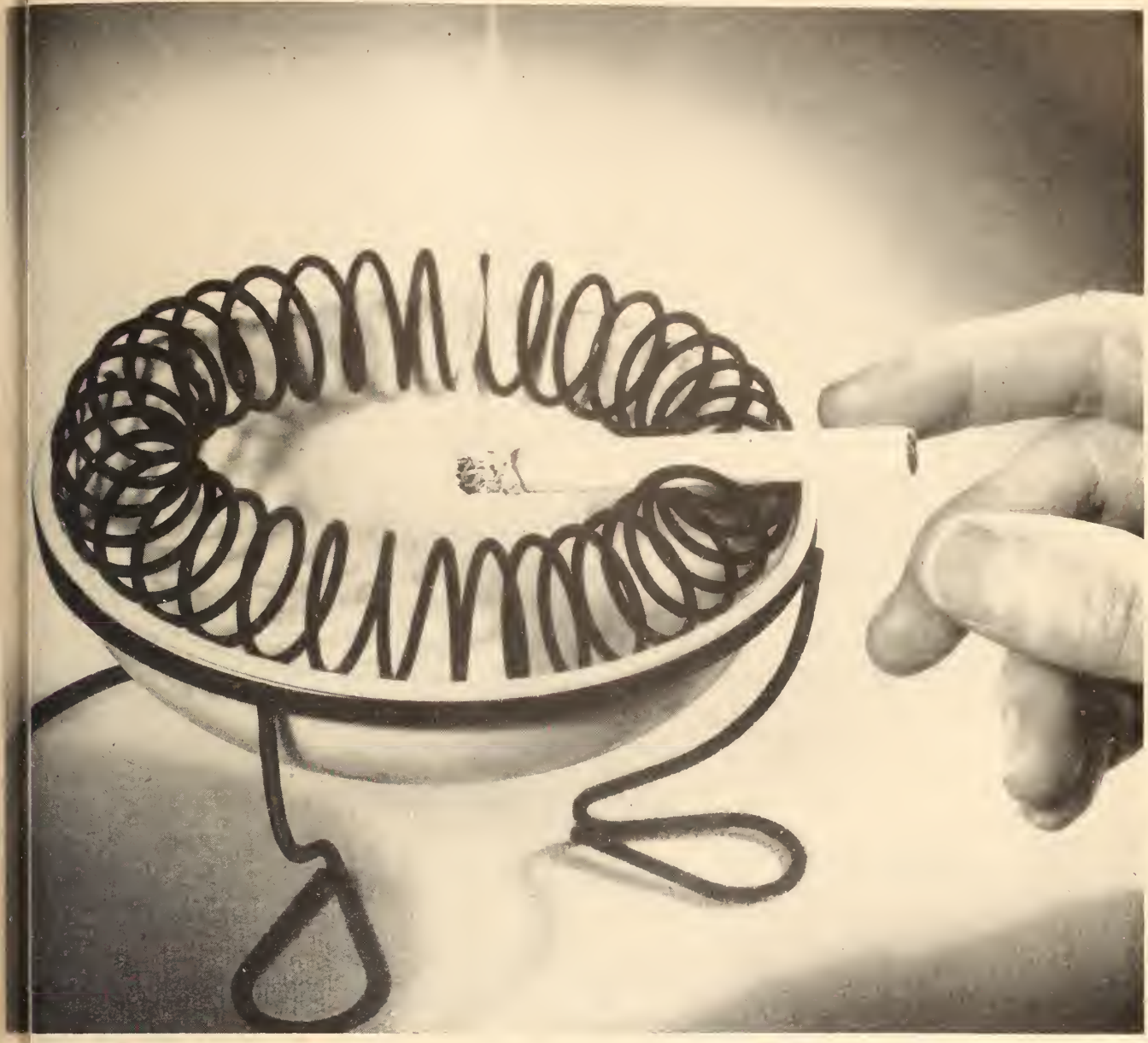
New Dominion Engineering Division. —Dominion Engineering Company Limited, announces the formation of a Western Division. A. C. R. Yuill, M.E.I.C., M.A.I.E.E., P. ENG., continues in his capacity as special representative for the Company. G. E. Plant is appointed manager of the Western Division.

●

Consulting Engineers.—P. R. Sandwell, M.E.I.C., president of Sandwell & Company Limited, consulting engineers of Vancouver, B.C., announces the appointment of S. D. Ford, M.E.I.C., to the position of chief engineer. Other appointments in the organization are E. S. Barton, assistant chief engineer, products administration; P. J. Vakomies, assistant chief engineer, development; J. A. Webster, M.E.I.C., assistant chief engineer, design; and S. A. Quis, procurement manager.

●

Canadian Company Formed. — Electronics Corporation of America, Cambridge, Mass., announces the formation of Electronics Corporation of America (Canada) Ltd., with headquarters in Toronto. James S. Carlile, who has been supervising ECA sales activities in Canada, will be general manager of the Canadian company.



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STELCO LOW CARBON WIRE WILL DO THE JOB!

For new and different wire products like the one above, or for the old familiar ones like coathangers, lampshades, cutlery, screwdrivers, and chains, Stelco produces specialty grades of Low Carbon Wire exactly suited to the end use. Each grade is designed also for fast, economical forming, good welding characteristics, and long, rugged service.

Canada's most extensive wire-making facilities, backed by the experience embodied in over five thousand different recorded specifications, are at your service when you come to Stelco for your needs in steel wire. A call to any Stelco Sales Office will bring you prompt attention.

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55401.S

Bus. and Ind. Briefs

N.R.C. Building Research.—Robert F. Legget, director of the Division of Building Research of the National Research Council, has been elected as the Canadian member of the Council of the Institution of Civil Engineers. Mr. Legget, who has been a member of the Institution since 1930, succeeds Edgar A. Cross, Consulting Engineer of Toronto, in this position of Canadian Councillor.

Edward H. Stock, administrative officer to the Division of Building Research of the National Research Council, is to take up post-graduate study in administration at the University of Syracuse as sole Ottawa winner of a scholarship offered by the Institute of Public Administration of the University to members of the public service of Canada.

New Equipment and Developments

Change of Address. — Permutit Company of Canada Ltd., announce completion of their move to the new Montreal location at 5500 Royalmount Avenue, Town of Mount Royal.

●

Ottawa Foundries Integrate. — L. W. Fleck, president of The Alexander Fleck Limited, and D. J. Beach, president of Beach Foundry Limited, both of Ottawa, jointly announce that The Alexander Fleck Limited have acquired common stock holdings in Beach Foundry Limited and that the firms will integrate their operations on the Beach site in Ottawa, while retaining their separate corporate entities.

●

Refinery Building. — Contract for a $300,000 administration and plant protection building at the Canadian Oil Companies, Limited refinery in Sarnia has been let to Con-Eng Contractors Ltd. of London, Ont. Gordon S. Adamson and Associates, Toronto are the architects and designers.

●

New Switchgear Plant.—Bepco Canada Limited announce that a new half-million dollar plant at Brantford, Ont., will operate early in 1956 for the manufacture of the company's switchgear. The plant will be owned and operated by Crompton Parkinson (Canada) Ltd., one of Bepco's four constituents. Crompton Parkinson have their own switchgear short-circuit testing station to provide test data for design purposes.

●

Safety Signs.—Canadian Line Materials Limited, Toronto, now has available a complete range of safety signs. Three standard sizes are available and all are equipped with dual flags and holders. The signs are finished in baked enamel; weatherproof and road tested for durability. Standard colours of yellow, red and black are used, with special colours on request. Signs can be furnished with special legends, artwork, or unusual cut-out shapes or sizes.

●

Thermal Demand Meter. — Ferranti Electric Limited now has in production a new thermal demand meter. It has been specially designed to ensure simple, inexpensive maintenance; all parts are easy to dismantle, clean, adjust and reassemble. To ensure a minimum of stock parts the new thermal demand meter includes the standard Ferranti type FM single-phase, watthour meter element.

●

Floor Boxes Approved. — "Latrobe" floor boxes manufactured by Fullman Manufacturing Company of Latrobe, Pennsylvania have been approved for use in Canada by the Approval Laboratories, a division of the Canadian Standards Association. Items approved include adjustable, non-adjustable and gang boxes. Leonard Electric, Ltd., Toronto, and W. E. M. Walsh, of Montreal, represent Fullman in Canada.

●

Federal Public Works Contracts. — Contracts involving expenditures totalling $9,057,068.19 were awarded by the Federal Department of Public Works during the month of July 1955, accord-

ALWAYS ON DUTY...
24 HOURS A DAY

Once a valve is installed in a pipe line it is never idle. Open or closed, it is always at work... controiling flow and withstanding pressure. That is why it is so important to select and install valves of proven dependability that will give long and trouble-free service . . . McAvity Valves.

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PULP STOCK VALVES

Non-clogging
Self-cleaning

Avoiloble in 8 different closses . . . including Cost Iron, Ni-Resist, Acid-Resisting Bronze, Stoinless Steel KA2MO, or Rubber Lined . . . for 10 different methods of operation.

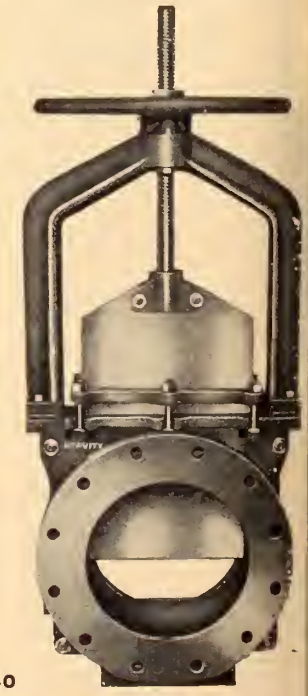

Fig. 9940

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Illustrated are four of the Art Woodwork laboratory furniture installations designed for the special requirements of the M. G. H.

Above: The Hystology Laboratory
Below: The Urinalysis Laboratory
Above right: Students' Dental Laboratory
Below right: The McGill Dental Clinic

Produced by Art Woodwork Limited to designs drawn by A-W technicians in conjunction with Montreal General Hospital and McGill University authorities and in consultation with the architects, these modern installations represent the ultimate in convenience and efficiency.

ART WOODWORK LIMITED *Furniture in* WOOD

B. K. JOHL INC. *Furniture in* METAL

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Bus. and Ind. Briefs

ing to a statement authorized by Works Minister Winters. The amount for new works is $7,245,958.50; for the repair and maintenance of existing structures $826,988.64; and for dredging contracts, $984,121.05.

Total contract commitments for the Trans-Canada Highway have passed the $200-million mark. Of this the Federal Government is committed to pay half. By mid-August claims submitted by the provinces and payments made by the Federal Government amounted to $66,514,217.33.

●

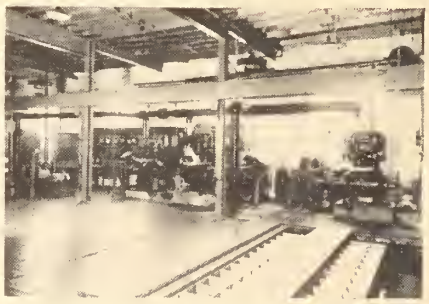
Relief Map of Canada.—A new relief map of Canada has been published by Canadian Aero Service Limited, Ottawa. It shows all Canada in three dimensions. Forty-nine by 45 inches in size, the map is printed in eight colours on heavy Vinylite plastic. Then it is formed under heat and pressure to depict relief. The surface is plastic coated so fingerprints or markings will not damage it. Scale of the map is 1 inch to 75 miles; its vertical exaggeration, to emphasize relief features, is 20 to 1. Weight of the map is only 2 pounds, compared with over 200 pounds for conventional plaster relief models of comparable size. Information shown includes: land forms, land use, and over 3,000 place names—highways, railroads, aerodromes, parks, and similar facts; new data on the Canadian Arctic shorelines and settlements are shown, and corrected positions given for certain island groups in the Far North. Canadian Aero Service Limited was aided by the Department of Mines and Technical Resources; assistance was given also by the office of

(*Continued on page 1328*)

Whatever your temperature requirements, you can be sur of perfect control with..

FRICK REFRIGERATIO and AIR CONDITIONIN

An office building that needs co fortable working temperatures r the occupants . . . a dairy or bev age plant where constant refrige tion is necessary . . . a deep freez unit that calls for constant low te peratures . . . all are served in e most efficient, economical way p sible by Frick Air Conditioning r Refrigeration Equipment! For o r 23 years, architects and engine s have been specifying "Frick by Lo" for lasting satisfaction. You can be s e —when you specify Frick Air Co tioning or Refrigeration Equipmer



One of several ice making plants supplied and installed for Belle Ewart Ice Co., Taranto.

Refrigeration Engineers and Distributors

J.H.LOCK&SONS Limite

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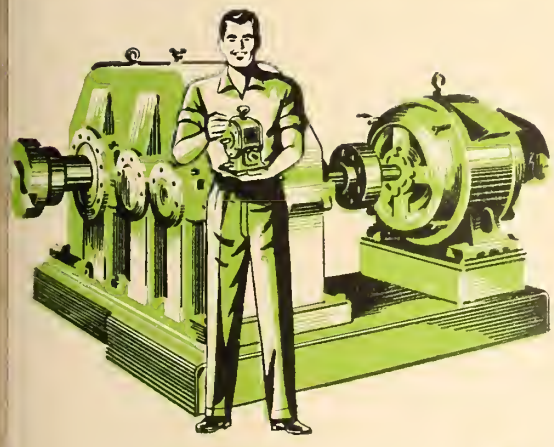
Gears



Rugged, quiet in operation and designed for extremely long service, Hamilton Gear Speed Reducers are favoured in a wide range of industrial and mining operations. Helical gear speed reducers—like the unit pictured above—have replaced herring-bone reducers in most applications because single helical gears require no centering and take the load evenly over the whole gear face despite any external thrust. These units can be equipped with a back-stop to prevent reverse rotation—for instance when used with an inclined conveyor or bucket elevator. These versatile Hamilton Gear reducers come in ratios from 2 to 1 up to 800 to 1, in single, double or triple reduction.

For further information write for Catalogue No. 113.

Hamilton Gear standard speed reducers are made in sizes ranging from units small enough to be carried easily by one man up to reducers weighing 18 tons.

Hamilton Gear and Machine Co., Limited.

HG-T-3-55

950 • 990 DUPONT ST., TORONTO 4

all sizes for every industrial application—

Bus. and Ind. Briefs

(*Continued from page 1324*)

the Surveyor General and by the Army Survey Establishment.

Price of the map is $45.00 f.o.b. Ottawa; available from Canadian Aero Service Limited, 74 Sparks St., Ottawa 4.

●

Alloy Welding Wires.—It is announced by Air Reduction Canada Limited on behalf of Stoody Company, that a new line of 7/64 in. tubular fabricated alloy wires designed for open arc application through Magna Welders and other semi-automatic welding machines, is available in Canada. The process requires no flux and offers the versatility of manual welding with the control of the full automatic. Depositing 7 to 15 pounds of hard metal an hour, a welding speed two to three times that of the manual process is claimed. Three materials are available from Airco—a 50% chromium hardfacing alloy, a 20% alloy for hardfacing, and a Hadfield nickel manganese for build-up of manganese steel parts.

●

Plastic Protective Jacket.—"Protektinsul", a new wrap-around zip-on protective jacket made of durable 12-gauge Vinylite plastic to cover pipe, cable, duct and conduit insulation, is manufactured in a variety of colours by E. T. Sampson & Co. Ltd., Montreal and Toronto. This covering can be used indoors and out, above and below grade. Requiring no priming or painting, it is flexible and easy to handle; it is prefabricated to individual requirements and simply zips on over pipe and duct insulation—thereby eliminating fitting, cutting and sewing—so reducing installation time and costs. The closure is a patented, electronically welded vinyl slide fastener which locks firmly into place, forming a watertight, vapourtight and airtight joint. End joints, bends and insulated fittings are taped with the same "Vinylite" material as the covering and sealed with a special vinyl sealer. The covering is non-flammable.

●

Auto Stop Meters.—Two new auto stop meters with double trip auto stop valves for positive control of industrial liquids are offered by Neptune Meters Limited. Automatic deliveries of water, syrups, oils, solvents and other liquids to batching and blending processes are accomplished with accurate cut-off and minimum hydraulic hammer even when handling high rates of flow. The quantity desired is set by pushing buttons, the meter shuts-off automatically when the exact amount is delivered. Neptune type "S" auto stop meters are bronze construction and have been used suc cessfully to measure more than 150 in dustrial liquids. Rates of flow are: 1½ in., 10 to 100 U.S. g.p.f.; 2-in., 16 t 160 U.S. g.p.f. One-in. and 3-in. auto sto meters are also made. Details from Nep tune Meters Limited, 1430 Lakeshor Rd., Toronto 14.

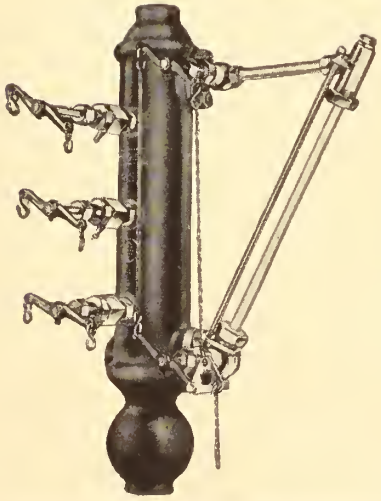
●

Low-Wattage Mercury Lamps.—Ne compact low-wattage mercury lamps a now available from the Canadian Wes inghouse Company's Lamp Division ratings of 100, 175, and 250 wat Though their major application is like to be for lighting residential ar secondary streets, the new lamps w also be applicable to industrial ar some commercial lighting. With th proper auxiliary equipment, the lam can be operated from any supply vol age. For normal indoor use or mi outdoor conditions, an open circuit ba last voltage of 220 volts is sufficient f reliable starting. At temperatures as lo as minus 30°F, 250 volts will be ad quate. Rated average life is 4,000 hou for the two smaller lamps, 6,000 hou for the 250-watt lamp.

●

Transformer Contract. — The Pow Authority of the State of New Yo has placed an order with the Engli Electric Company Limited for tw large transformers for use in conne

MORRISON



Morrison Brass make the most complete line of Boiler Mountings in the Dominion.

WRITE FOR COMPLETE CATALOGUE NO. 85-B

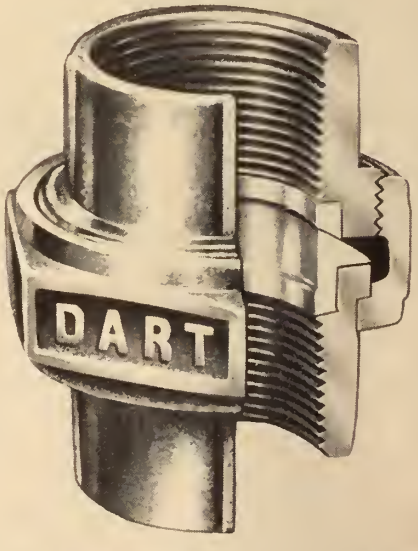
"MADE TO LAST"

THE JAMES MORRISON BRASS MFG. CO. LIMITED

276 KING ST. W., TORONTO, ONT.

DART UNIONS

for efficient service and economy



Two Bronze Seats Ground to a True Ball Joi

DART UNION COMPANY OF CANADA LT

TORONTO CANADA

How Farval lubrication makes a turbine behave!

FARVAL—
Studies in Centralized Lubrication
No. 171

THIS hydraulic turbine had costly maintenance problems. Every few months, 6 to expensive bearings had to be replaced. Oldshioned grease gunning just couldn't keep bricant in bearings. Repairs interfered with ectric power production.

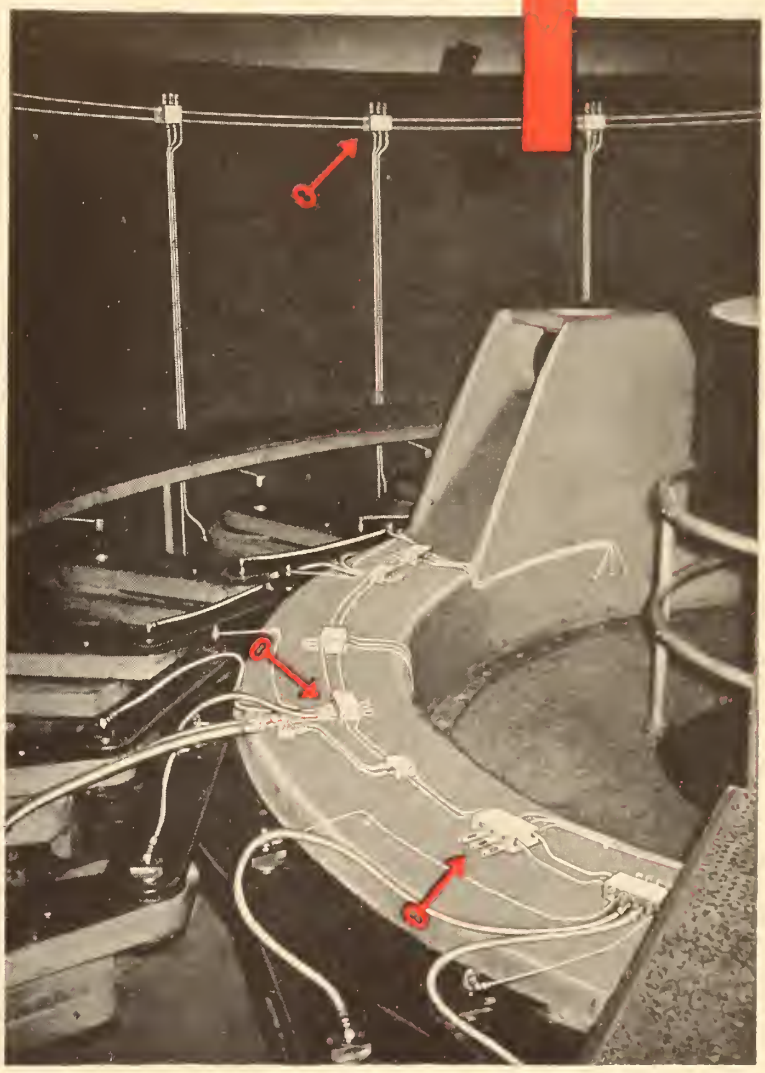
rval Lubrication Engineers were called in. A rval System of Centralized Lubrication extly suited to the turbine's needs was recomended. Result—lubrication troubles ended. owntime was eliminated. Now, even beargs under water keep working properly. rval works as the turbine operates—no time t for lubrication. Manpower is saved, beuse Farval is wholly automatic. Important oney is saved. In 14 years, the manager reorts thousands saved in bearings and lubrint. These savings led to Farval Systems on 9 her turbines.

Farval saves in many industries

his is a typical example of the economies rval brings to industrial equipment. Farval a simple, dependable system that lubricates ickly, without shutdown, from one central mping station. Oil or grease is delivered failingly, to each bearing served, in the exact nount *when* required. And, Farval Centralized brication Systems, manual or automatic, n be installed on new or old equipment.

Free Bulletin tells you all

nd out how Farval can save for you and pay r itself in quick order. Write for helpful chnical advice and ask for Bulletin 26. eacock Brothers Limited, P. O. Box 1040, ontreal 3, Que. Branch offices in Sydney, oronto, Sudbury, Winnipeg, Edmonton, Calry and Vancouver.



KEYS TO ADEQUATE LUBRICATION — Wherever you see the sign of Farval—the familiar volve manifolds, dual lubricant lines and control pumping stotion — you know a machine is being properly lubricoted. Farvol manually operoted ond automatic systems protect millions of industrial beorings.

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CENTRALIZED SYSTEMS OF LUBRICATION

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SUB-SURFACE EXPLORATION

Soil Sampling ❖ Foundation Testing

Core Drilling ❖ Grouting

FOR EXAMPLE:

HYDRO PROJECTS

Job 54-107

Ladore Falls Powerhouse

B. C. Power Commission

Construction is now underway on the hydroelectric plant at Ladore Falls near Campbell River on Vancouver Island. On completion of the project a further 105,000 h.p. will be added to the power available for west coast industries at a total cost of $9,700,000.

Boyles Bros.' crews have completed the extensive foundation testing program for this major development during the past year.

BOYLES BROS DRILLING COMPANY LTD., VANCOUVER, CANADA

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Bus. and Ind. Briefs

tion with the St. Lawrence power project. On the American side of the joint Canadian/American power station, part of the power will be stepped up to 115 kv. and part to 230 kv., and the transformers will be used to couple these two bus-bars together for the interchange of power. They are three-phase units, and will have an output of 120,000 kv. with a voltage ratio of 230/115 kv. with auto-connected windings. Cooling is of the OFW type (purified oil circulation through water coolers), and the main windings will be impulse tested at a level of 900 kv.

●

Terylene Plant Opening.—The new "Terylene" plant of Canadian Industries (1954) Limited, at Millhaven, Ont., will be officially opened on September 28. Officiating at the opening ceremony will be Rt. Hon. C. D. Howe, Minister of Trade and Commerce, and guests will include John R. Whinfield, inventor of "Terylene" polyester fibre. The Millhaven project was started in 1953, and pilot plant production began late in 1954. Main units of the plant went into production this summer. It will employ about 800 people when fully operating.

●

Double Headed Nails.—The Steel Company of Canada, Limited, Hamilton and Montreal, now provides double headed nails. Otherwise known as duplex nails, double headed form nails, double headed scaffold nails, hold-down nails and American dual head anchor nails, they are used as fastenings where their application is temporary only. Designed to be removed without damage to the material in which they have been driven, applications include temporary form work, railway car bracing, scaffold erection, false doors on box cars for grain shipping and insulators for temporary electric wiring.

●

New Metallized Tapes.—Two new pressure-sensitive film tapes, each possessing unusual strength although only 2-mils thick, were announced this month for widespread industrial marking, labelling, and decorating use by Minnesota Mining and Manufacturing of Canada Limited, London, Ontario. The polyester film tapes, Nos. 850 and 852, have similar physical characteristics and metallic (silver) appearance achieved by vapour-depositing aluminum between the tape's adhesive and backing. The No. 852 tape is printable and is supplied with a special polyethylene-coated paper liner. Tensile strength is per inch of tape width, 100% elongation, and 40 ounces of adhesion per inch of width. In addition, the tapes are said to retain their flexibility at very low temperatures, and have high dimensional stability despite heat and humidity changes.

●

Lighting Units.—J. A. Wilson Lighting & Display Limited has recently entered into an agreement with The Holophane Company Limited to manufacture lighting units embodying Holophane L-Brite Controlens (requested trade name The Holophane Company Limited). The new agreement makes the J. A. Wilson organization a fully licensed Holophane Controlens distributor.

●

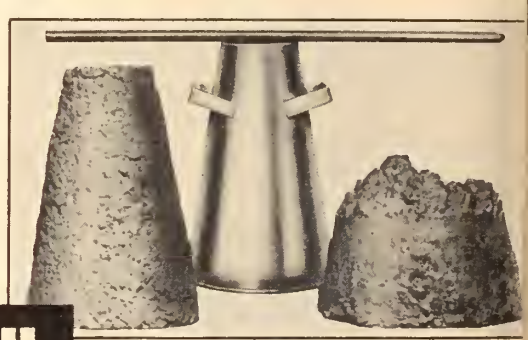
High-Speed Potentiometer Recorder.—A new high-speed recording potentiometer which features full-scale pen traverse across its 11-inch chart in 0.4 second without any overshoot at the end of the traverse has been announced by The Bristol Company of Canada Limited. The recorder, known as the High-Speed Dynamaster Potentiometer, has a dead band of less than 0.1% of the full scale span. It is offered in standard ranges as low as 0 to 1 millvolt d-c for full scale, with source resistance up to 10,000 ohms. Chart-speeds up to 4 inches per second are available.

●

Natural Gas Contracts.—Trans-Canada Pipe Lines Limited has signed a contract to sell 200,000,000 cubic feet of natural gas daily to Tennessee Gas Transmission Company of Houston, Texas, at the international boundary near Emerson, Manitoba, with an option to sell an additional 200,000,000 cubic feet daily when available, it was

increased concrete workability at lower cost with

POZZOLITH



Pozzolith Produces Greater Slump with Same Amount of Water

PLAIN MIX		POZZOLITH MIX
5-1/5 Gallons	W/C	5-1/5 Gallons
1 Inch	SLUMP	5 Inches

Producing increased concrete workability by adding water has two serious disadvantages. First, it increases the cost of concrete because more cement is required to maintain strength. Second, it lowers the quality of concrete because it increases shrinkage and permeability and decreases durability.

Effect of Pozzolith on workability is shown above.

The fact that Pozzolith increases workability without the use of extra water, is one of the reasons why it was employed in more than 13,000,000 cubic yards of concrete last year alone. *Full information on request.*

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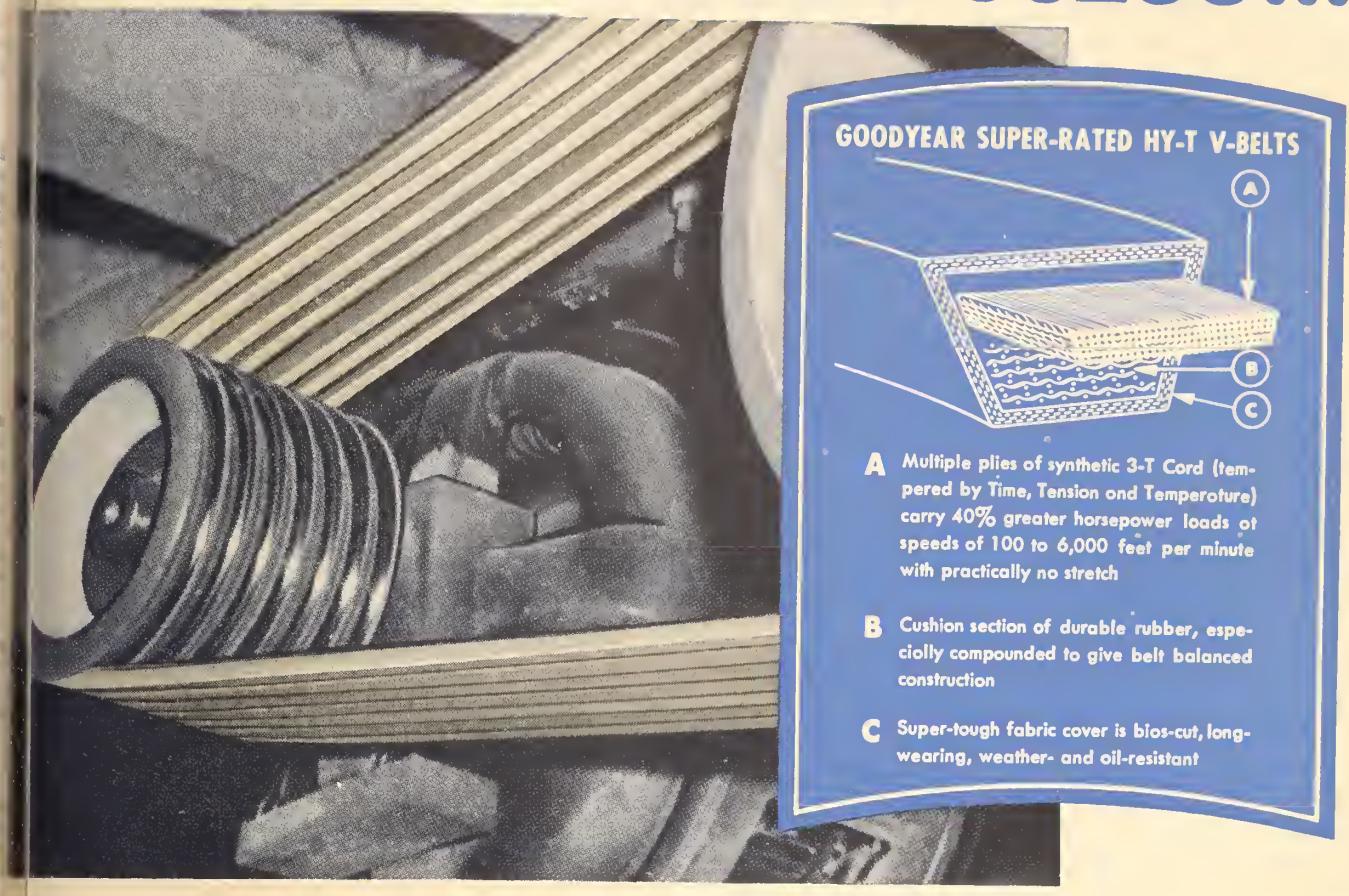

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Goodyear HY-T V-BELTS are sinewed with Triple Tempered (3-T) Cords to provide 40% higher H.P. ratings—7 belts can do the work of 10 — or the same number of belts will substantially increase belt service life. Goodyear HY-T V-Belts have oil resisting covers, are mildew inhibited and can be supplied static-conducting.

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announced in Calgary by N. E. Tanner, President of Trans-Canada. The Canadian gas will be sold along a new pipeline to be built by Tennessee Gas from Minnesota to Tennessee, with sales principally to gas distribution companies having no present source of natural gas. Trans-Canada also has entered into a short-term contract to purchase up to 90,000,000 cubic feet daily of natural gas from Tennessee Gas at the international boundary near Niagara Falls.

When the Trans-Canada line has been completed to eastern Canada, Tennessee Gas has agreed to purchase surplus gas over and above the requirements of the eastern Canadian markets. This arrangement would give Trans-Canada a market for gas during off-peak periods and thus would assure more economic operations of the pipeline throughout the year.

●

Airblast Circuit Breakers. — Ontario Hydro has recently completed an installation of 12 outdoor 115 kv. airblast circuit breakers at the Burlington Transformer Station near Hamilton. These circuit breakers are rated at 5,000 mva. at 115 kv. and are replacing bulk oil circuit breakers which were installed when the interrupting capacity requirements of this transformer station were lower. The oil circuit breakers are being transferred to other parts of Ontario Hydro's system. The circuit breakers installed at Burlington are of English Electric axial blast design.

●

Aid Maritime Coal Industry.—Public Works Minister Robert Winters has announced that a newly developed automatic furnace designed to help the coal industry of the Maritime Provinces will be tried out by the Department of National Defence in the homes of servicemen stationed at Camp Gagetown, N.B. Half of the first group of 30 houses to be built as permanent married quarters for the Army's largest camp will be equipped with this hot water furnace which is designed to use the type of coal produced in the Maritimes. The other 15 units will have standard DND oil-fired hot air furnaces installed, and a comparison of the two systems from the point of view of tenant satisfaction and fuel and maintenance costs will be made over the next heating season. The new down-draft furnace, developed by the Dominion Steel and Coal Corporation Limited, is equipped for automatic firing and ash removal and will be installed in each of the four types of houses to be built.

●

New Feeder Busway.—A high-reactance feeder busway design permitting interrupting capacities of more than 100,000 amperes RMS symmetrical at transformer output terminals, has been announced by engineers of the Panelboard Section, Canadian General Electric Company, Limited. Known as the Type CL, this new factory-assembled busway is designed for use in commercial and industrial buildings for connection between the service entrance and main switchboard, or wherever it is desired to reduce the available short-circuit current. The new design provides values of reactance which are from eight to 23 times that of conventional feeder busways. One ten-foot section of the new Type CL busway offers more reactance than a 200-foot run of busway of standard design in the same rating, it is claimed.

●

Rubber Asphalt Road Surfacing.—In a comprehensive in-use test designed to determine the advantages of rubber asphalt surfacing, the Minnesota State Highway Department recently put down a variety of rubber asphalt mixtures over some twelve miles of highway on Route 152, about 15 miles outside of Monticello, Minnesota.

One control section using RC5 in its natural state, and three rubberized sections using RC5 in conjunction with various rubber additives were laid. The natural rubber section, about three miles in length, consisted of an RC5 base asphaltic stock (85-100 pen.), 10% cutter and 2% natural rubber powder dissolved in the asphalt cement prior to use of the cutter. While the viscosity of the RC5-natural rubber combination was slightly lower than that without rubber, the temperature used in laying both the non-rubber control and the natural rubber section was the same—275°F.

Use of the natural rubber occasioned no changes in the procedure, other than the blending of the rubber powder with the RC5 materials.

During the laying itself, the asphalt-rubberized mix flowed freely, with no clogging of nozzle or spreader bars. Due to rain just before the laying of the natural rubber strip, the chips were wet when placed. Despite this, whip-off was negligible. Actually, it was less apparent than during the laying of the non-rubber control section, which went down dry. This would seem to indicate that adding natural rubber tends to prevent whip-off even under unfavourable conditions.

Minnesota is considered an excellent testing ground for the weathering attributes of the natural rubber asphalt combination. Weather extremes experienced there should give good indications of rubber's ability to help counteract the effect of cold weather cracking and hot weather bleeding.

●

Industrial Television. — Miniature industrial television cameras are now being used for research purposes by two leading British aircraft manufacturers. The de Havilland Aircraft Company have installed a television system in an aircraft for detecting the presence of flame in a new engine which they are trying out in the bomb bay of a test aircraft. The TV camera, which is pre-focused and controlled by the navigator in the pilot's cabin, watches the test engine in complete darkness through a heat-resistant glass window. The Bristol Aircraft Company are also using industrial television for engineering research and are at present fitting it to a flying test bed aircraft for engine study. Equipment is made by Pye Limited, Cambridge, England.

●

Early-Warning Line Contract.—Canadian Marconi Company announce tha

Photo courtesy of Dominion Foundries and Steel Ltd.
Charging G.L.A. Lime to an Open Hearth Steel Furnace.

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they have been awarded a contract for radio relay equipment for the Mid-Canada early warning defence line. This contract runs into several millions of dollars. The units will provide the essential link betwen the scanning antenna of the radar units which would first detect enemy intruder planes and the defence forces which would be brought into action to deal with them. The equipment is of a type that could be used effectively in commercial communication networks.

●

Airborne Magnetometer Survey.—First week's flying of the first large-scale airborne magnetometer survey in Great Britain was completed on 30th August. About 2,000 miles were flown in an Anson aircraft specially modified for geophysical surveys. Canadian Aero Service Limited of Ottawa, Canada, is making the survey of an area of 10,000 square miles in the Midlands.

Primary purpose of the survey is scientific investigation, rather than the discovery of new mineral resources. It is being financed by the Nuffield Foundation, and administered by the Department of Scientific and Industrial Research, through the Geological Survey of Great Britain. There has been a great deal of careful geological and geophysical study of the Midlands area and therefore the area is already very well known geologically. According to Dr. W. J. Pugh, F.R.S., Director of the Geological Survey, this test will provide an opportunity to assess the accuracy, utility and economy of the airborne magnetometer under such conditions.

The world's first commercial survey was flown in Ontario in mid-winter, 1947, and since then the airborne magnetometer has proved especially useful in helping to uncover deposits of iron ore, titanium, asbestos and nickel in Canada, as well as in reconnaissance over large areas in the Canadian Northwest for the oil industry. Canadian Aero has made surveys totalling more than 600,000 miles in Canada.

Nearly 2,000,000 miles of airborne magnetometer surveys have been flown since 1947 in virtually all parts of the world, and the operational standards and accuracies established in these governmental and commercial surveys will apply to this project. Magnetic measurements as small as 1 part in 50,000 are being recorded.

The airborne magnetometer was manufactured by the Gulf Research & Development Co. of Pittsburg, a part of the Gulf Oil Company. It is used under lease, and Gulf is cooperating with this special, non-commercial scientific investigation.

Decca Navigation, an outstanding British development in aerial navigation, is guiding the survey aircraft along its flight lines. It is believed that this is the first major use of Decca for aerial geophysical surveys, and one objective of the Midlands survey is to evaluate the Decca system in such uses.

The survey aircraft carries a recording radio-altimeter and a continuous "strip" camera, which photographs the entire flight path on 35mm. film. These instruments and the Decca instruments are required for reconstruction of the exact path and altitude of the aircraft, so that magnetic data can be compiled in precise maps.

The survey flying will be completed in about two months. Compilation of the data will be done in a few more months. Magnetic surveys on the ground would take many years and entail the expenditure of considerably more money than the aerial survey. It is also expected that the air magnetic study will be less affected by the power plants and cities of the heavily industrialized Midlands than a ground survey would be.

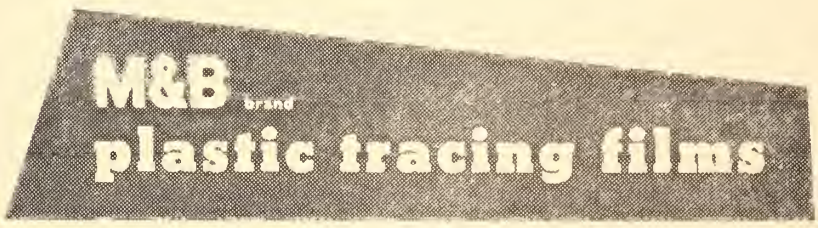
●

Electrically-Operated Valves. — The Saunders Valve Company, Limited, of Cwmbran, Monmouthshire, is producing a new range of electrically-operated valves in which electrical actuators provide positive opening and closing. The units, which are supplied in sizes from 6 inches to 12 inches are arranged for operation with contactor type control and for either local or remote control. In the latter case, panels can be fitted with indicator lights or with dial indicator giving the actual position of the valve. The drive is reversible in any position between open and closed.

●

Glandless Circulating Pump.—As pressures and temperatures in power plant have risen, troubles have been encountered in gland leakage in circulating pumps, and it has been necessary to use large volumes of water for stuffing-box cooling purposes. To overcome these difficulties a totally-enclosed pump and motor unit in which there are no gland or rotating seals has been developed by Hayward Tyler and Company, Limited, of Luton, Bedfordshire, England. In this boiler circulator the pump and motor are enclosed in a single pressure-tight shell. The shell is completely filled with water, which serves to lubricate and cool the motor, and the design is such that possibility of leakage round the pump shaft is eliminated. The circulators are made with a single radial or mixed flow impeller, and can be designed for working pressures up to 3,000 p.s.i. Driving motors from a few horse-power up to 250 h.p., according to duty, are available for the standard range being made at present, although special requirements units of up to 2,000 h.p. can be supplied.

The circulators are normally installed in a vertical position in the pipe system by means of flanges or by welding the pump casing into the pipe work, and their design is such that there is no need for heavy anchorages or pedestals. The motor shaft runs in two journal bearings and is extended to carry the overhead impeller. For operation, the casing is filled with water at boiler pressure, the only external connections being the pump suction and discharge, the inlet and outlet to a high pressure cooler, and the glands for the power supply. A squirrel-cage induction motor is used and no electrical contact with the rotating assembly is therefore necessary.



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• Branch News

(*Continued from page 1279*)

and convention at the Gratiot Inn in Port Huron on June 9, 10 and 11. The attendance of engineers and their families from all parts of Michigan was excellent.

The arrangements for these meetings were handled by the Blue Water Chapter of the Society and this hard working group instituted a number of new ideas—probably the most significant of which was to declare June 10 as International Day.

The Finance Committee approached the Sarnia Branch of the Engineering Institute of Canada asking for assistance and co-operation in arranging for a truly international program.

On the morning of June 10 buses left Port Huron on field trips to the Imperial Oil Limited and Fiberglas plants in Sarnia. While the plant tours were in progress the wives of the Michigan Society members, in company with the wives of the Sarnia E.I.C. members, went on a shopping tour of Sarnia. At noon the ladies retired to Port Huron for a luncheon meeting at the Black River Golf Club.

Luncheon Meeting

The luncheon meeting for the men was a buffet affair on the lawns of the Gratiot Inn overlooking Lake Huron. Following the luncheon the group assembled in the main dining room under the chairmanship of J. E. Harris, chairman of the Sarnia Branch of the Engineering Institute of Canada. This meeting was attended by engineering representatives from Sarnia industries. The president of the E.I.C. was represented by G. R. Henderson, retiring vice-president. Mr. Montague, the president of the Association of Professional Engineers of Ontario was present and was accompanied by his executive director, T. Medland. L. S. Crockett, a councillor for the Chemical Institute of Canada, represented E. R. Rowzee, their recently retired president.

Orval Johnston, assistant generating engineer of the Hydro-Electric Power Commission of Ontario was guest speaker and addressed the meeting on the subject of the Sir Adam Beck No. 1 Plant at Niagara Falls, Ontario. Mr. Johnston's address was most appropriate and was exceptionally well presented.

The Society's annual banquet and ball was held the evening of the same day and was also attended by a number of guests from Canada.

• Employment Service

(*Continued from page 1276*)

CONSULTING MANAGEMENT ENGINEER requires engineer with thorough knowledge of plant maintenance and operation for consulting work in Canada and the U.S.A. Starting salary $150 per week or more plus expenses depending upon qualifications. File No. 5367-V.

MINING OR CHEMICAL ENGINEER having design and detail experience in ore handling or chemical plant equipment is required by a large Kingston manufacturing company. Reply giving complete information on personal history, education and experience. File No. 5372-V.

YOUNG ENGINEER or architect required for young construction firm, specializing more in sewer work and excavation but also doing building construction. Salary to start $400.00 per month. Must have at least two years experience and not over 35 years of age. Apply stating age, graduation, experience, and references to File No. 5373-V.

PROJECT AND CONSTRUCTION ENGINEER. Graduate in civil or mechanical engineering with three to five years experience in building structure, material handling equipment, structural and machine design. Supervisory ability in draughting. Experience in smelting operation or construction would be an asset. Fluent English is essential. File No. 5378-V.

EASTERN TOWNSHIPS OF QUEBEC firm requires graduate and/or practical engineer to take over responsibility for all plant mechanical, electrical, heating and construction problems. This is basically a planning and coordinative job with appointment as mechanical superintendent as its aim. File No. 5379-V.

APPLICATIONS ARE INVITED for engineers and architects with good academic records and preferably with a few years of experience for positions as research officers in the division of building research, National Research Council, for work in the following fields: **Housing**, to undertake studies leading to the assessment of materials and the evaluation of the performance of components for application in housing. **Construction**: the dissemination of technical information to the construction industry. Study in the performance of new materials and techniques used in construction. **Building Code**: to undertake studies relating to the preparation of building regulations, particularly in the field of public health engineering, in relation to the National Building Code of Canada. **Building Design**: A civil engineer for the investigation of the structural performance of building components and completed structures. The work in view includes the testing of full scale structural elements in the laboratory and in the field. **Soil Mechanics**: A civil engineer to work in the laboratory and in the field on urgent projects already under way in this section. **Fire Research**: A chemical engineer or chemist for laboratory research into the combustion properties of materials especially those used in buildings, and into the application of chemical agents for the suppression of fire. File No. 5386-V.

PLANT ENGINEER required for a plant located in Sherbrooke, P.Q. Should be capable of taking full charge of all maintenance and construction work. Salary dependent upon qualifications. File No. 5387-V.

PHYSICAL METALLURGIST to undertake both fundamental and applied research on nonferrous metals primarily lead and zinc and their alloys. Salary dependent upon qualifications and experience. Location Southern British Columbia. File No. 5391-V.

INSTRUMENTATION ENGINEER to design measuring and control systems for chemical and metallurgical process. Work includes preparation of flowsheets, wiring and piping diagrams, layout and detail drawings, detailed instrument specifications and cost estimates. Location Western Canada. Salary open. File No. 5391-V.

CIVIL, MECHANICAL OR CHEMICAL engineers with about 5 years experience on construction of industrial plants and process equipment required as field engineers by company planning to build new plant. Location Ontario. File No. 5392-V.

MANUFACTURING EXECUTIVE, required by Pharmaceutical Industry, to direct manufacturing and related operations in Montreal plant servicing the entire Canadian market. Although part of a leading American company, general management resides in Montreal. The applicant should have knowledge of light manufacturing and packaging technique, preferably in pharmaceutical or cosmetic field. Degree in Chemistry, Pharmacy and Engineering necessary. Age under 45 years. Send resume and salary required to File No. 5394-V.

ENGINEERING GEOLOGIST, required by well known company specializing in the field of Soil Mechanics, foundation engineering and geotechnical processes. Must have post graduate studies in Pleistocene and be interested in the application of geologic aspects to civil engineering works. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

MECHANICAL, MINING OR CIVIL ENGINEER, required for sales work in the Province of Quebec. Requirements: earthmoving and/or heavy equipment experience, bilingual preferred, free to travel. Age up to 40. Good appearance and background. Excellent remuneration, insurance and pension benefits guaranteed by advertisers who are Quebec distributors for world renowned make of heavy equipment in the earthmoving field. File No. 5397-V.

WAVE FILTERS AND OSCILLATOR NETWORKS FOR FREQUENCY-DIVISION MULTIPLEX SYSTEMS

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"	F2125	Receive filter	170 "	255-4835 "	28
"	F9610	Oscillotor network	170 "	255-4835 "	28
"	F6131	Send filter	120 "	300-4980 "	40
"	F8261	Receive filter	120 "	300-4980 "	40
"	F9631	Oscillotor network	120 "	300-4980 "	40
F-5 Corrier-Telegroph, S+Dx	F11294	Send filter ond oscillotor network	120 "	3120, 3240, 3360 "	3
"	F11291	Receive filter ond discriminotor network	120 "	3120, 3240, 3360 "	3
"	F11209	Low-poss filter	—	0 to 2950 "	—
Corrier-Telephone (Type C System)	F15002	Chonnel filter	opprox. 3 kc.	3-32 kc.	8
Corrier-Telephone (Type C System)	F15340	Oscillotor network	opprox. 3 kc.	3-32 kc.	8
Corrier-Telephone	F9511	Channel filter	4 kc.	4-36 kc.	8
"	F9520	Oscillotor network	4 kc.	4-36 kc.	8
Corrier-Telephone (Type C System)	F2121	Line filter ond boloncing network	—	5-kc. crossover	—
Corrier-Telephone (Type C System)	F8910	Line filter ond boloncing network	—	3-kc. crossover	—
Corrier-Telephone (Type H System)	F1922	Line filter ond boloncing network	—	3-kc. crossover	—

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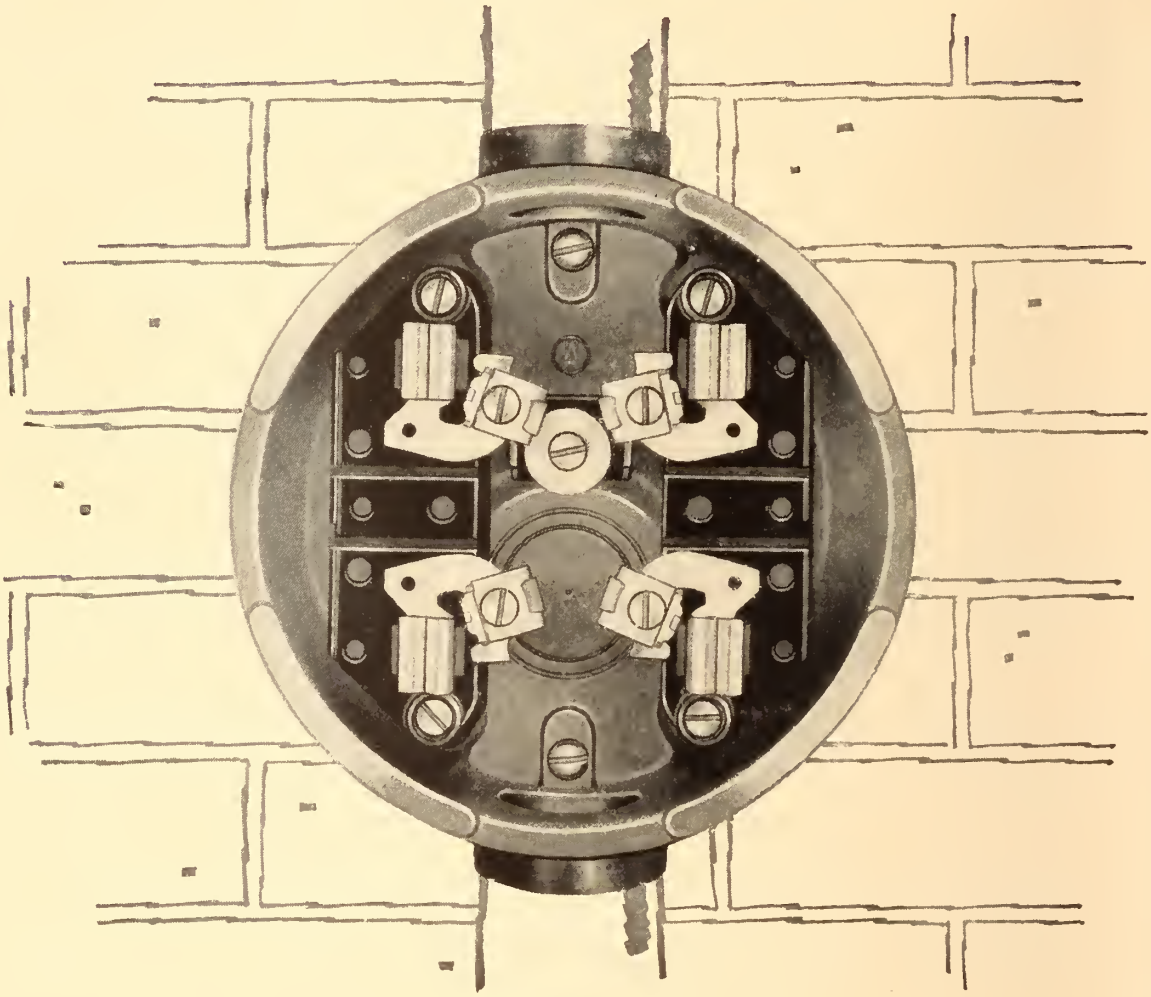

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A Family of New
Engineering Materials

THE SILICONES

by

D. C. R. Miller, M.E.I.C.

General Manager,
Dow Corning Silicones, Limited,
Toronto, Ontario.

Presented at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada. Toronto, May 1955.

A whole new family of substances, the silicones, have recently found their way into the rubber, plastics, plywood, aircraft, paint, electrical equipment, automotive, cable, hardboard, construction, clothing, footwear, baking, bottling, packing, and many other industries. Their uses are multiplying daily. The trend is towards increasing utilization of types which, combined with organic materials, may be used to upgrade their durability and extend their temperature range. There is something in this paper of interest for every engineer, wherever his field of work.

At rare intervals there is born into the engineering world a new material or process with ramifications reaching into practically every industry. One such material is the glass fibre reinforced plasties. Other examples which come most readily to mind are all metals —nickel, aluminum, and magnesium. Though diverse in their uses, these materials retain the same basic form throughout, whether used alone or in combination with other materials.

The silicones, however, are a whole family of substances, with uses multiplying almost daily, available in such diverse forms as liquids, rubbers, or resins of many types. More even than the most useful of metals these new substances, in the twelve short years since their first commercial production, have spread into almost every engineering field. The survey of this important development which follows is particularly appropriate to a diverse engineering group such as ours, for one or another type of silicone cannot fail to be of interest to everyone, no matter what his field.

The term 'silicone' has come to be applied to all the polymers based on alternate silicon and oxygen atoms, or siloxane linkages, with organic groups attached through carbon to the silicon. The siloxane structure, which is responsible for the durability, oxidation resistance and chemical inertness of glass and quartz, is what imparts to the silicones their remarkable properties.

An even broader use of the term 'silicone' may be expected in years to come to cover silicon-carbon, silicon-nitrogen, or other linkages replacing the siloxane bonds in whole or in part. By varying their molecular arrangement, composition, and degree of cross-linking, these silicon-containing polymers can be made as fluids, rubbers, or resins in an immense variety of types. No attempt will be made here to describe details of methods of synthesis or chemical composition, except in so far as either relates to the properties and uses of each of these three main groups.

The Silicones As Fluids

Methyl Silicone Fluids—Properties.—The silicone fluids in commonest use at present are the methyl silicones, usually depicted as straight-chain polymers based on a siloxane backbone with two methyl groups attached to each silicon atom, and chain lengths from two to many hundreds or even thousands, they give fluids varying in viscosity from that of water to that of asphalt. These methyl silicone fluids are about 60 per cent inorganic, and thus exhibit many of the properties of their quartz parentage and of the family in general.

Excluding the volatile low polymers of the series, the methyl silicone fluids are inert, heat-stable, non-oxidizing, and non-volatile. They have low freezing and high boiling points, and change viscosity extremely little with temperature or under shearing conditions. They are soluble in most aromatic and chlorinated hydrocarbons, but incompatible with most organic polymers.

They have extremely low surface tensions and a correspondingly great affinity for wetting metal and glass surfaces. They are highly water repellent, have excellent dielectric properties, and have much greater compressibility than organic fluids. On one or several of these properties depend all their multitudinous uses.

Typical medium-viscosity fluids have freezing points around —55° C., boiling points over 250° C. and a volatility of less than 2 per cent after 48 hours heating at 200° C. Their glass-like non-volatility is further shown from the fact that they may be heated to 150° C. for 12 months with a weight loss of only one-half per cent. A typical heavy mineral oil would show a 15 per cent weight loss after one month.

These fluids show less change in viscosity with temperature than any others. Compared with a typi-

cal S.A.E. 30 motor oil, which increases from 6.6 centistokes at 120° C. to 70,000 centistokes at —25° C., a methyl silicone fluid having the same room temperature viscosity as the petroleum oil, increases only from 75 centistokes at 120° C. to 1300 at —25° C. The change in viscosity is barely 1/50th of that of the organic fluid over the same operating span.

This behaviour is thought to result from the fact that individual molecules of the fluid are not straight chains but are helical, with 6-7 silicon atoms per turn. On heating, thermal agitation increases the molecular spacing, thus tending to reduce viscosity; but the coiled molecules lengthen and thereby exert an opposing effect.

The lubricating properties of these fluids, while satisfactory for many conditions of loading and combinations of bearing metals, is poor under extreme pressures and with sliding ferrous surfaces. This is thought to be related to the helical form of the molecules, which permits the silicone film to be easily displaced. This helical form also makes it easy to visualize why the methyl silicone fluids are so compressible.

Figure 1 shows the comparison in compressibility between a range of methyl silicone fluids and a typical mineral oil. At 15,000 p.s.i. the organic oil is compressed 4.7 per cent by volume, the methyl silicone fluids from 7.8 to 10.4 per cent, the lower viscosity polymers having the highest compressibility. The centre line shows values achieved for a medium viscosity silicone fluid specially developed for maximum compressibility. Additional properties are shown in Table I.

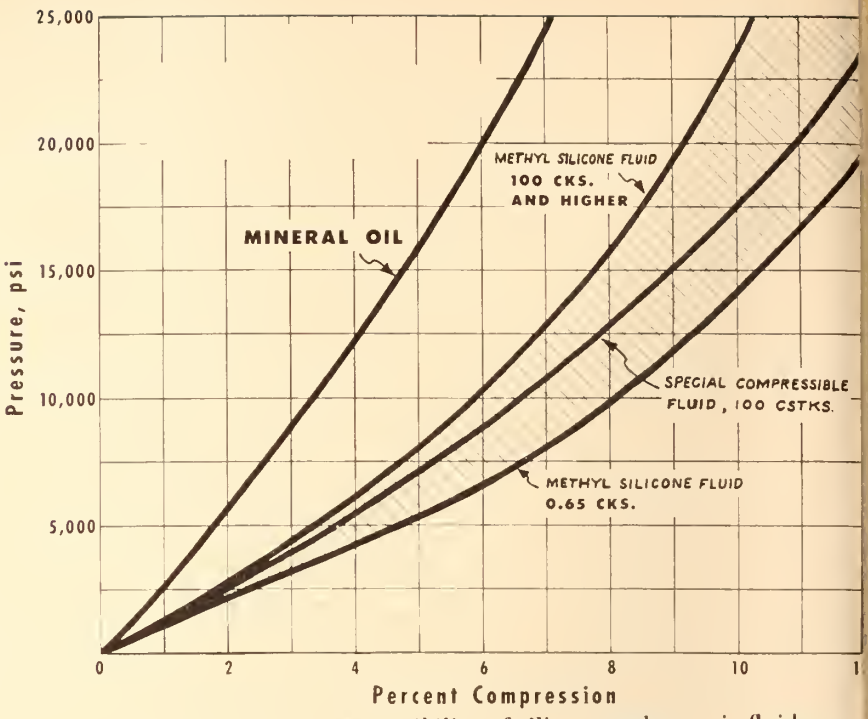


Fig. 1. Comparative compressibility of silicone and organic fluids.

Table I Properties of Methyl and Methyl-Phenyl Silicone Fluids

Silicone Fluid	Viscosity (centistokes)	Viscosity Temperature Coefficient[1]	Pour Point (°F.)	Flash Point (°F.)	Volatility after 48 hr. at 500°F. (per cent)	Gel Time at 500°F. (hours)
Methyl[2]	1.0	0.37	—123	100	Distils	Distils
Methyl[2]	10.0	0.60	— 67	575	5	24
Methyl[2]	500	0.61	— 58	600	5	24
High-Methyl Phenyl[3]..	500	0.64	— 70	525	9	400
Med.-Methyl Phenyl..	150	0.76	— 58	575	10	750
Low-Methyl Phenyl...	500	0.83	— 8	600	15	1000

[1] 1 — viscosity at 210°F./viscosity at 100°F.
[2] Produced in viscosities from 0.65 to ∧ 1,000,000 centistokes.
[3] Produced in viscosities from 50 to 100,000 centistokes.

Methyl Silicone Fluids—Applications. — The flat temperature-viscosity slopes of the methyl silicone fluids and their resistance to shear breakdown have led to their widespread use in overload relays, instruments such as accelerometers and recorders, torsional vibration dampers for internal combustion engine crankshafts, dashpots and shock absorbers.

Because they are heat-stable, oxidation-resistant and non-volatile, as well as incompatible with most organic polymers, they are ideal release agents for many types of moulding operations. They do not decompose or carbonize when applied to hot moulds, and so reduce mould maintenance and improve surface finish. For this purpose they are used neat, or as water dilutable emulsions, as grease-like compounds, or solvent dispersions. Their low surface tension makes them effective in concentrations as low as ¼ per cent, and thus economical.

In the rubber industry their us has become universal for tire heels, soles, floor tiles and me chanical goods. In the plastic in dustry they are used to releas all types of mouldings — poly styrene, melamine, phenoli polyester and epoxy resins. In th plywood industry they preven build-up of adhesive on platen and cauls and are used to lubricat edge gluer chains and saws. I the food industry they facilitat heat-sealing operations on all type of film wrapping materials an prevent build-up and adhesion o foods to cooking coils, tanks an kettles. In the metal casting fiel they improve release of zinc an aluminum die-castings, zinc an silver ingots, and brass ingot poured in cast iron moulds.

Silicone release agents have con tributed towards making the shell casting process practicable by per mitting the consistent clean, eas release of the sand-resin shell from automatic shell mouldin machines. Production of parts t close tolerances is possible becaus of minimum build-up on the met patterns.

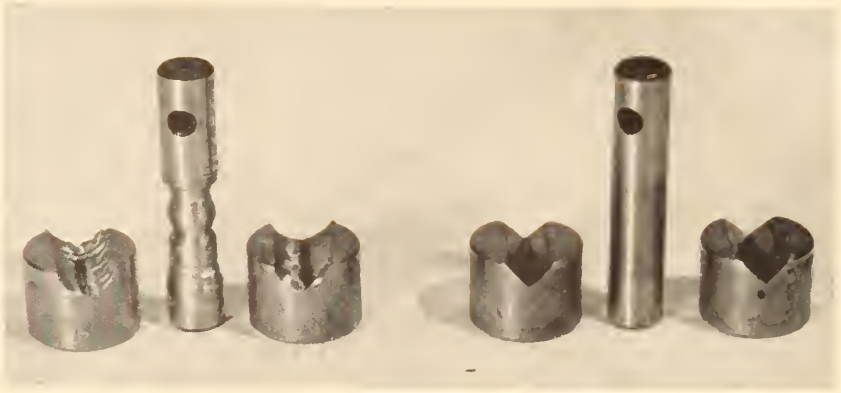
Their properties of compressibi ity are already being utilized i liquid spring devices involvin high force, short stroke applica tions, such as aircraft landing gea and dies for forming and punchin sheet metal. A piston and cylinde assembly is filled with silicone flui and spring action obtained by flui

compression. By providing small orifices in the piston it is possible to obtain both a spring and damping action in a single device.

Such units make possible great savings in weight and space, as illustrated in Fig. 3 where for a ¼ in. stroke the liquid spring develops a 3,800 lb. force, against 3,250 lb. for the tractor coil spring shown. Increases in force compared with coil springs of equal size range from 300 per cent greater force for 2,200 lb. per inch spring rate, to 3,000 per cent for 50,000 lb. per inch rate. Liquid springs have the further advantage of being able to operate at high speeds without resonant frequencies.

The properties of inertness, non-compatibility, non-volatility and water-repellence are now being utilized in most furniture and automobile polishes. The polishes have a high gloss and provide a weather-resistant and non-staining surface. The same properties are being used in various cosmetic preparations as hand creams, ointment bases and burn unguents. Their excellent dielectric properties, unchanged over a wide frequency range, make them useful as liquid dielectrics for condensers, capacitors, and small transformers designed for maximum reliability over a wide temperature range.

These silicone fluids, when combined with inorganic fillers, can be made into grease-like compounds with many useful properties. One such material is used as a non-melting, non-drying, moisture-proof dielectric seal for ignition and electrical systems, and as a lubricant and preservative for automotive rubber parts. Another similar silicone compound is used as a valve and pump packing lubricant in systems handling hot water, steam, many dilute and concentrated acids and alkalis, and many corrosive gases, over a temperature range from − 40° to 250° C.



Courtesy Westinghouse Electric Corp.

Fig. 2. At the conclusion of a high pressure bearing test on a Falex machine, steel against steel, this shows comparative wear between (left) specimen lubricated with a methyl silicone oil, and (right) a specimen showing no wear when lubricated with one of the newer silicone fluids (p-bromophenylmethyl silicone oil).

Yet another methyl silicone compound is an extremely active and versatile defoaming agent for the majority of aqueous and non-aqueous foamers. It is equally effective in oils, asphalts, varnish cooking, rubber latices, detergents, jam, tallow, and glue—usually in concentrations of less than 40 parts per million.

This compound is supplied also as an edible emulsion and as an aerosol spray. Its efficacy is thought to be related to the combination of low surface tension and incompatibility effects at the gas-liquid interface of the foam. The same properties make the fluids useful as paint additives, to reduce pigment floating and 'silking', to improve flow-out, and impart mar resistance.

Methyl-Phenyl Silicone Fluids—Properties and Applications.—Next come the methyl-phenyl fluids, in which phenyl radicals are partially substituted for methyl to give methyl-phenyl silicones with varying proportions of methyl to phenyl. These fluids become progressively more heat-stable as the amount of phenyl is increased, and exhibit better lubricating properties, as well as being more compatible with organic substances. Table I compares the properties of three viscosity grades of methyl silicone fluid with a high-, medium-, and low-methyl phenyl silicone.

These materials are used as extreme range lubricating oils and as heat transfer media in heat treating and high temperature baths. The medium-methyl phenyl fluid may be heated to 200° C. for 12 months with a weight loss of only 14.6 per cent.

By combining suitable fluids of this type with lithium soaps and thickening agents such as carbon black, silicone greases may be made which will operate within the range —100° F. to 500° F., or higher in intermittent service. These greases are very satisfactory for ball and roller bearing lubrication for high or low temperature service. Their oxidation resistance makes possible permanent lubrication at normal temperature.

Under identical conditions the silicone grease may be expected to

Fig. 3. The silicone-filled spring on the right has about 20% greater capacity than the much larger caged coil spring.

have ten times or more the life of organic grease. These greases are used in various meters and instruments exposed to extremely low temperatures, electric motor and fan bearings, textile driers, oven conveyors, kiln car bearings, and in similar extreme services. Savings in maintenance cost and downtime justify their much higher price.

Other Silicone Fluids.—Much effort has been expended recently to produce silicone fluids having better lubricating properties in sliding friction between ferrous surfaces. The aircraft gas turbines now being designed for even modest supersonic speeds need a lubricant with an operating range —65 to 800°F. Silicone fluids with halogenated organic groups give promise of having the necessary lubricating properties. It is unlikely that such an operating span as this will ever be approached by non-silicone lubricants.

A Falex machine test, steel versus steel, for a methyl silicone and one of the newer types, gives convincing proof of progress made already. [1]In a recent test, steel ball bearings were immersed in lubricant, turned at constant speed and subjected to increased bearing pressures till seizing occurred. The new silicone fluid permitted the ball to slide at 107,000 p.s.i. versus 27,000 p.s.i. for an organic diester and 14,000 p.s.i. for a petroleum base jet engine lubricant. Such fluids can of course be formulated into greases in the same way as the conventional types. (Fig. 2)

Considerable work has also been done towards developing a non-flammable aircraft hydraulic fluid by blending a methyl silicone with a halocarbon oil. This product appears to have better lubricating properties in hydraulic systems than standard mineral oils, will operate for hundreds of hours at 500°F., and does not swell organic rubber seals. It should be of special value in military aircraft.

Methyl and phenyl radicals, alone, in combination, or modified, are those mainly used in the commercial silicone fluids to-day. When larger organic groups are used the resultant fluids suffer reduced heat stability and lose more and more of the special properties deriving from the central siloxane structure. Nevertheless, at normal indoor or outdoor temperatures, resistance to weathering and sunlight, and durability may still be far superior to organic polymers. These materials may well find uses as water repellents. When produced in equal quantities they should be cheaper than the methyl silicones, currently around $4.00 per pound.

Silicone fluids having reactive organic radicals such as hydrogen, allyl, vinyl, or many others may be prepared and have interesting and useful properties. As these are converted to resins by application of heat or exposure to air, they will be covered under resins, as also will the reactive water-dispersible types.

Table II Comparison of Heat Aging Behaviour of Silicone and Organic Rubbers

Aging Temperature and Time	Flex Life*			Durometer			Tensile Strength (p.s.i.)			Elongation (per cent)		
	Silastic		Organic	Silastic		Organic	Silastic		Organic	Silastic		Organic
	50	80	Rubber	50	80	Rubber	50	80	Rubber	50	80	Rubber
Initial	OK	OK	OK	54	80	61	931	800	2077	310	260	530
300°F.												
3 days	OK	OK	OK	56	80	78	904	816	1018	276	244	69
7 days	OK	OK	**	59	81	**	885	744	**	257	216	**
8 weeks	OK	OK		64	88		792	616		173	125	
30 weeks	OK	OK		64	89		437	527		71	44	
39 weeks	OK	†		65	†		410	†		65	†	
392°F.												
16 hours	OK	OK	OK	..	..	85	...	...	332	...	...	5
1 week	OK	OK	‡	55	81	‡	884	696	‡	257	157	‡
16 weeks	OK	OK		63	94		568	640		118	54	
24 weeks	OK	†		64	†		558	†		115	†	
28 weeks	OK			66			540			96		
480°F.												
4 hours	OK	OK	OK	..	..	98	...	...	3550	...	...	11
1 day	OK	OK	***	59	80	***	856	727	***	235	187	***
4 weeks	OK	OK		63	89		688	560		96	15	
6 weeks	OK	†		68	†		632	†		87	†	

* Test — 180 degree bend over ⅜ in. mandrel without breaking. † Failure point, flexural test. **Failed after 4 days at 300° F.
‡ Failed flex test after 19 hours at 392° F. *** Failed flex test after 8 hours at 480° F.

The Silicones As Rubbers

Silicone Gums — Types and Properties.—When the chain length of the methyl silicone fluids is sufficiently lengthened, they become elastomeric gums, which may be compounded with inorganic fillers and caused to cross-link by heating with a "vulcanizing" agent to form a whole new class of materials, the silicone rubbers. Because of the close resemblance between the silicone gums and the silicone fluids we find in the resulting silicone rubbers many of the same properties — they are unaffected by extremes of temperature, weathering, and attack by most chemicals; they are water repellent and have good dielectric properties. They look and feel like organic rubbers but retain their rubber properties over a 600°F. range.

The silicone gums may be varied in molecular weight and composition, just like the fluids. The lower molecular weight gums are used for compounding into putties or pastes, with or without vulcanizing agents. One such non-vulcanizing form is "bouncing putty" which may be regarded as a bridge between the fluids and the rubbers. It has the anomalous properties of flowing like a viscous liquid, bouncing like rubber, and shattering like a brittle solid at a sharp blow.

Other types of paste may be made in various degrees of fluidity for different methods of application —knife-coating, vacuum impregnating, dip coating or caulking. These may be converted to rubbers without significant shrinkage by heating, since they contain no solvent. No latex forms are yet available, but the coatings can be applied from solvent dispersions.

A recent important advance has

been the development of room-temperature vulcanizing pastes. These are supplied as two components which, when mixed together in equal amounts, will cure at room temperature overnight to silicone rubbers.

When gums of higher molecular weight are used and compounded with fillers, vulcanizing agent, and possibly other additives, crude silicone rubbers are produced analogous to organic rubber crepes. The most generally used gums are methyl silicone polymers. These yield rubbers with brittle points down to —80°F. Where brittle points down to —130°F. are needed, methyl-phenyl gums are used. Special gums are also available for producing low shrinkage stocks, and low compression set. (This is the term used to describe the ability of a rubber to resist permanent deformation when heated and compressed, an important property in gaskets and 0-rings).

The vulcanizing agents normally used for silicone rubbers are strong organic peroxides, such as benzoyl peroxide. These materials decompose when heated, liberating free oxygen which reacts with the methyl groups on adjacent polymer chains. Cross-links are formed at these points and rubberiness quickly develops.

In addition to the usual silicone gums, there has recently been developed a vinyl-modified methyl silicone gum which is compatible with many organic rubbers and can be co-vulcanized with them using the conventional sulphur and sulphur-containing vulcanizing agents. This new polymer is heat-stable up to 200° C., and when blended with natural gum rubber, butyl, or neoprene will improve heat stability, resistance to weathering, corona and ozone, and improve low temperature flexibility.

Silicone Rubbers — Compounding and Properties.—As the compounding of silicone rubbers is a subject in itself and much of the available information unpublished, no attempt will be made to cover it fully here.[2] By the proper choice of quantity, quality, and combination of fillers, vulcanizing agents, and gums, the properties may be varied widely. When certain properties are required to the maximum extent, it is necessary to compromise on other properties—e.g., in order to obtain the lowest compression set, some elongation, or tear strength, may have to be sacrificed.

The various grades of fine silica commercially available are the most effective re-inforcing fillers and of these fumed silica (silica soot) is outstanding. Other inorganic fillers such as calcium carbonate, iron oxide, titanium dioxide, and zirconium silicate may be added, depending on properties desired, colour, and type of fabrication. Mercuric and cadmium oxides may be used as compression set additives. As scores of different stocks may be compounded, the information which follows on properties must necessarily be either general in nature, or apply to specific compounds.

Probably the most important property of silicone rubbers is resistance to heat aging. Table II compares this behaviour for two particular general purpose silicone rubber stocks of 50 and 80 durometer, with a representative organic rubber.

This comparison shows the very limited usefulness of organic rubbers at even 300° F. and the serious drop in strength and elongation after only 3 days at this temperature. These rubbers were still in good condition after 30 weeks at 300° F., and are useful engineering materials at temperatures up to 500° F.

At the opposite end of the scale, the extreme temperature grades of silicone rubber, with brittle points of —130° F. or lower, retain their rubbery properties down to —100° F. with little change, whereas organic rubbers, though they can be compounded for brittle points of —65° F. and lower, are very much stiffer and less resilient at sub-zero temperatures. Silicone rubbers are unaffected by outdoor weathering. Samples have been exposed on roof racks for five years in Florida with no significant change in properties.

Table II will also serve to compare physical properties of silicone and organic rubbers. Although silicone rubbers can be compounded with tensile strength close to 2,000 p.s.i. and elongation of 850 per cent, such stocks at present have limited heat stability and values of 800-1,100 p.s.i. tensile and 250-300 per cent elongation are more representative. These properties, in the general purpose stocks, are well maintained over the wide operating range. The particular stocks shown lost only 10 per cent of tensile strength after 1,000 hours at 392° F. The organic rubber had lost 90 per cent of its strength after 16 hours at this temperature.

Silicone rubbers compounded for optimum electrical properties have a dielectric strength of about 550 volts per mil in $\frac{1}{8}$ in. thickness, and retain their dielectric properties at high temperatures and high frequencies. Special cloth-coating stocks, with dielectric strength on 0.010 cloth of 1,200 volts per mil, showed no loss in dielectric strength after 800 hours at 480° F. or 200 hours at 600° F.

When compounded with silica soot, silicone rubbers with very low moisture absorption can be made. These stocks retain both

Fig. 4. These electronic parts were encapsulated by spatula-coating with a room-temperature-vulcanizing silicone rubber paste to provide complete protection from water or humidity. Parts shown include a transformer, choke, solenoid, tube socket, resistor, and toggle switch.

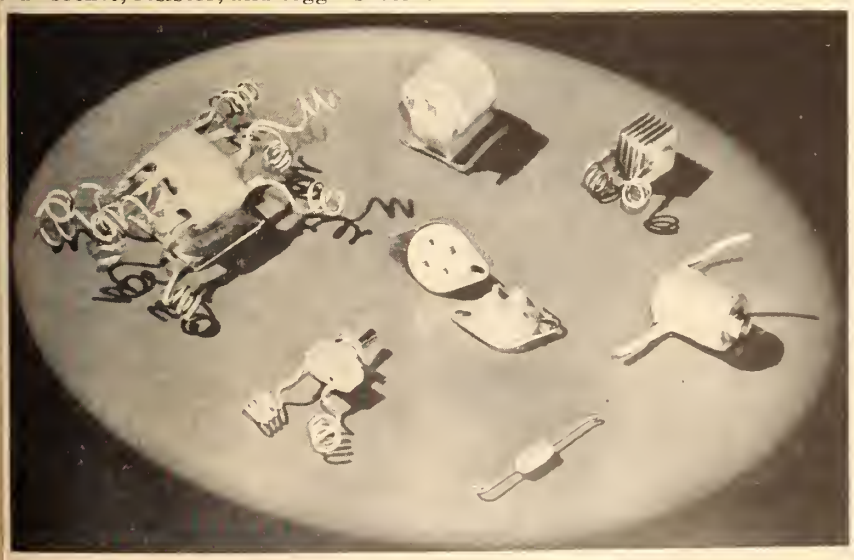


Fig. 5. Selection of aircraft and industrial parts made of mandrel-wrapped silicone rubber coated glass cloth, including bellows, connections, ducting, hose, and seals. These parts will withstand long exposure to high temperatures, remain flexible at low temperatures, and resist most oils, chemicals, and weathering.

electrical and mechanical properties after 4 months' immersion in boiling water. In a test for corona resistance on 5 mm. ignition wires at 14,000 volts, the organic rubber covering broke down from corona cutting in 30 minutes; the silicone rubber was still unaffected after 12,000 hours.

The silicone rubbers are resistant to a variety of chemicals and some, but not all, hot oils. Certain stocks are resistant to hot water and saturated steam at pressures below 100 p.s.i. All are badly swelled by most volatile hydrocarbons such as gasoline, kerosene, and carbon tetrachloride. Usually they recover their properties on removal.

Fabrication.—This is done on the same equipment and with much the same techniques as with organic rubbers. Silicone rubbers may be moulded, extruded into shapes or on to wire, calendered, and knife-coated onto cloth. Only thick sections, over 1 in., present difficulty. In moulded parts, initial curing takes place in a few minutes at 260° F., so that press time is far lower than for organic rubbers, and tooling cost thereby reduced. After vulcanization a 24 hour oven cure at 480° F. is necessary with stocks where minimum compression set is required. On others where only maximum strength and toughness are sought, one hour at 300° F. is enough.

Silicone rubbers can be easily bonded to metals or glass either by direct moulding or through the use of suitable primers and baking or air-drying adhesives. Like organic rubbers, and by similar methods, they can be sponged. Special stocks have recently been developed to permit continuous hot air vulcanizing of extrusions or calendered sheet. At 350° C. thin sections may be cured in 15-20 seconds in an 8-foot tunnel. This permits production of intricate extrusions to greater precision at low cost.[3]

Applications.—The price of silicone rubbers, currently in the $2.50-$4.00 per pound range, limits their use to places where organic rubbers are totally unsuited or fail rapidly. The following examples will show the variety of uses to which engineers have already put these remarkable materials, and the uses foreseen for the newest types.

No volume uses have yet developed for the silicone "bouncing putties" though their use in a combination slip clutch and flexible coupling has been proposed.[4] As cloth coating materials, the silicone rubber pastes are used in many gasket applications. A typical example is in aircraft engine rocker box gaskets in contact with hot engine oil at temperatures up to 450°F. Similar coated glass cloths are used in aircraft hot air ducts for heating and de-icing, as diaphragms in pumps and valves exposed to heat or cold, and in domestic steam irons. Fig. 5 shows a variety of aircraft and industrial parts made by mandrel wrapping of coated glass cloth.

Electrical insulating tapes, fully or partially cured, are made from these materials and used in the hot pressing of field and armature coils in diesel-electric locomotive motors, and as cable wrapping tapes. The pastes are used alone for sealing, caulking and bonding. They may also be used for encapsulating and potting electronic components, coils, or small transformers, through the development of an improved type that will vulcanize rapidly in thick sections without sponging, or the need for a confining mould. For components that might be damaged by the heat of curing, the room temperature vulcanizing pastes are used. Fig. 4 shows components which were spatula-coated and cured at room temperature. Other uses in caulking, glazing, sealing and cloth coating may be expected.

Silicone rubber mouldings are used as flexible boots and seals on aircraft limit switches, and as heat-resistant and moisture-excluding covers for automobile spark plugs. Aircraft engine push rod housing seals remain pliable after more than 1,000 hours in contact with hot engine oil, and greatly reduce maintenance cost. In the form of O-rings they are used in literally dozens of places in aircraft gas turbines.

In the lower cylinder liners of locomotive diesel engines they are used in contact with both hot water and hot oil, giving 9 times the life of organic rubber O-rings. Similar O-rings are used in certain automobile automatic transmissions. Silicone rubber covered rolls are used in embossing thermoplastic films, and the heat-resistant and non-sticking properties utilized in press pads for heat sealing and belts for conveying sticky foods like candy.

As extrusions, silicone rubber are used for sealing the oven doors of domestic stoves to withstand hot cooking fats and temperatures approaching 500°F. In aircraft bomb-bay-doors and cockpit canopy seals they will remain flexible at —100°F. Sponged silicone rubber is used as a cushion seal between aircraft flaps and wings.

Extruded over wire, silicone rubber is used in the waterproof ignition systems of army vehicles as a general purpose high temperature lead wire for motors, ovens and outdoor flood lights. The large

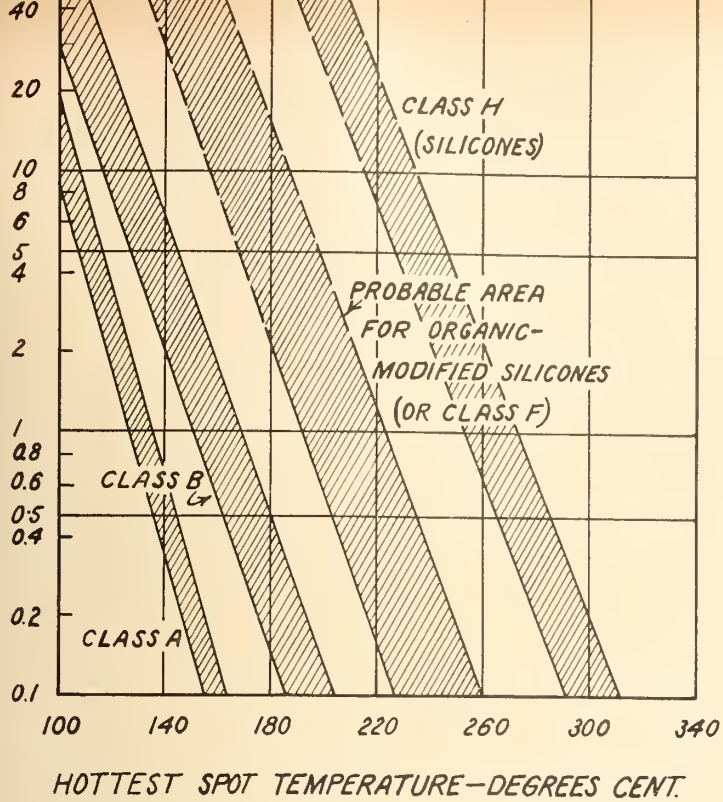


Fig. 6. Comparative life expectancy of Class A, B, F, and H electric insulations, based on motor tests.

est volume use is in the reduced liameter Navy cable program, as a means of saving valuable weight nd space on warships, and keeping vital control and power cables operating despite fire or water damage. These cables must continue to transmit power or signals after 3 hours in a gas flame at 950°C. and rated voltage. The non-conducting nature of the decomposition product, silica, makes this possible.[5]

The sulphur-vulcanizable silicone gums are expected to be useful in extending the low temperature range of organic rubbers in such applications as fan belts and tires for Arctic vehicles; in extending the high temperature range of, for example, hot conveyor belts or landing wheel tires for supersonic aircraft; and in wire and cable uses to improve resistance to ozone, corona, and weathering.

The Silicones As Resins

General Properties.—By a variation of molecular arrangement, silicones can be produced with a greater degree of cross-linking than the fluids or rubbers. These polymers, normally supplied as solvent solutions, will further polymerize either by heating, or in particular cases by air drying, to form silicone resins or varnishes. The physical properties of these resins may be varied by varying the ratio of organic radicals per silicon atom—that is, the degree of cross-linking—and by varying the organic radicals themselves.

Certain low molecular weight resins are compatible with organic resins and may be cold blended with them to up-grade their properties. Still other types may be made by co-polymerizing with organics such as alkyds or phenolics for the same purpose. Such types are becoming more important.

Where some other property than heat-stability is sought—e.g. water repellence — resins with reactive organic groups may be used. These will develop their properties either by relatively mild heating (e.g. 5 minutes at 300° F.) or at room temperature through oxidation, reaction with absorbed surface moisture, or CO_2 from the air. As with organic resins, properties may also be modified by the addition of silicone fluids or gums to act as plasticizers or confer special properties, such as adhesion.

The curing temperature or time of all the silicone or modified silicone resins can be reduced by addition of accelerators or driers, usually fractional percentages of organo-metallic compounds such as zinc naphthenate. These may affect heat life, and reduce shelf life.

The primary properties of the silicone resins are heat stability, resistance to oxidation and weathering, and excellent dielectric properties. By continuing improvements in composition, the heat life of the best silicone resins has been greatly extended: the earlier resins produced had a life, as measured by crazing of films 2-3 mils thick, of about 300 hours at 250° C.; resins with equal or better physical properties are available today with 3,000-hour lives at this temperature. The corresponding life of the most heat-stable phenolic-alkyd organic resins is about 5 hours.

Dielectric strength is equal to or better than the best organic resins and is maintained under extremely humid conditions because of low moisture absorption. Dielectric properties are also maintained even at extreme high frequencies, as is dielectric life at high temperatures, since the decomposition product, silica, continues to insulate, rather than conduct, like carbon. Dielectric life at 200° C. is over 100 times that of organic resins.

All the silicone resins are water repellent, but this behaviour in contact with water as a liquid must be carefully distinguished both from water absorption, and transmission of water vapour. Thin films of silicone resins (as also silicone fluids and rubbers) have high rates of gaseous diffusion, which,

Fig. 7. Part of Dow Corning motor test laboratories shows two 5 h.p. silicone-insulated (Class H) motors which are still operating at 240°C. after 17,000 hours. They have been under test for over 10 years. Organic-insulated motors (Class A) would barely last 30 hours at this temperature.

if undesirable, may be reduced by addition of mica flakes.

Certain of the silicone resins when applied and thoroughly cured on metal surfaces have pronounced and semi-permanent release properties for most organic materials. The solvent resistance of even fully cured silicone resins is, in general, poor, but resistance to acids and dilute alkalis is good. Low temperature flexibility of thin resin films should not be taken for granted. It can be obtained when needed.

Electrical Applications. — Both the all-silicone and the modified silicones are used in high temperature electrical insulation. The resins are used as dipping varnishes and as coatings for glass cloth, tapes, and sleevings, and glass-served magnet wire. They are used as bonding agents for rigid and semi-flexible laminates of glass cloth, asbestos, and mica. A recent important advance has been the development of modified silicones as bare wire enamels, with toughness and solvent resistance comparable with the best organics.

Accelerated aging tests, still continuing after 12 years, and the many thousands of motors built and operated under the most severe conditions during this period, have established the comparative life expectancy of silicone insulated motors (Class H, hottest spot temperature 180° C.) versus those insulated with organic materials (Class A, hottest spot temperature 105° C.) (Fig. 6). This also gives the same data for the new silicone bare wire enamel, which borders on qualifying as a Class H material.

Under identical conditions, the silicone insulated motors have a life expectancy of the order of 100 times that of Class B motors (glass or asbestos, with organic varnishes, hottest spot temperature 130° C.). Figure 7 shows a view of the Dow Corning motor test laboratories including, amongst others, two 5 h.p. motors which are still operating at 240° C. after 47,000 hours, or over 10 years. Class A motors would barely last 30 hours at this temperature.

Such results as these have led to the widespread adoption of Class H insulation for motors operating in moist or corrosive atmospheres or high ambient temperatures; motors in vital production operations where down-time is prohibitive; motors subject to heavy overload or starting loads, or rapid reversing; and motors where size and weight must be kept to a minimum. Life and reliability of solenoid and induction heating coils is similarly increased by silicone insulation. Figure 8 shows a typical application in a steel mill crane motor, exposed to temperatures of 300-400°F. The motor bearings are lubricated with silicone grease.

Fig. 8. Used for pouring steel, this 19-h.p., d.c. crane hoist motor is exposed to fumes at 300°-400° F. Silicone insulation and bearings lubricated with silicone high-temperature greases are incorporated.

(Photo: Canadian Tube and Steel Products Ltd.)

Progress has been made in Canada in applying these new materials to uprating generators as large as 40,000 kva. where turbine capacity permits the loading to be increased, or otherwise by increasing the permissible reactive power.[6] Where larger motors are needed, existing ones may often be rewound Class H to provide 75 to 100 per cent or more additional horsepower.[7] The cost of motor rewinds, taking Class A as 100, may be 150 for Class B and 160-210 for Class H. This comparison strengthens the ease for Class H considering the vastly greater life and reliability, and that labour and down-time costs on failure may far exceed the cost of rewinding.

Yet another consideration is that Class H motors reduce fire hazards by not burning on failure. This fireproofness is one of several reasons why many dry type transformers from 3 to 2,000 kva. are now being silicone-insulated. They require no vaults or maintenance, have great overload capacity and can be efficiently located close to load centres.

Consideration of the great difference in life between Class H and Class B equipment, of the order of 100 times under identical conditions, has led to the recent introduction of an alkyd modified silicone dipping varnish. Barely half the price of a straight silicone this material (Fig. 6), has nevertheless 25 to 50 times the life expectancy of good Class B organic varnishes. It has in addition better oil and solvent resistance than the silicones, better bond strength and excellent moisture vapour resistance. This modified silicone will qualify for the suggested Class H (155°C. hottest spot temperature).

Protective Coating Applications —Silicone resins similar to the electrical resins can be pigmented and used as protective coatings to span the gap between the less expensive organic paints and the costly but brittle vitreous enamels. The base resins may be either soft and flexible, or hard and tough depending on use.

Unmodified silicone paints are used for extreme temperature applications in the range 500 to 1,500°F., for application to stacks, mufflers and other high temperature surfaces exposed to the weather. High loadings of aluminum powder in conjunction with a soft, flexible resin result in

maximum heat and weather resistance.

Resins of this type are used in aircraft gas turbines in pigmented form to protect combustion cans and as clear films to protect the compressor blades at temperatures up to 300°C. In refinery stack applications paints of this type have demonstrated an outdoor life of 18 months where organic paints failed after a week or two.

For less severe high temperature requirements, modified silicone enamels of either baking or air-drying types may be used. The base resins, usually alkyds, may be modified either by cold blending with specially compatible silicone resins, or by cooking with reactive silicone intermediates, which co-polymerise with the alkyd resin components. The cold-blending types are the most versatile, and as little as 10 per cent addition may be enough to give substantial improvements in gloss retention, weather and heat resistance. These types are compatible with the common organic resins. They are used on space heaters, or domestic appliances and incinerators, replacing the more expensive vitreous enamels.

The air-drying silicone-alkyds are opening up some interesting fields both as clear varnishes with superior weather-resistance, and as paint vehicles for general purpose industrial maintenance finishes. There is economic justification for using a paint with twice the cost of a conventional paint, even if it lasts only twice as long, because 75 per cent or more of the cost of painting jobs is labour, particularly where the structures involved can be repainted only from scaffolding or platforms.

The greatly extended life under outdoor weathering should lead to their adoption first for painting bridges, storage tanks, water towers, and similar inaccessible structures. Eventually, use should be extended to house and trim paints, repainting less often. As an example, large oil storage tanks at Sydney, N.S., were painted two and a half years ago with an air-drying silicone aluminum paint and are still in excellent condition. In this salt atmosphere, conventional aluminum paints failed within a year.

Fig. 9. Silicone glass laminates made by conventional low or high pressure laminating methods. Lighter than aluminum, they have better structural properties at 500° F., and will withstand intermittent exposure to temperatures as high as 900° F.

Fig. 10. These parts were compression or transfer moulded from silicone moulding compounds. They are intended for high-temperature electrical or heat isolation uses. Heat distortion point is over 500° C.

Air-drying silicone phenolics are too new to have found volume applications yet. As they have excellent water-resistance and very low rates of water vapour transmission, they are useful in marine varnishes and paints, and as insulating protective coatings in, for example, printed circuits.

Silicone Laminating Resins. — Special silicone resins have been developed for laminating with glass cloth to form rigid sheets, rods or tubes with excellent strength and electrical properties at high temperatures and high frequencies. These laminates are used for coil forms, slot sticks, and similar electrical applications. Of special interest to the plastics industry is the recent development of a silicone low pressure laminating resin which, in combination with glass fibre reinforcing materials, is used to make low pressure laminates with great strength at high temperatures.

These laminates are outstanding in their strength to weight ratio, and at 500° F. are superior to most light metal alloys. They are not damaged by brief exposure to temperatures up to 900° F. The properties suggest structural uses in high speed aircraft and guided missiles, or for use in gas turbine compressor blades because of freedom from fatigue failures. Figure 9 shows the range of flat, tubular, or complex curved shapes which can be made by conventional low or high pressure laminating methods.

Silicone Moulding Compounds. —Using similar resins, glass reinforced silicone moulding com-

pounds can be made for compression or transfer moulding by standard methods. The resulting parts retain their electrical and physical properties at temperatures over 200° C. The heat distortion point is above 500° C. Potential applications include switches, connector plugs, coil forms and moulded parts for aircraft ignition systems, or any Class II electrical use. They may also be used as high-strength heat isolating materials, as in aircraft brake-shoe assemblies. Figure 10 shows some typical silicone compression and transfer mouldings.

Silicone Foam Resins. — Silicone resins are also available which, in combination with blowing agents and accelerators, may be expanded and cured to rigid, low density, unicellular foams. These are supplied as dry powders containing all the ingredients necessary to permit foaming in place. Foams with a density of 14 lb./cu. ft. retain much of their original compressive strength after 200 hours heating at 500° F., have a heat distortion point above 700° F., and are not damaged by brief heating to a dull red heat. They will not burn. The high price of these foams will limit them for the time being to specialty uses, such as in aircraft for light weight sandwich structures, fillers for airfoils, radomes, and firewall seals.

Silicone Release Resins.—Certain silicone resins, when applied as clear coatings to metal surfaces and thoroughly cured, have the same release properties as some of the silicone fluids, but are semi-permanent. The largest use for such materials is on bread and bun pans in bakeries. Despite baking temperatures around 500°F., a single coating may last as long as 200 bakes, eliminating the cost and smoke of pan grease. Probably half or more of the bread baked in Canada now comes from silicone glazed pans. The same treatment is effective on pans for cooked meats, frozen food trays, and in various rubber, plastic, and hardboard moulding operations.

Silicone Masonry Water Repellents.—The highly water repellent properties of the silicones, coupled with outdoor durability, have led to special types for application to above-grade masonry. These should be flooded onto the surface from a minimum 5 per cent solvent solution, which penetrates to a depth of 1/8 in. to 1/4 in., and on drying forms a durably water-repellent surface. The cost of this dilute resin treatment is low and a single saturating coat should be effective for 5 or 10 years, or more. The coating is invisible and does not prevent the masonry from breathing.

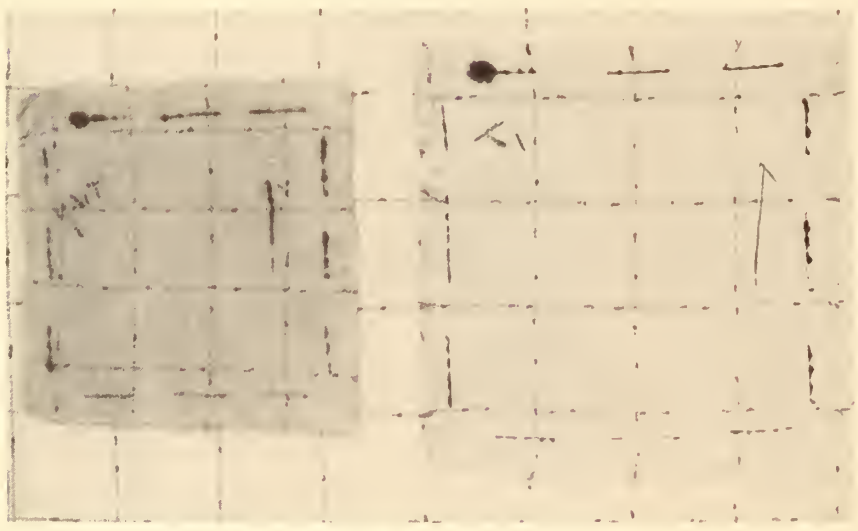


Fig. 11. Comparative shrinkage resistance of silicone treated and untreated wool fabric with the original (the background). The untreated fabric, after five 140° F. launderings in a reversing wash wheel, has shrunk 21.5% in the warp, 23.0% in the fill. Treated fabric shrank only 2.5% in the warp, 5.0% in the fill.

By preventing water absorption into masonry, unsightly efflorescence and staining are eliminated, mortar joints protected, and damage through spalling, caused by repeated wetting and freezing, is prevented. Of equal importance in the Canadian climate is the reduction of heat loss, since the thermal conductivity of masonry may be 85 per cent higher when wet than when dry.

Water Soluble Reactive Silicones.—Similiar results may be obtained from water soluble sodium salts of silicone resin diluted in water and sprayed on the surface being treated. The silicone salt converts and develops repellence on exposure to air and drying. Not only masonry but paper and other organic materials can be similarly treated. When applied to soils or clay, seepage into the ground and rain erosion is prevented. Whether this behaviour will be utilized in highway and irrigation ditch construction remains to be seen. The concentrated salts are highly alkaline and require some care in handling.

Chemically different silicones with reactive organic groups which may be directly dispersed in water without objectionable alkalinity, are also beginning to be available. These may assume importance as protective treatments for glass, masonry, and other surfaces. A non-oily, water-repellent film is developed instantaneously after spraying, flooding, or dipping in solutions containing from 0.0 to 0.1 per cent silicone. The film is not removed by steam, detergents, or solvents.

Glass Treating Resins.—It has been known for many years that polished glassware is greatly weakened by scratching or similar damage to the surface. Recently it has been found that when a reactive silicone polymer is sprayed on the virgin surface of newly moulded glass containers at the exit end of the annealing lehr, the heat of the glass and the lehr will cure it and bond it to form a permanent lubricating surface. Treated glass containers have only 1/10 the breakage rate on filling lines, and much lower shipping losses. This treatment is of interest in prolonging the life of returnable bottles, such as those used for milk, beer, and soft drinks.[8]

For some years now pharmaceutical manufacturers have been using various types of silicones for treating glass vials to make them water-repellent and free-draining inside, and thus avoid waste of valuable antibiotics. The new treatment will provide this as an incidental advantage, if the containers are sprayed inside as well as out.

Textile and Paper Treating Resins. — Special silicone resins have been developed for application to textiles to make them water-repellent. These are methyl hydrogen silicone polymers which

when heated in the region of 300°F. for a few minutes, give off the hydrogen and cross-link to form a resinous envelope round each filament of the fabric, durably bonded in place and resistant to repeated launderings and dry-cleanings.

All types of natural and synthetic fibres can be treated, usually from emulsions of the silicone resin and an accelerator. As only 1 to 2 per cent silicone pick-up, based on fabric weight, is needed, and these particular resins are among the cheapest offered, the cost of the treatment for most fabrics is of the order of 10c per square yard.

In addition to the water repellent property, originally applied only to outerwear garments, the finish has spread to mens' and womens' suitings, because the lubricating effect of the surface treatment improves the feel and handle of the fabric, reduces flex abrasion, and raises the ironing temperature of thermoplastic fibres. These versatile and durable finishes are now being applied to millions of yards of fabrics annually in Canada, and the use has recently spread to automotive and domestic upholstery fabrics.

By using similar resins and increasing the silicone add-on to 4 or 5 per cent, woven woollen fabrics or blankets can be quickly and effectively shrink-proofed, without the usual harshening or weakening. Treated materials will withstand ten 30-minute launderings in a commercial wash wheel at 140° F. with no significant felting shrinkage. This behaviour is vividly illustrated in Fig. 11. The treatment is beginning to come into commercial use.

Identical silicone resins are used, applied in much the same way, to make paper or parchment non-adhesive. Again, 1 or 2 per cent add-on is sufficient for the purpose. Typical uses are for packaging sticky foods and interleaving adhesive tapes.

Leather Water Repellents. — A special type of silicone is now available for application to leather. For best results a 15 per cent add-on is applied from a solvent solution during the tanning process. Whereas untreated leathers wet through in a wet-flex test in 100-200 flexes, silicone-treated chrome tanned leathers average 10,000 to 20,000 or more flexes before wetting through. The vapour transmission of the leather is not impaired and low temperature flexibility improved. The leather also becomes more resistant to alkaline salts, cutting oils, and chemicals, and is 20 per cent lighter than fat-stuffed leathers. The additional cost will be about $2 for a pair of shoes at the retail level[7]. Other types are under development as dry-cleanable water-repellents for garment leathers.

Fig. 12. Pressure-sensitive silicone adhesive sticking to a glass beaker full of dry ice. Its effective range is from −55° to 250° C.; it will stick to such "adhesive" materials as Teflon, polyethylene, and silicone varnished glass cloth.

Silicone Adhesives.—Brief mention has already been made under silicone rubbers of the special adhesives developed for bonding silicone rubbers to themselves or metals. A pressure-sensitive adhesive has recently been developed having such remarkable tack that it will stick to even such non-adhesive materials as polyethylene, Teflon, or silicone varnished glass cloths. This material has an effective range from —55° C. to 250° C. It is weather-resistant and will stick to cold or wet surfaces, or even under water. Fig. 12 shows a glass tape coated with this silicone adhesive being used to lift a beaker of dry-ice. Such tapes are used for high temperature electric insulation and for weather- and water-resistant low temperature wrapping and sealing applications.

Conclusion

This closing instance of the versatile properties of the silicone family shows the danger of generalization: while many of their uses depend on incompatibility they can also be made highly compatible. In fact, the trend seems to be towards the increasing development and utilization of types which, by combining with organic materials, may be used to upgrade their durability and extend their temperature range.

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(For discussion of this paper, see Discussion of Technical Papers)

The Sir Adam Generating

The history of the early power developments on the Niagara river and a general description of the two Sir Adam Beck - Niagara plants have already been discussed at some length by Dr. R. L. Hearn.[1] The present paper will describe in greater detail the design and construction of the two intake structures associated with the new station. However, in order to provide a better understanding of the function of these works in relation to the overall project a brief review of the main features is in order.

General Features of the River

The total fall through the thirty-seven miles of the Niagara river system is 326 feet and the greater part of this fall is concentrated in the seven-mile reach of the river from the head of the upper rapids or Cascades, just downstream from Chippawa, to the Queenston end of the Whirlpool rapids. The flow in the river averages 200,000 cubic feet per second with a maximum of about 320,000 cubic feet per second.

Sir Adam Beck-Niagara G.S. No. 2

The new Sir Adam Beck-Niagara Generating Station No. 2 is designed to utilize the gross head concentration of the Chippawa-Queenston reach.

Intake structures located on the upper river about one-quarter mile downstream from the village of Chippawa, twin tunnels each 45 feet in diameter and about 5½ miles long constructed beneath the city of Niagara Falls, and an open-cut canal some 2¼ miles in length form the water conveying system to the power plant, which is located on the lower river near Queenston. The installation in the generating station will consist of twelve units each rated at 105,000 horsepower under a net head of 292 feet and, at the present time, ten have been placed in service. Provision has been made for an ultimate installation of sixteen units. A pumping-generating station is also under construction which will permit the most efficient use of available water to increase the daytime peak capacit of the two Sir Adam Beck plant

Requirements of Intake

The Niagara river is well know not only for the scenic beauty an attraction of the Falls but also f the destruction caused by i jams. Under certain conditions temperature and wind, flowin ice on the river has been know materially to reduce the output the present plants, and in the ca of some of the older ones to cau a complete shut-down.

The problem in the selecti and design of the intake wor therefore resolved itself into tw elements:

(a) To extract some 40,000 c.f from the river with a mi

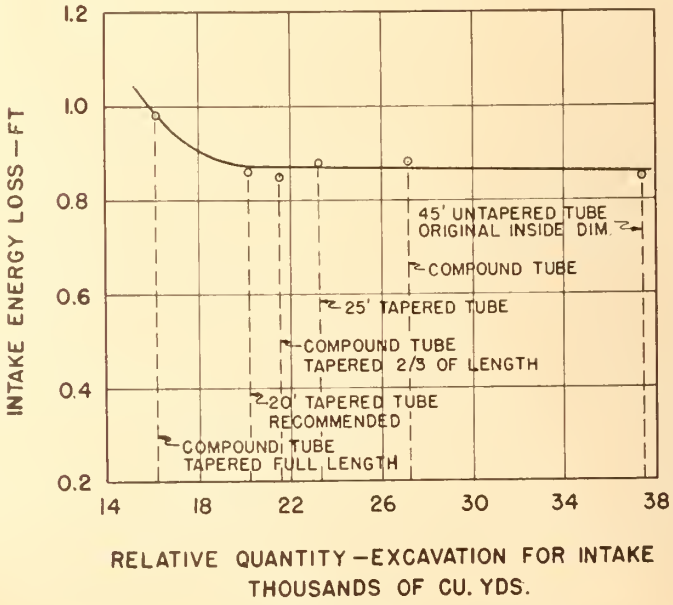


Fig. 1. Inta energy los relative qua tity of exc ation for i take.

[1] Canadian Hydro Electric Developments on the Niagara River; read at the 68th Annual Meeting of the E.I.C., and published in the *Engineering Journal*, Aug. 1954.

Intakes for Beck-Niagara Station No. 2

by

O. E. Johnston, M.E.I.C.,
D. G. Harkness,

The Hydro-Electric Power Commission of Ontario, Toronto, Ontario.

Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

High velocities and shallow depths in the Niagara river posed unique problems in designing intakes for the water conveying system on the Sir Adam Beck—Niagara Generating Station No. 2, in order to exclude floating ice. Theoretical designs were developed and tested by means of hydraulic test models before starting structural designs. In this paper the authors discuss how the design was developed and describe the methods by which construction was carried out. Performance of the intakes under operating conditions proved identical to those predicted in the model tests. During a serious ice jam in the river in March, 1955, complete exclusion of ice from the water-conveying system gave further evidence that the use of models was fully justified.

mum of head loss without interfering with natural flow conditions.

(b) To prevent the intrusion of flowing ice into the water conveying system.

Preliminary Considerations

Various studies were made both s to the type of intake and its cation on the river in relation the overall plan of develop- ent. Following the decision to se tunnels, the choice of the in- ke site was almost automatic. he chosen location, just down- ream from Chippawa, provided e take-off point for the shortest nnel route to Queenston and e maximum obtainable head ncentration of the river.

Some thirty years ago, while signing the intake works of the o. 1 plant, an original theory of take design was developed which as subject to a rational mathe- atical solution. A model instal- tion of this type of intake—he Johnson-Wahlman draft dis- butor or gathering tube"—was nstructed, and tests confirmed e correctness of the theory. The odel consisted of a dam-like ucture with a series of slotted llow fingers reaching out into e river. The purpose of the gers or gathering tubes was to tract water with the least dis- rbance to the natural flow, i.e., intercept a large area of flow, keep the entrance velocities to minimum, to gather water from e river bottom and thereby ex- ude surface flowing ice. The in- take works were constructed as originally designed but with the provision for the later construction of the gathering tubes. However, the performance of the structure as built has been satisfactory and it is unlikely that the gathering tubes will ever be built. Several intakes of this basic type have been constructed elsewhere and put into successful operation since that time. The slot through which water enters the tube has been located in the horizontal, vertical, and inclined planes as dictated by local conditions of flow and topography peculiar to the various sites.

It was logical that serious consideration should be given to the adoption of a gathering tube type of intake since it was developed initially to meet the local conditions on the Niagara river. From a review of existing installations and studies carried out by our staff, it was evident that such a structure located parallel to the flow lines of the river and with the entry slots located in the vertical face would be desirable hydraulically, and it would not detract from the natural beauty of the Niagara Park lands along the river. Located in this manner it permitted unimpeded progress of flowing ice past the structure.

Models Used

Investigations were carried out on the Niagara river model at our Islington laboratory to obtain the best location, the length of the structures, and the necessary river bed excavation. However, the small and distorted scale of this model was unsuitable for developing the hydraulic design of the tubes themselves. A larger model to an undistorted scale of 1:36 of the structures and the adjacent river was then constructed in the laboratory of the University of Toronto to study this problem.

A more detailed account of the solution of the many engineering problems involved in the design of the Sir Adam Beck project, together with an estimate of the savings in cost effected wherever possible, has been presented in a paper by J. B. Bryce.[2]

Hydraulic Design

A preliminary design for the structure was made based on the Johnson - Wahlman theory. The theoretical approach proved unsatisfactory for this application due probably to the high velocities and currents in this region of the river. The model, as first built, included only the area affected by intake No. 1. In 1950, when this plant was authorized, it was the intention to construct only one-half the present installation. However, due to the delay in starting the St. Lawrence power project and the continuing increase in demand for power, it was found necessary to enlarge the plant to its present capacity. For this reason complete tests were made and a final design for intake No. 1 was determined before the model

[2] Economic and Design Advantages of Niagara Hydraulic Models; read at the 69th Annual Meeting of the E.I.C. To be published in the *Journal*.

was enlarged to include No. 2.

The first intakes tested in the Niagara model represented structures each 1000 feet long; however, progressive tests indicated that equally good performance could be obtained from gathering tubes just one-half the length, 500 feet, at a considerable saving in cost, both in the structures and the dredging required outstream in the river to improve entry conditions. Having established the basic dimensions of the tubes, more detailed hydraulic investigations were then undertaken.

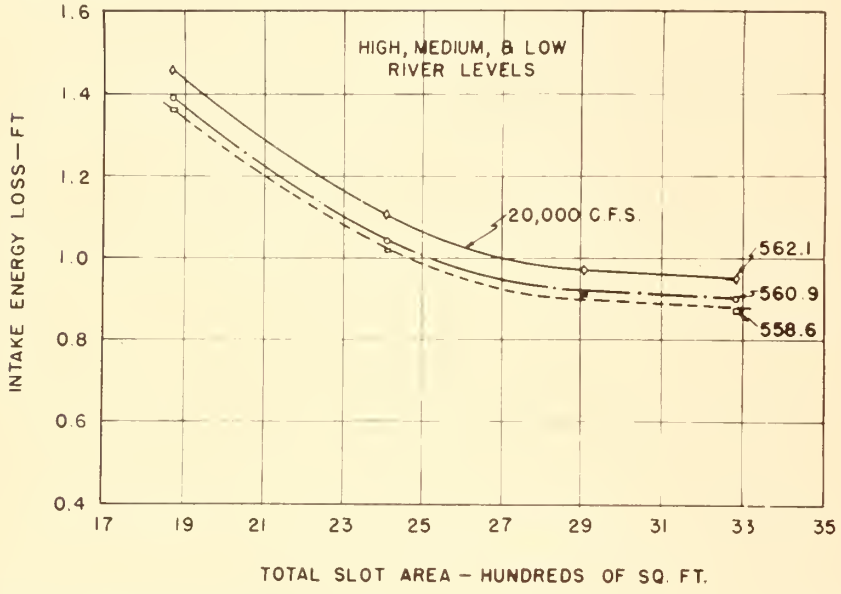


Fig. 2. Intake energy loss—total slot area. Variable water levels.

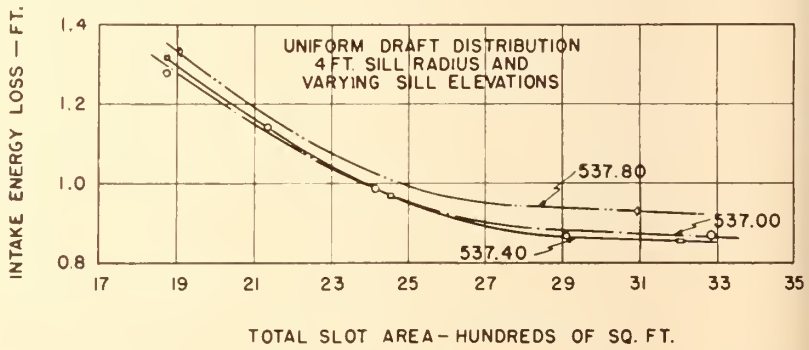


Fig. 3. Intake energy loss—total slot area. Uniform draught distribution, four-foot sill radius, and varying sill elevation.

Internal Dimensions

Two theoretical designs were developed and models constructed. One was designed to have constant acceleration of the water inside the tube and the other was a compound tube having constant velocity for the upstream half of the length and a constant acceleration for the remainder. The interior dimensions of each of these designs were reduced progressively by moving the back wall closer to the front wall and raising the bottom at the upstream end to form a tapering tube. This procedure was continued through a series of tests until the overall energy loss began to rise. Figure 1 shows a graph of intake energy loss plotted against relative quantity of excavation for the intake. It must be realized that, at this time, no structural design work had been started so that the quantity of excavation was a measure of overall cost. The graph indicates that the head loss is practically constant over a range of internal dimensions from a 20-foot tapered tube to a 45-foot square uniform tube. However, any reduction below the 20-foot tapered section resulted in increased losses. Therefore, a basic design for the tube was adopted in which the length was 500 feet and in cross-section varied from essentially a 20-foot square at the upstream end to a 45-foot square at the downstream end.

Slot Area

Following the determination of the optimum interior dimensions, attention was directed to the area of the slot opening. The model was constructed having fixed piers set at 45 degrees to the longitudinal axes of the structure, and the remaining components so constructed that the sill elevation, sill and lintel radii, and the slot height might all be varied. Previous tests had indicated that for this application, variable vane angles had only a minor effect on the overall performance of the model. Figures 2 and 3 indicate that there is no appreciable decrease in energy loss for slot areas in excess of 2900 square feet based on either variable river or sill elevation. In general, it was found that the smaller the slot the larger the loss, as is apparent from the graphs. However, increasing the slot area beyond that selected above resulted in very unstable operating performance under varying river flow conditions. A sill elevation above 537.6 tends to increase overall energy loss slightly and for other considerations this elevation was adopted as the maximum allowable to permit adequate submergence of the top of the slot.

The elevations quoted in this paper are to U.S.L.S. datum, 193[illegible] adjustment.

Sill Radius

The radii of the sill and lintel had a marked effect on the energy loss for a given slot area. Figure 4 indicates a rapid decrease of loss with variation of sill and lintel radii from zero to 4 feet respectively, followed by an increase when the radii were 8 feet. Figure 5 confirms the selection of a slot area of 2900 square feet and radii of 4 feet for the sill and lintel.

From the results of these tests it was possible to fix the sill elevation at 537.55, the sill and lintel radii at 4 feet, and the slot area at 2900 square feet. In the meantime structural analysis indicated that the piers in the slot should be about 2 feet 6 inches thick and spaced at 16-foot 8-inch centres. Tests had indicated that, within limits, pier thickness and spacing had very little effect on performance. The model was then reconstructed incorporating these features but with an adjustable slot height.

Slot Height

The remaining feature to be determined was the height of the

slot to produce uniform draught distribution throughout its length. Tests were continued and a slot height was found which produced for natural river conditions equal draught in each 100-foot section within one per cent. However, at this time a new variable was introduced into the overall scheme.

It was found that in order to utilize the full diversion for power purposes in accordance with the terms of the Niagara Treaty of 1950, a control dam would be required to regulate the levels of the Chippawa-Grass Island pool. This structure now under construction and described in a paper by Dr. Holden,[3] is located immediately downstream from the intake structures. With the gates closed in this dam the natural flow pattern in the river adjacent to the intakes was altered. It was found that equal draught distribution for this condition could only be obtained by a slot of different dimensions. Therefore, a compromise slot shape was adopted since the intake would have to operate under both conditions. The slot height adopted varied from 13.3 feet at the upstream end to 7.5 feet at the downstream end and the taper was uniform. Figure 6 indicates the performance obtained in the compromise shape. The maximum variation from uniform draught in any 100-foot section for either condition is four per cent.

The general dimensions of intake No. 2 are the same as for intake No. 1. However, it was found necessary to vary the vane or pier angle and to introduce a non-uniform tapering slot to achieve comparable performance.

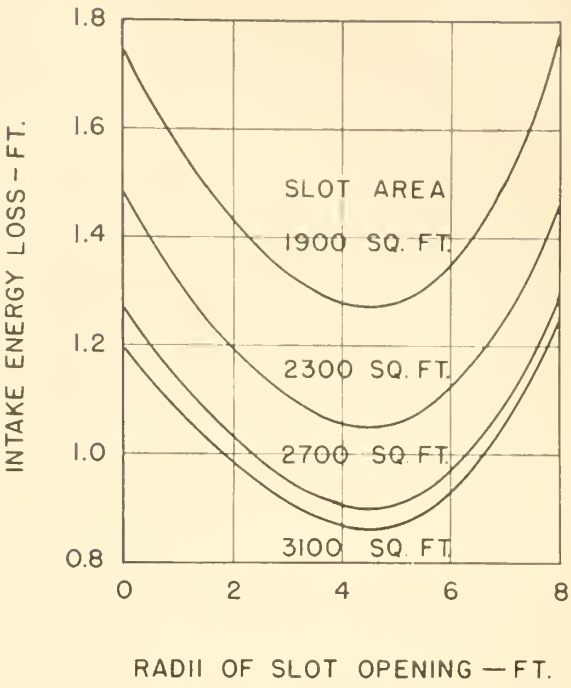


Fig. 4. Intake energy loss—radii of slot opening. Variable slot area.

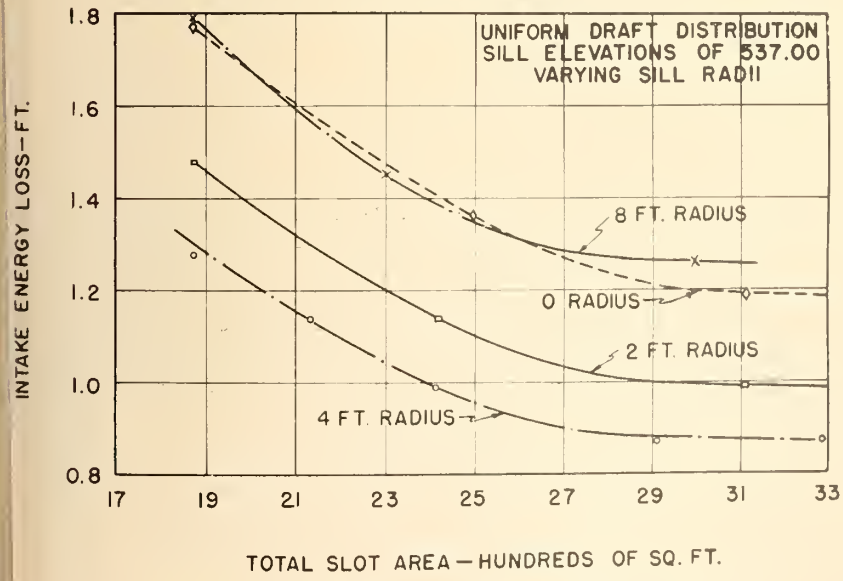
Construction

The general layout of the intakes as constructed is shown in Fig. 7. A funnel-shaped excavation in the river bed extending upstream from the structure about 1000 feet and outstream 750 feet was made to intersect a large cross-section of the flow and attract a flow past the structure about 50 per cent in excess of that to be diverted. The excavation from its upstream limit slopes down with a grade of 0.5 per cent from elevation 546 to 542 at a point roughly 200 feet out from and parallel to the structure. It then slopes down on a steeper grade towards the structure to an elevation approximately 6 feet below the sill of the slot.

In spite of the heavy current and hazardous location in the open river just above the Falls, this work was carried out using two 6-cubic-yard dipper dredges. Approximately 300,000 cubic yards of material were dredged and hauled upstream about two miles in bottom-dump scows to a disposal dump in the river adjacent to Navy Island. This work was performed under contract by the Canadian Dredge and Dock Company Limited.

As noted previously the intakes were located 200-300 feet out from the original river shore line. A cofferdam enclosed this area to permit dewatering of the site in which the average depth of water was about 17 feet at normal water levels. The cofferdam consisted of rock-filled timber cribs 30 feet in width to permit trucking. The rock in this area is covered with a layer of clay 10 to 15 feet thick. Lightweight steel sheet piling was driven to rock along the river side to form a cut-off. Steel was selected here rather than the conventional wood-sheathing to stand the wear and tear of the flowing ice. The cofferdam was constructed simultaneously from both ends using cribs roughly 20 feet by 30

Fig. 5. Intake energy loss—total slot area. Uniform draught distribution, sill elevation 537.0, and varying sill radii.



[3] The Niagara Remedial Works, read at the 69th Annual Meeting of the E.I.C. and published in the *Engineering Journal*, Apr. 1955.

feet. Very little trouble was experienced in placing the cribs although the current is about 6 feet per second.

In the early stages of design we were fortunate to have on our staff the late Francis W. Clark who had been resident engineer on the construction of the first intake. His knowledge and remarkable memory of rock conditions in the area during the excavation stages were most helpful in planning the method of attacking the dewatering problems. The rock formation in the area in which the structures were constructed is Lockport dolomite. This rock is extremely seamy, having not only horizontal but vertical cracks and the top five feet is badly shattered. Diamond drilling along the shoreline adjacent to the site also indicated large seams at various depths through which the excavation was to proceed. These seams carried water in considerable quantity and under full river head.

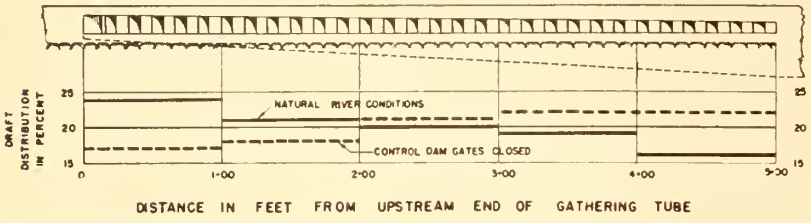


Fig. 6. Draught distribution, per cent, in each 100-ft. section of gathering tube.

Fig. 7. General layout of intakes.

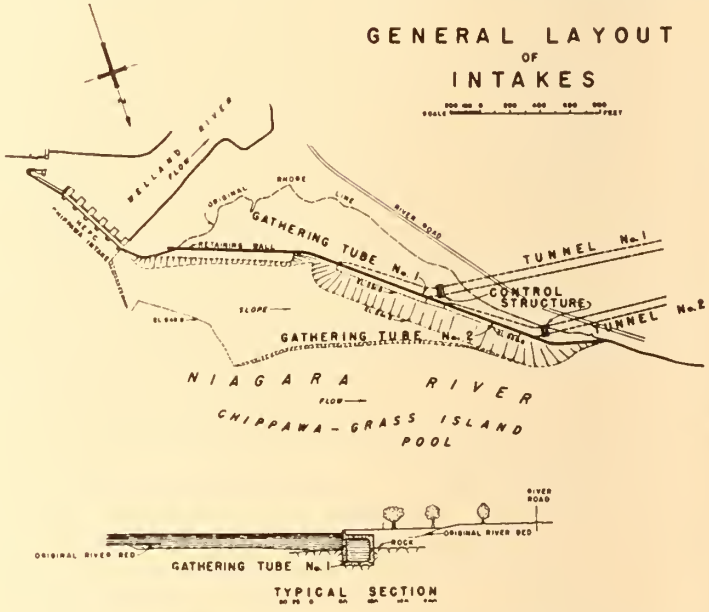
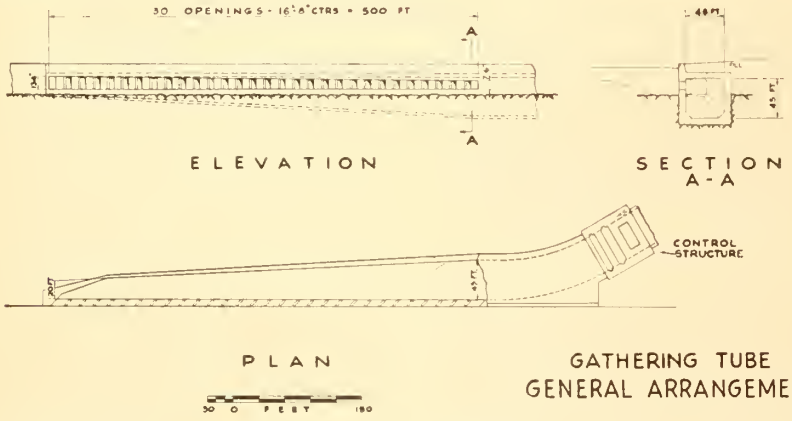


Fig. 8. General layout of No. 1 intake structure.



It was decided to enclose the entire area with a grout curtain and later results proved the wisdom of this plan. Diamond drilling and pressure grouting along the outer face of the cofferdam proceeded simultaneously with the crib work. Cement grout was injected under varying pressures of 10 to 100 pounds per square inch, depending on rock conditions and depth in the hole, working from the bottom upwards. The primary holes were spaced at 10-foot centres with intermediate holes at 5- and 2.5-foot centres in some areas. In general, the criterion for a tight job was when less than 10 cubic feet of grout was accepted in any hole. Approximately 1200 holes involving 65,000 linear feet of drilling and about 107,000 bags of cement were used. The grouting programme though time-consuming and costly, proved its value during the construction period when very little water trouble was encountered although at times work was being carried out in the bed of the river 60 feet below the water level.

Excavation of approximately 500,000 cubic yards of clay overburden was carried out within the cofferdam area in the conventional manner using 2½-cubic-yard shovels and Euclid trucks. Drilling for rock excavation was carried out by wagon drills on a pattern for the holes of about 4 feet by 4 feet spacing.

The general layout of the No. 1 intake structure as constructed is shown on Fig. 8. Essentially it consists of a tapering box section 500 feet long with the width varying from 20 feet to 45 feet and the height from 20 feet to 45 feet from the upstream to downstream end. A uniformly tapering slot was formed in the vertical face on the river side which varies in height from 13 feet 4 inches to 7 feet 6 inches in the upstream-downstream direction. Concrete piers or guide vanes were set into this slot at an angle of 45 degrees to its longitudinal axis at 16-foot 8-inch centres.

The overall dimensions of the second tube are essentially the same except that the slot is larger at the upstream end, 17 feet 0 inch, and smaller at the downstream end, 6 feet 1 inch, has a non-uniform taper, and the vane angles vary. Five upstream vanes are 55 degrees, the next seven at 45 degrees, and the remainder at 40 degrees. The selection of these three angles rather than a constantly changing vane angle resulted in considerable economy in form costs since prefabricated steel forms were used for this detail. Three such forms were sufficient for the construction of both intakes.

As noted previously, the varia-

tion of slot height and vane angles in the second tube was required to conform with flow conditions peculiar to its location just upstream from, and influenced by, the operation of the remedial works control dam.

The sills of the slots are approximately 30 feet below normal river level, the lintels being a minimum of 10 feet and a maximum of 21 feet below normal water level.

Fig. 9. View showing front elevation of intake No. 1 nearing completion.

Structural Design

The structural design of this box-like structure presented many problems. Preliminary stress analysis indicated that it would not be possible to design it as a continuous frame due to the inability of the small cross-sectional area of the vanes to resist the major bending stresses. The vanes are approximately 11 feet long, 2 feet 6 inches wide, semi-circular shaped at the ends and, as noted previously, are set at an angle to the stresses induced. Therefore, continuous horizontal hinges were introduced in the structure above and below the vanes. The structure then resolved itself into a rigid frame with two hinges at the vanes. The vanes act structurally as columns supporting the roof but are not subjected to bending stresses.

Figure 9 shows the front elevation of No. 1 intake nearing completion. On page 1350 is an interior view looking upstream.

The structure is massive and is confidently expected to be trouble-free and require no maintenance in its operation. Since the basic requirements were to provide entry conditions with minimum losses, no permanent features were incorporated into the design to permit future dewatering. This can be accomplished, however, by driving sheet piling or placing bulkheads along the face. The structures are entirely below the ground surface and their location and presence is not apparent to the casual observer.

Downstream from the gathering tube slot a 45-foot square conduit continues for a distance of about 120 feet to a control structure. This structure contains a control gate having a clear span of 45 feet, a height of 58 feet, and a weight of 200 tons, and which may be raised or lowered by an electrically-operated screw and nut arrangement. The gate functions only when it is necessary to isolate a tunnel for inspection or other purposes.

The conduit continues downstream from the gate structure, a distance of about 500 feet, changing from the square to a circular shape 45 feet in diameter to become the tunnel proper.

Formwork

Moving steel forms were used quite extensively with considerable success in forming many parts of the gathering tubes and the circular sections.

The changing dimensions of the gathering tubes presented a most difficult forming problem. The inverts, poured directly on rock required only timber bulkheads and cutout boxes. The lower half of the walls, up to the rock line, were formed by an ingenious steel form which was adaptable to every required dimension along the length of the tube. This form, moving along on rails laid on the completed inverts, was 33 feet 4 inches long and pours were possible almost every other day in the summer weather. The upper half of the back walls was done with steel panels, large enough to cover one complete pour 33 feet 4 inches long at a time, and was moved by a crane as a complete unit.

The vanes, sills, and lintels comprising the entrance ports for the water were also formed in steel. Here the sill and a stub of each vane were poured to a constant elevation. The upper part of the vanes and the sloping lintel were done as a second pour, the changing height of the vanes was adjusted by adding more sections of pier form.

Two travellers, constructed of Bailey bridge equipment, were made to support the roof slab. Each traveller also covered a sec-

Fig. 10. View showing ice flowing past intake structures, March 23, 1955.

tion 33 feet 4 inches long, and supported roof slabs up to 7 feet 0 inch thick. These travellers moved on track which was supported on a continuous timber trestle built on the invert. The function of the trestlework was to create a constant dimension from the track to the under side of the roof, and so varied in height from zero to about 8 feet depending on the grade of the invert.

The control works were formed in timber, sheathed with plywood panels, and again Bailey falsework was used to support the 10-foot thick roof slab.

The transition was formed of prefabricated timber sections 20 feet long. These sections were constructed to be stripped whole, and a construction joint at the springline allowed the same form to be used for the top and bottom half. Thus, with two transitions to be built, each panel had four uses.

The 400 feet of circular section was done by standard tunnel procedure. The invert (60 degree arc) was shaped by a steel screed pulled over the fresh concrete. The upper arch section was formed by a 20-foot long collapsible steel form, moving on rails laid on the invert. Again, steel forms were used quite successfully for the outside hips and end bulkheads, short pieces of timber being used to meet the irregular rockline where necessary.

Fig. 11. Aerial photograph of power plant area showing ice conditions March 25, 1955. Note absence of ice in canals and forebays (centre).

Concreting

Concrete for the intake structures came from the Chippawa mixing plant. This plant, built and operated by Hydro's construction division, also supplied concrete for the two tunnel contractors for the upstream half of the two 5½-mile tunnels.

All concrete placed at the intake was transported from the mixing plant, a half mile distant in two-cubic yard buckets, two buckets per truck, and placed directly into the forms by crawler cranes. This system worked exceptionally well, owing to the wide-spread nature of the job, and was free from mechanical breakdown. Using 12 buckets, six 10-ton trucks and two cranes, the pouring rate was about 90 cubic yards per hour and of course it was very easy to cut down to any lesser rate required as dictated by the form.

Concreting operations were carried out right through the winter months. Owing to the extensive use of steel forms, which of course provide no protection against frost, each pour was carefully covered by a tarpaulin framework, and heated with steam unit heaters, maintaining temperatures of 55° to 65° F.

During the winter months the mixing water and the sand were also heated so that the mixed concrete left the plant around 70° F. and was usually placed in the form above 65° F. Steam heat was kept on for at least 48 hours after concrete placing was completed, by which time the concrete had obtained a strength of 2000 p.s.i. or more. High early strength and quick stripping times were very important factors in the economical use of steel forms where the one form is used many times and thus cannot be left idle.

Operating Performance

Intake No. 1 was placed in service on June 25, 1954, followed by No. 2 on October 20, 1954. It was apparent from the first day of operation that the performance of the tubes hydraulically was identical to that predicted from the model tests. A preliminary field test on No. 1 indicated an energy loss to be within 0.1 foot of that expected. The surface water flowed past the structure without a trace or indication to the observer of what was taking place beneath the surface. It remained only to await the whim of Mother Nature to determine the performance under flowing ice conditions.

This happened much sooner than expected. On March 22, 1955 suddenly about noon a 35-m.p.h. south-west wind started to blow down Lake Erie which increased its level at the easterly end, and at the same time drove shore ice into the Niagara river at Buffalo. The flow in the river increased from about 227,000 cubic feet per second to 316,500 cubic feet per second in the following 12-hour period, carrying along with it tons of ice which on March 23, 1955 completely jammed the river from Lake Ontario to the foot of the Falls. Figure 10 shows the ice *flowing past* the intake structures.

This condition continued for several days during which time a constant watch was maintained to observe the presence of ice in the canals and forebays. During this period *no* ice entered the water conveying system. The successful operation of the intake in excluding ice is apparent from the aerial photograph (Figure 11) taken on Friday, March 25, 1955. Note the complete absence of ice in the canals and forebays in the centre portion of the photograph while the lower river remains completely blocked and the tailwater at this time is some 40 feet above normal.

Acknowledgements

The design of the intake structures was carried out by the staff of the generation department and the construction work in the field by the construction division of the Ontario Hydro.

The writers would like to express their thanks to members of both departments for the valuable assistance so freely given in the preparation of this paper.

An Unusual Case of Corrosion of Aluminum Conduit in Concrete

by

T. E. Wright,

Aluminum Laboratories Limited, Kingston, Ontario.

A paper read at the Montreal Corrosion Symposium, sponsored by the National Association of Corrosion Engineers, September 15, 1955.

Results of research work had shown that aluminum embedded in concrete normally suffered only mild superficial corrosion during the setting period of the concrete and should not require a coating if subsequent conditions were dry. Unexpectedly severe corrosion in conduit installed in a hospital building led to a thorough investigation to determine the causes. This paper will be of considerable interest to a wide field of engineers.

In 1946 the construction of a large hospital was commenced in Smiths Falls, Ontario, for the care of 2,400 mental patients. Construction proceeded in stages and was still underway at the time of writing (June, 1955). Some idea of the size of the hospital may be gained from the fact that the wing concerned in this report is 1,680 feet long. Electrical wiring was installed in aluminum conduit (Alconduit*) in some of the two-storey buildings.

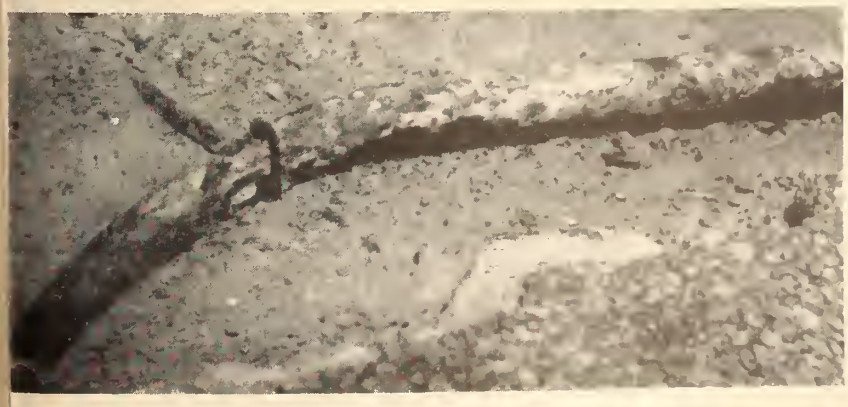
By 1950, there was evidence, although it was not recognized at the time, that some of this conduit had corroded in the concrete between floors in which it was embedded. The first difficulty involved an electrical wire which could not be removed from one of the circuits. By 1953 about four cases had been discovered where the conduit had corroded with the result that wires were jammed when the conduit walls collapsed due to the pressure of corrosion products on the outside. The concrete was strong enough to resist cracking and hence the only indication of corrosion of the conduit was found when it was necessary to replace wires.

The hospital has been constructed under the supervision of the Ontario Department of Public Works who brought the matter of the corroded conduit first to the attention of the research laboratories of the Hydro-Electric Power Commission of Ontario and then to the Aluminum Company of Canada, Limited. Preliminary investigation of the case indicated that the conduit had been installed according to practices recommended by Alcan and the matter was referred to Aluminium Laboratories, Limited, Kingston.

According to work over a seven year period at these laboratories[1] aluminum embedded in concrete normally suffers only very mild superficial corrosion during the setting period of the concrete. The amount of corrosion is so slight that aluminum conduit does not require a coating unless it is expected that the concrete might subsequently remain damp. Since the conduit in the concrete in the hospital was between floors it would be expected to remain dry and unaffected by contact with the concrete.

In view of the unexpected yet severe corrosion of aluminum conduit at the Smiths Falls hospital and because a somewhat similar case had gone unexplained when it occurred in a building in Montreal it was decided to carry out a thorough investigation to determine the causes of this type of corrosion.

Fig. 1. Corroded Alcondnit as excavated in case 1 at Smiths Falls hospital.



History of Corrosion of Aluminum Conduit at Smiths Falls

Case 1.—In December 1950—approximately a year and a half after construction—an electrician attempted to wire an empty conduit in order to install a dishwasher. He found the conduit plugged, assumed this had been done during construction, and laid a ceiling conduit for the line. It is suspected, in the light of results of this investigation, that the con-

* Aluminum Company of Canada, Ltd. trade name of aluminum conduit

[1] Wright, T.E.; Godard, H.P.; Jenks, I. H.; The Resistance of Aluminum to Some Alkaline Building Materials. *The Engineering Journal*, 1954, vol. 37, No. 10, Oct., 1952

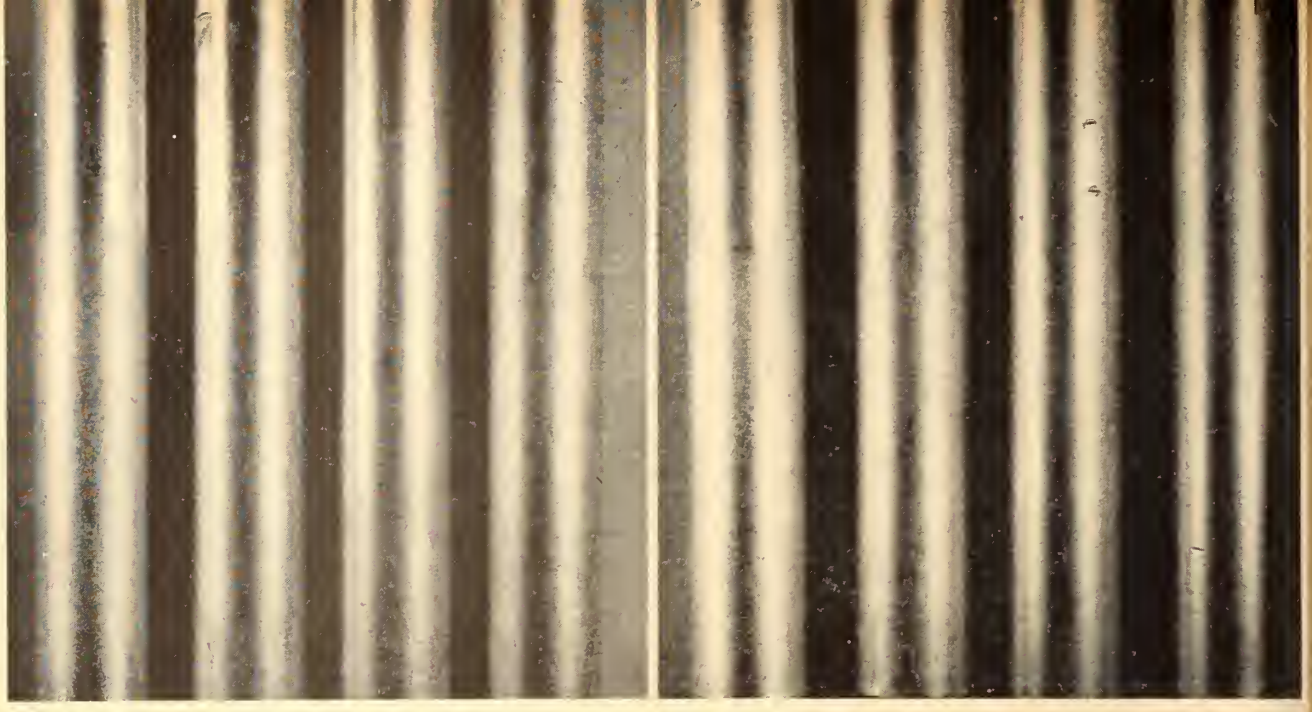


Fig. 2 (l.); Fig. 3 (r.). Alcan 3S conduit embedded for one week in concrete with calcium chloride additions of 0, 1, 2, and 5% of cement content (l. to r.). Fig. 2 — no current applied. Fig. 3 — one volt applied.

duit had actually collapsed due to corrosion.

Case 2.—In 1952 — 3½ years after construction—an electrician attempted to change a circuit. This involved withdrawing one wire and drawing in two others. He was unable to move the wire and gave up the attempt at repair without further effort or any suspicion of conduit corrosion.

Case 3.—In early 1953 a maintenance man complained that a light would not go on. The wire could not be moved in the conduit and for the first time the blockage was located by using a fish wire from each end. The conduit after excavation with a pneumatic hammer was found to be severely corroded and had collapsed, binding the wire and cutting through the insulation. The corroded piece of conduit was sent to the laboratory of the Hydro-Electric Power Commission of Ontario, Toronto, where the opinion was expressed that corrosion was probably due to chemicals in the concrete.

Case 4.—In the spring of 1953, when it was suspected that collapsed conduit was the cause of "plugging", a number of other conduits were "plumbed" with a fish wire and three of six tested were found to prevent free access of the wire. All the failures located were in dry concrete between floors and were scattered at random throughout the sections of the hospital where aluminum conduit had been used. One of the locations was excavated. It was at this point the Aluminum Company of Canada was notified and representatives of Aluminium Laboratories were called in to investigate. Samples of the conduit and concrete from Case 4 were obtained.

One conduit in another wing of the hospital was also found to be jammed but no other cases have been reported although there are doubtless some which have not been discovered.

Examination of Corroded Conduit

Figure 1 shows the conduit in Case 4 after it had been bared in the concrete. Severe general attack had occurred over the entire length and numerous large rounded depressions pock-marked the surface. A particularly large one was located near the steel wire which ties the conduit to the steel reinforcing rods in the concrete. The corrosion products around the conduit were voluminous and had a distinctive p i n k coloration. Specimens of the various materials were examined.

An analysis of the conduit showed it to be normal Alcan 3S of the following per cent composition: Cu 0.05, Fe 0.47, Mn 1.05, Si 0.51, Ti 0.015.

A metallographic examination of the metal showed that its metallurgical structure was normal and it was concluded that the conduit material itself was not abnormal.

The corrosion products scraped from the conduit were analyzed for metallic constituents a n d chloride content. The spectrographic results, which are semi-quantitative, are: Cu 0.004, Fe 0.3, Mg 0.07, Mn 0.4, Si 2.0, Ca 0.006, Al major constituent.

The chloride content determined on a two-gram sample was 8 per cent. The silicon and the trace of calcium were from concrete in the corrosion products and otherwise the metallic elements were what could be expected from Alcan 3S alloy. The presence of chlorides was due to the addition of calcium chloride to the concrete when mixing.

A water extract made from the corrosion products had a pH of 5.4 relative to a blank of 7.6. This acid reaction was thought significant.

Since Alcan 3S alloy contains manganese the pink colour of the corrosion products was most probably due to the oxidation products of manganese. This, together with the acidic water extract, suggested oxidizing conditions during corrosion such as would occur if the surface were acting as an anode (see further discussion in a later section).

Examination of Concrete

(1) *Cement.*—The Portland cement used in this project was from the Hull, Quebec, plant of the Canada Cement Company. It was, of course, impossible to obtain a sample of the cement actually used in 1946. However, the cement was not considered to be a probable cause of the corrosion in view of extensive tests carried out at Kingston with cements of different Canadian origins including some from the Hull plant.

(2) *Sand.*—The sand employed

in the concrete was from the Fuller Pit, Belleville, Ontario. This pit is known to deliver a high quality product and the sand was not suspect. However, a fifty pound bag was obtained and a sample forwarded to the Canada Cement Company for analysis. They reported that it was good quality sand and that it gave good quality concrete.

(3) *Gravel and Crushed Stone.*—Although the gravel and crushed stone were not suspect, the original plan was to sample and examine them; with the progress of the investigation this was found unnecessary.

(4) *Water.*—Two water supplies had been used for the concrete and samples were obtained and analyzed with the following results:

	Total Hardness p.p.m.	Chlorides p.p.m.	pH
Smiths Falls Municipal Supply	120	8.5	7.3
Deep well	288	1.0	8.2

The water was regarded as a very unlikely cause of corrosion.

(5) *Admixtures* (including calcium chloride).—No water-proofing or other agents were added to the concrete with the exception of calcium chloride used during cold weather. The amount of calcium chloride added depended on the judgment of the foremen and the weather but was supposed to be no greater than 2 per cent of the Portland cement content.

The addition of calcium chloride to concrete results in an earlier set and increased strength at early ages. "Its use to lower the temperature of freezing is of doubtful expediency and where reinforcing is used may, in the presence of voids and moisture, tend to produce rusting"[2]. The ultimate strength of concrete is not affected by calcium chloride.

Regarding corrosion, the chloride content of the concrete was of interest since it affects electrical conductivity. In the present case a sample of concrete removed from Case 4 contained 0.45 per cent chloride (0.7 per cent $CaCl_2$) while the chloride content of some concrete from Case 3 contained 0.17 per cent chloride. A 1:2:4 mix such as was used contained 14.3 per cent cement and thus the calcium chloride content found amounts to 4.5 per cent of the cement content for Case 4 and 1.9 per cent for Case 3. The calcium chloride content of some of the concrete at the hospital may be regarded as high (as much as double the normal amount). Calcium chloride-free concrete was found to contain only 0.02 per cent chloride. From these facts came the first suspicion that calcium chloride might have been responsible for the corrosion.

(6) *Concrete.*—A sample of the concrete and a sample from which as much as possible of the coarse aggregate had been removed (mortar) were analyzed by the Canada Cement Company. The results are shown in Table I.

Table I. Composition of Concrete and Mortar

Constituent	(Per cent) Concrete	Mortar
SiO_2	34.8	35.7
Al_2O_3	9.0	11.1
Fe_2O_3	3.8	1.7
CaO	20.1	21.2
MgO	7.9	4.1
SO_3	0.24	0.56
Loss on ignition	19.7	18.9
Na_2O	2.0	1.8
K_2O	1.4	1.5

The standard concrete mix was 1:2:4 (cement, sand, aggregate). Six bags of cement were used per cubic yard of concrete. On the basis of these results there was nothing to suggest that the concrete might have been responsible for the corrosion.

Examination of Environment

Since none of the corroded conduit had been found in floor slabs in contact with the ground, but rather in the slabs between floors, excessive moisture was ruled out as a possible cause of corrosion. Indeed experience has shown that even wet concrete would not produce the extensive corrosion encountered. Further the possibility that corrosion might have been caused by spilled chemicals was ruled out as failures occurred in widely separated locations.

Galvanic corrosion due to stray currents or contact with steel reinforcing or water piping was then considered and a programme of work was planned to investigate this possibility. During an inspection it was found that the potential between conduit and ground was 0.6 volt in one case and 0.4 volt in another with the conduit

[2] Marks, L. S.; Mechanical Engineers Handbook. 4th Ed., 1941, p. 709.

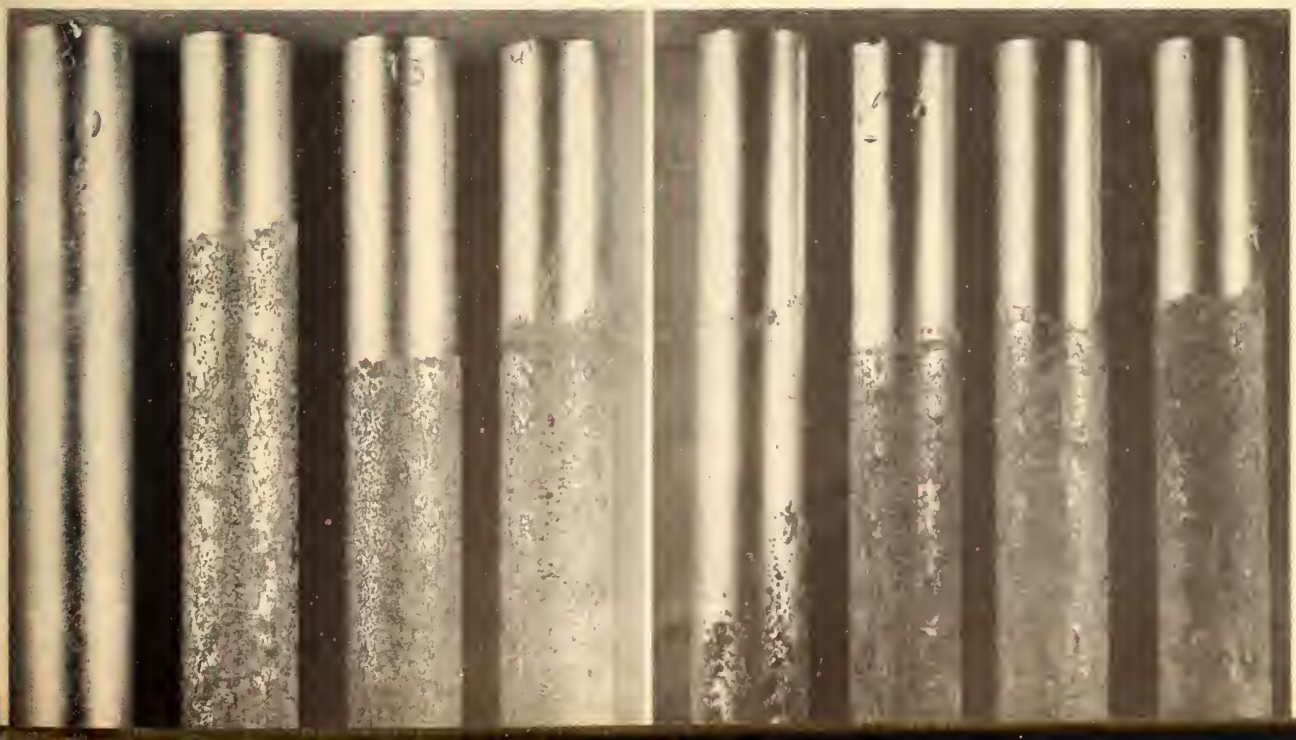


Fig. 4 (l.); Fig. 5 (r.). Alcan 3S conduit embedded for one week in concrete with calcium chloride additions of 0, 1, 2, and 5% of cement content (l. to r.). Fig. 4 — ten volts applied; Fig. 5 — 25 volts applied.

negative, i.e. the conditions were conducive to corrosion.

It was deduced that, with the exception of high amounts of chlorides in the corrosion products and the concrete and the possibility of stray currents, there was no factor which might explain the excessive corrosion encountered.

Calcium chloride would not be expected to cause corrosion of aluminum under these conditions since the work reported earlier [1] showed it to have a negligible effect. The effect of larger amounts (2 per cent being normal) was not known, although excessive calcium chloride accelerates the corrosion of embedded steel.

Serious consideration was next given to the possibility that stray currents were responsible. Although no direct current is used in the hospital it was learned that generators for arc welding were used during construction and it was conceivable that corrosion took place at this early period. Accordingly work was started to ascertain if current applied to aluminum specimens embedded in concrete could produce the type of corrosion found at the hospital.

Concrete Blocks Poured with Embedded Samples of 3S Conduit

Alcan 3S conduit in one-inch standard pipe size was embedded in 6 in. x 6 in. x 6 in. concrete blocks made in wooden forms using a 1:2:4 mix to which varying percentages of $CaCl_2$ were added. Four blocks each of four mixes were made. These contained $CaCl_2$ in the following percentages of the cement content: 0, 1, 2 and 5. An eight inch length of conduit was placed centrally in each block at a depth of five inches.

As soon as setting would permit, the blocks were removed from the forms and placed in four shallow aluminum tanks containing one inch of water. Each tank contained one block of each of the four mixes. Direct current from a generator was applied to the specimens in three of the four tanks, one set receiving 1 volt, another 10 volts and a third 25 volts, with the aluminum tanks acting as cathodes. The fourth received no current.

The tests were continued for one week. Although the voltages were kept constant the current densities became less with time in all cases. The range of current readings over the final three days is shown in Table II.

Table II. Current Variations in Alcan 3S Anodes in Concrete Containing Ca Cl_2

Per cent $CaCl_2$ in concrete	Range of Current Readings in ma.		
	One volt	10 volts	25 volts
0	0.7-0.9	8-10	19- 42
1	0.5-0.8	24-31	22- 43
2	0.5-0.8	22-27	18- 48
5	0.3-0.5	28-38	40-115

After only one day the concrete blocks with the highest $CaCl_2$ contents, and the highest applied currents, began to crack in the area around the specimens. It was noted that a thick grey coloured liquid was exuding around the conduit sections. As time progressed these conditions appeared even on those blocks with the lowest $CaCl_2$ contents, but it was not found in any case where $CaCl_2$ had not been added to the concrete or where there was no applied current. The pH of a 1:40 dilution of the exudate in distilled water was strongly acid, in fact only slightly less so than similarly diluted N/10 HCl.

After seven days the blocks were broken up and the conduit lengths examined. At the two higher voltages and particularly where calcium chloride was present corrosion was severe. Voluminous pink corrosion products similar to those at the Smiths Falls hospital were found on all specimens embedded in chloride-containing concrete to which the higher currents had been applied. The conduit which received no current showed only the slight corrosion which has come to be considered normal for aluminum after a short period.

The weight loss of each specimen was determined and these are shown in Table III.

Table III. Weight Loss of Alcan 3S Conduit Embedded in Concrete

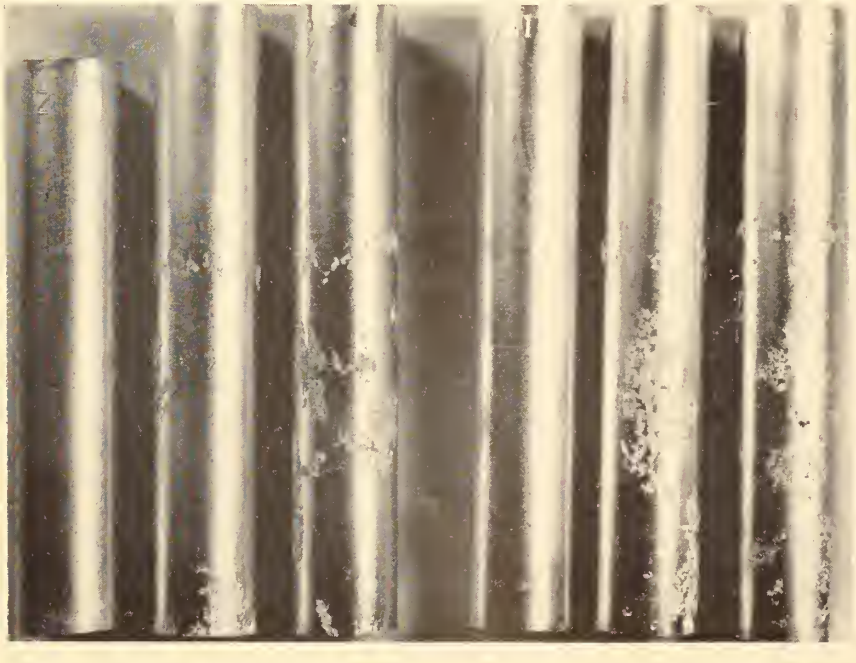
Per cent $CaCl_2$ in concrete	Weight loss in Grams*			
	Zero volts	One volt	10 volts	25 volts
0	0.99	0.87	1.04	2.43
1	0.50	0.42	5.21	7.68
2	0.42	0.43	5.06	8.85
5	0.26	0.23	10.08	16.09

*All specimens originally 170 grams approx

It is interesting to note that $CaCl_2$ has no detrimental influence when no voltage is applied or when the voltage is very low. In fact it tends to lessen slightly the usual amount of attack probably because of the more rapid setting when calcium chloride is present. Photographs of the specimens after removal from the blocks and cleaning, arranged in order of $CaCl_2$ concentration at each voltage, are shown in Fig. 2-5.

A portion of the pink corrosion product from the specimen embedded in 5 per cent $CaCl_2$ receiving 25 volts was ground up finely and mixed well. The chloride content was 0.4 per cent by weight which is much less than 8 per cent found in the Smiths Falls hospital

Fig. 6. Alcan 3S conduit embedded for one month in concrete containing calcium chloride and coupled to steel. Three specimens on left were from dry blocks; three on right from wet blocks. Steel/aluminum area ratios were ½:1, 1:1, and 3:1 (l. to r.) for each group of three.



corrosion product. A hot water extract of the powder was alkaline.

This short-term accelerated test showed that severe corrosion of aluminum conduit, the pink coloured corrosion products, and the acid surface condition found at the Smiths Falls hospital could be reproduced in the laboratory with the aluminum functioning as an anode. Although the addition of an excess of calcium chloride to concrete could result in an intolerable amount of corrosion of aluminum it was possible to produce severe corrosion with even normal chloride additions.

Galvanic Relations Between Aluminum and Steel in Concrete

Since aluminum in contact with steel in concrete would also act as an anode it was thought desirable to investigate whether this set of conditions might explain the Smiths Falls corrosion.

To this end more blocks of 1:2:4 concrete were made with 5 per cent calcium chloride based on cement. Eight-inch lengths of degreased and weighed 3S conduit were embedded and pieces of mild steel sheet were placed in the concrete about two inches from the conduit. The steel and aluminum were electrically coupled externally, using a switch in the circuit system that permitted the introduction of a milliammeter to measure the galvanic current. The steel sheet was 0.060 inch thick, eight inches long and 1, 3 and 6 inches wide, giving approximate Fe:Al surface ratios of ½:1, 1:1 and 3:1. In each case duplicate blocks were prepared. One set was left dry on a laboratory bench and the other set was placed in a tank of water one inch deep. Galvanic corrosion current readings were taken several times daily over a period of 30 days.

As in previous tests current densities decreased with time. Typical values obtained at different periods are shown in Table IV.

Current densities increased with increasing cathode area (i.e. iron).

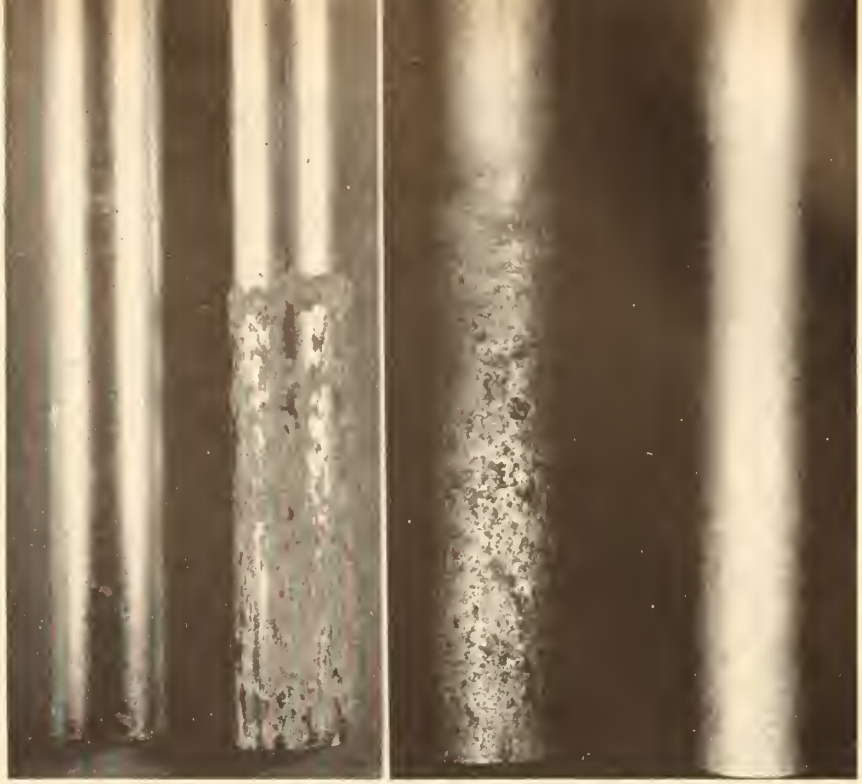


Fig. 7 (l.). Alcan 3S conduit embedded for one month in concrete containing calcium chloride and coupled to steel. Steel/aluminum area ratios were 3:1 (l.) and 12:1 (r.).

Fig. 8. (r.). Alcan 3S conduit coupled to steel (12 × area of aluminum) and embedded for one year in concrete containing (l.) calcium chloride and (r.) no calcium chloride.

An exception was the 3:1 dry block which, however, cracked after six days. This probably caused the rapid current drop from that time. A grey, acidic exudate appeared around the aluminum specimens in both the 3:1 blocks.

When the blocks were broken up after 30 days it was found that the aluminum conduit sections connected to the smallest of the iron cathodes were very little affected, but corrosion became more severe with the larger iron areas as shown in Fig. 6. The corrosion products were white in colour. The iron cathodes were in good condition, particularly on the side adjacent to the aluminum, indicating that they had been cathodically protected. The weight losses are shown in Table V.

The weight losses for wet and dry blocks were similar. The fact that the bottoms of the blocks were immersed apparently had no effect although the current densities were somewhat higher.

Table IV. Iron-Aluminium (Alcan 3S) Galvanic Corrosion Currents in Concrete 30 Days (measured in milliamps over 30 days)

	Dry			Wet		
Fe:Al Ratio	½/1	1/1	3/1	½/1	1/1	3/1
Days						
0*	13.0	14.0	17.0	12.0	11.0	17.0
1	1.5	4.4	6.0	1.5	3.8	15.0
5	1.05	3.6	4.7	0.75	3.9	6.4
10	0.65	2.7	1.9	0.64	5.5	6.2
20	0.54	2.0	0.75	0.55	4.5	5.5
25	0.46	1.7	0.58	0.61	4.1	5.6
30	0.44	1.5	0.55	0.61	3.8	5.0

*Before setting of concrete.

Table V. Weight Losses of Aluminum Coupled to Steel 30 Days in Concrete Containing CaCl

Fe:Al Ratio	Weight Loss in Grams*	
	Dry Concrete Blocks	Wet Concrete Blocks
½:1	0.09	0.08
1:1	0.48	0.47
3:1	1.67	1.35

* Specimens originally weighed 170 grams approximately.

Second Galvanic Experiment

When the preceding experiment had been underway for about two weeks and the influence of the iron-to-aluminum ratio was evident, three more concrete blocks were made. These were 12 in. x 12 in. x 6 in. deep but otherwise similar. The iron-to-aluminum ratios were 3:1 in two and 12:1 in the third. The iron was electrically coupled to the aluminum conduit

Table VI. Galvanic Corrosion Currents (in ma.) for Fe/Al Ratios of 3/1 and 12/1

Days	3:1	12:1
0*	19.0	13.0
4	2.6	7.6
10	5.5	5.9
20	4.1	4.6
26	3.9	7.0
30	3.4	8.3

*Before setting of concrete.

in the 12:1 block and one of the 3:1 blocks. The remaining block served as a control. All were immersed in a tank containing one inch of water. The galvanic current readings are in Table VI.

The weight losses of the aluminum conduit sections were:

Fe:Al 3:1 no current—0.09 gram
Fe:Al 3:1 coupled —0.23 gram
Fe:Al 12:1 " —2.40 gram

The conduit from the block with 12:1 ratio had fairly voluminous corrosion products with a brownish coloration. Over a longer period of time this might have developed into a heavy layer of pink corrosion products such as found at the Smiths Falls hospital. The much lower weight loss of the 3:1 coupled conduit specimen than found in the previous experiment (0.23 vs. 1.67g.) cannot be explained as both trials were carried out under exactly similar conditions. The conduit specimens after removal and cleaning are shown in Fig. 7.

When it was found that aluminum conduit coupled to steel corroded in concrete containing calcium chloride, two blocks 12 in. x 12 in. x 6 in. were made with iron-to-aluminum ratios of 12:1. The blocks were similar to those made previously except that no calcium chloride was added to one of them and the usual 5 per cent was added to the other. The iron was coupled to the aluminum in both cases and the blocks were left in a dry location indoors for one year. Current readings were taken periodically and after one year the blocks were broken open. The current readings have been plotted in Fig. 9. It will be seen that initially the currents dropped very rapidly. In the concrete containing chloride the current fluctuated at values under one milliampere but when in chloride-free concrete the current was negligible.

When the conduit specimens were removed and examined after one year it was found that the conduit specimen in chloride-free concrete was in very good condition (see Fig. 8). The specimen in the concrete containing chloride was corroded in a manner which resembled that experienced at Smiths Falls, although in this case corrosion was much less severe than that found on the lengths which were excavated because of collapsed walls. In the block with $CaCl_2$ the corrosion products were white with pink spots in places. In the chloride-free concrete there was very little evidence of corrosion products and no pink colour.

This experiment showed that aluminum coupled to steel in concrete containing $CaCl_2$ can corrode severely depending on the ratios of the aluminum and steel areas. Even under dry conditions corrosion can be extensive.

As a check on the laboratory findings a second trip was made to the hospital. Aluminum and galvanized conduit had been embedded in concrete to which $CaCl_2$ had been added if the weather was very cold; the more usual condition was without calcium chloride. It was planned to remove short lengths of conduit from locations representative of the two conditions.

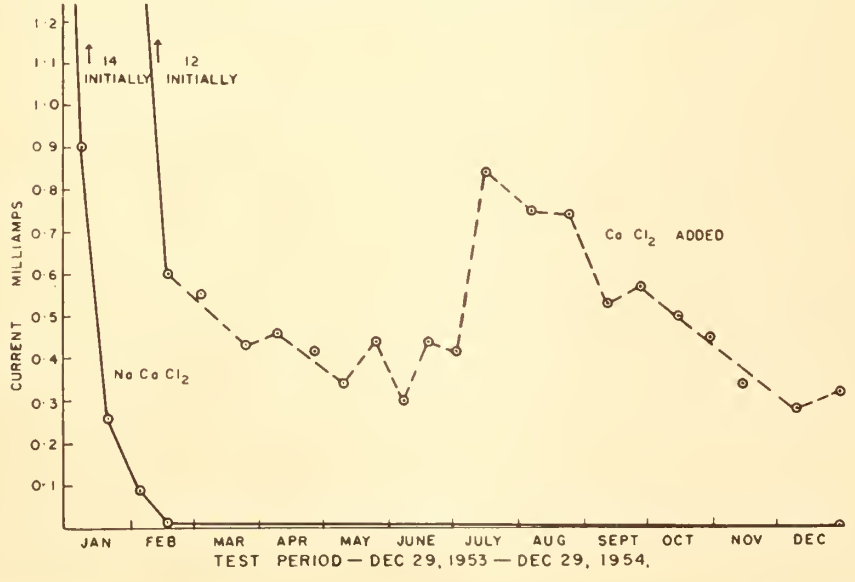
The concrete was checked on the site for chlorides by placing a few chips in dilute nitric acid. The extract was filtered and tested for chlorides by adding dilute silver nitrate. Since the wards of the hospital were occupied it was feasible to excavate only four lengths—one each of galvanized and aluminum conduit from chloride-containing and chloride-free concrete.

None of the conduits showed evidence of corrosion. This was normal behaviour for aluminum in the chloride-free concrete. However, considering the results of these present laboratory experiments an explanation appears necessary for the absence of corrosion in concrete containing calcium chloride.

Corrosion of aluminum in concrete takes place for the most part during the setting period[1]. In wet or cold weather this would be longer than during dry weather. It was learned that the winter construction had included some very severe cold weather. In summer the drying time was very short and in the winter the concrete remained damp a long time the corrosive conditions were greater in winter than in summer.

Further, the chloride content of the concrete where the lengths were excavated, when examined quantitatively in the laboratory later, proved to be 1 per cent and 0.7 per cent of the cement content for the galvanized and aluminum lengths respectively. This is much lower than that previously found around corroded lengths of aluminum conduit (1.9 and 4.5 per cent respectively). This is in agreement with experiments showing that corrosion was less in concrete with lower chloride contents.

Fig. 9. Current readings for Fe/Al : 12/1 couples embedded in concrete for one year with and without calcium chloride added.



Summary

The corrosion of aluminum conduit embedded in concrete floor at the Smiths Falls hospital has been shown to be due to calcium chloride in the concrete mix, together with the presence of galvanic currents from contact with embedded steel. Both of these must be present together in order to create conditions which would allow such corrosion to occur.

Since corrosion under such conditions cannot be prevented with certainty by painting or other means and since steel is almost invariably associated with structural concrete work, the conclusion to be drawn from this investigation is that aluminum conduit should not be buried in concrete containing calcium chloride additions.

The Influence of Tropical and Sub-Tropical Factors in the Design of Hydro-Electric Plants

by

J. K. Sexton, M.E.I.C.,

Chief Civil Engineer,
Montreal Engineering Co. Ltd.,
Montreal, Que.

Hydro-electric design in tropical regions is influenced by many factors not met in temperate climates. Some of the effects of tropical temperature, humidity, and other climatic factors are discussed.

The power resources of a river depend on the flow of water that can be made available and the head that it is feasible to develop at one or more power sites. The rate of flow depends not only on the annual volume of runoff and the natural distribution of that runoff over the seasons of the year but also on the reservoir sites that can be developed to store water during periods of high flow and discharge it during periods of low flow.

Head can be concentrated by constructing a dam across the river where the cross section and foundation conditions are favourable, or it can be obtained by a canal, tunnel or penstock to bypass the water around a fall or rapid reach of the river. Frequently a combination of these two methods is used, and sometimes it is possible to develop great concentrations of head by diverting the drainage basin into another.

The power plants so constructed must be able to contend with all the forces of nature that may be thrown out of balance by the artificial obstruction and diversion of streamflow; big floods must pass safely over the dams; ice must not endanger the structures or block the water passages; gravel and silt must not be allowed to fill reservoirs and canals. If these problems can be solved with structures sufficiently low in cost to permit generation of electrical energy at a price that is cheaper than that of energy produced by thermal plants, then the water power resources in question constitute a valuable national asset. The problems vary in the different temperature zones of the earth's surface and hydro-electric practices must conform to the requirements of the region if maximum value from water power resources is to be obtained.

Features of Tropical and Sub-Tropical Regions Affecting Design

Meteorological

Temperature is the fundamental variable between the tropical regions and those further from the equator. At sea level a mean annual temperature of approximately 27° C prevails over a belt 30° wide at the equator and diminishes with north and south latitude in a variable manner depending on ocean currents and prevailing winds.

Mean monthly freezing temperatures at sea level are first encountered at about latitude 38° in the northern hemisphere and mean annual freezing temperatures at about latitude 50°. Temperatures also decrease with altitude so that some localities in tropical latitudes have temperate climates. La Paz in Bolivia, for example, at an elevation of 3,658 metres and a latitude of 16° 30′ S has a mean annual temperature of 9.5° C which is but slightly higher than that of Santa Cruz at sea level in Argentina at a latitude of 50° 11′ S.

As a direct consequence of the higher temperatures of the tropics the rate of evaporation is also high and relative humidity tends to vary between an extreme high in the wet season and an extreme low in the dry. Evaporation of over two metres per year is common near the equator, whereas the maximum rate in a climate such as that of Canada seldom exceeds one metre per year.

The peculiar winds of the tropical and sub-tropical regions exert both a direct and indirect influence on the design of hydro-electric plants. Most obvious of these are the hurricanes of the Caribbean Area and the typhoons of the south west Pacific that bring destructive wind velocities and torrential rains.

Of indirect importance are the periodic winds of the tropics that make a reversal of direction between winter and summer and thereby accentuate the tendency to divide the year into two radically different seasons, the rainy and the dry. The best example of these are the monsoons of the Indian Ocean that carry heavy rains in a north easterly direction towards the Asiatic mainland during the summer months and are reversed in winter time to create a period of drought.

Geographical

There has been no recent glaciation on a large scale in the tropics such as occurred in North America where the ice cover extended as far south as latitude 38° N at Cincinnati, or in Europe where it reached a latitude of 52° N. Recent glaciation has occurred at a few limited areas of high altitude in the tropics such as in the highlands of the Andes and the Hima-

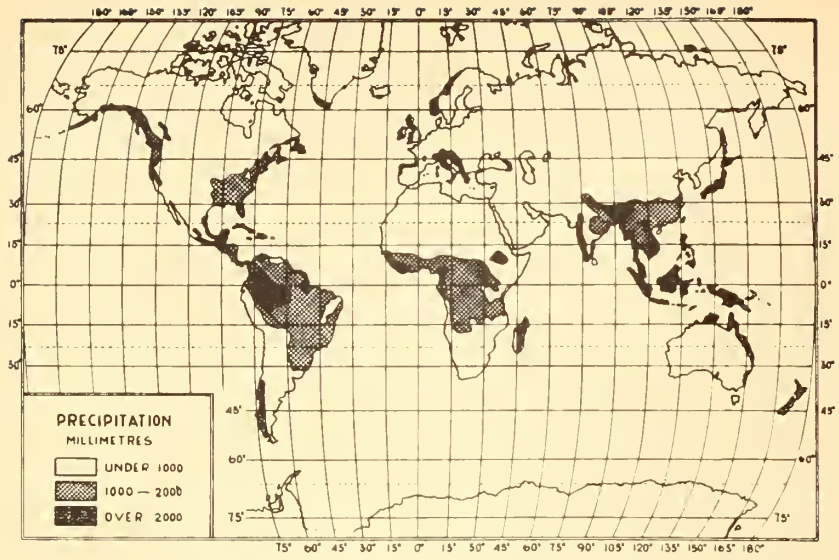


Fig. 1. World map of mean annual precipitation.

layas but the total effect has been small.

As a result, tropical river basins do not usually contain the many lakes and irregularities found on water courses farther north which provide natural regulation of stream flow, remove sediment, and facilitate creation of artificial storages. There are, of course, some notable exceptions such as the great lakes of Central Africa which contribute to the enormous water power resources of that continent, but as a general rule there is a scarcity of lakes and ponds in tropical and sub-tropical regions which makes the regulating of runoff difficult.

Hydrological

Since the principal source of precipitation is water previously evaporated from land and water surfaces, it follows from the high evaporation rate of the tropics that there is generally a greater volume of rainfall in tropical latitudes than in other parts of the world. This rainfall is by no means evenly distributed, and the location of mountain ranges in relation to prevailing winds causes areas of permanent drought in the tropics just as it does in other areas further from the equator. The coastal plain of Peru is an excellent example of such drought.

Where geographical features do not prevent precipitation, however, the general tendency for greater rainfall in the tropics prevails. An examination of the map of mean annual precipitation given in Fig. 1 will serve to illustrate this point.

The greatest intensities of rainfall are also found in tropical and sub-tropical regions. This is evidenced from the approximate tabulation of maximum recorded rainfalls of the world. (Table 1.)

The net hydrological effect of the various climatic and geographic factors acting on tropical regions — high temperatures, periodic winds, high evaporation rates, scarcity of lakes, high rates of rainfall — is to produce a large volume of runoff with great seasonal variation and high rates of flood discharge.

A tropical river derives most of its flow from ground water during the dry season months, and runoff during this season is low and uniform with a tendency to slight diminution as the season progresses. It may even disappear entirely, as happens to many of the streams of South Africa. With the arrival of the rainy season, however, the flow rises immediately to a series of irregular peaks which follow the variations o rainfall over the drainage basin The pattern of peaks is difficult t predict and the flow may rise t great heights with little warnin

Figure 2 shows a hydrograph o the Lempa River in El Salvado for 1945 and is typical of tropica rivers in climates with distinc wet and dry seasons. It will b noted that during the early pa of the rainy season the flow r turns almost to its preceding dr season low after each freshet.

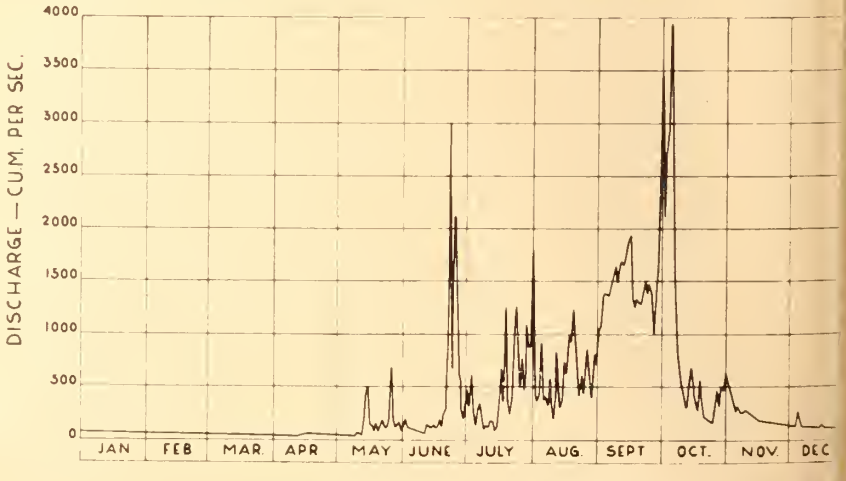
Excepting the Nile River wit its record of gauge heights goin back to 640 A.D., the records stream flows of tropical and sub tropical rivers are not usually a extensive as those of more nort erly rivers. Accordingly, a stati tical analysis of the measuremen available may fail to disclose th heights to which maximum floo in the tropics can rise and there a temptation to apply flood con stants determined for more nort erly rivers.

Caution is advisable in this ca if structures that will not stan overtopping are involved. Refe ring to Creager's equation f flood flow, a value of C of 30 less may be adequate in the lat tudes of Canada but values grea er than 100 may be required the tropics.

In certain tropical regions th phenomenon of hurricanes a typhoons is a serious factor co tributing to floods. During th past 26 years at least two hur canes have caused floods in th Caribbean area that were di astrous to hydro-electric install tions.

In 1928 a hurricane passed ov Porto Rico and caused floods unprecedented magnitude th wrecked two power plants on th

Fig. 2. Hydrograph of the Lempa River in El Salvador, for 1945.



La Plata River. Figure 3 shows all that was left of one of these plants after the flood had passed.

Again in June, 1934, another Caribbean hurricane crossed to the Pacific Coast of Central America and caused floods in El Salvador that completely submerged most hydro-electric installations in the country. At the Rio Sucio Plant on the river of the same name with a drainage area of 440 square kilometres the maximum flow was calculated to be 3,600 cu.m./sec., and on the Lempa River with a drainage area of 17,254 square kilometres the maximum flow was estimated at 25,000 cu.m./sec.

Fig. 3. All that remained of Comerio Plant No. 1 on La Plata River, Puerto Rico, after the 1928 hurricane.

Miscellaneous

The main feature to be mentioned under this heading is the almost invariable tendency of tropical rivers to carry heavy silt loads during the flood season. The problems of soil erosion and sedimentation are by no means confined to the tropics. Heavy loads of sediment may be encountered in the glacial streams of northern British Columbia as well as in rivers near the equator, and probably the highest silt rates in the world are found in the Yellow River in China and the Little Colorado in the United States—both in temperate regions. However, these are exceptional cases.

Most of the major power rivers of the higher latitudes give little trouble from silt. In tropical and sub-tropical regions, on the other hand, the intense rains and rapid runoffs alternating with seasons of drought add a high silt content to most rivers, particularly to those of steep gradient on which power sites are usually found.

TABLE I

Duration	Rainfall in metres
1 year	23
1 month	9
5 days	3.8
4 "	2.1
2 "	1.6
1 day	1.1

Location and Date			Latitude
Cherrapunji, India,		1886	25°16′N
"	"	1861	"
"	"	1841	"
Funkiko, Taiwan,		1913	23° ± N
Cherrapunji, India,		1876	25°16′N
Baguio, P.I.		1911	16°30′N

Influence on Hydro-Electric Planning and Design

General

It is seldom possible to develop a tropical river entirely for hydro-electric production. Usually the water must be shared with irrigation and where there is conflict of interests those of irrigation predominate. Unlike the higher latitudes where frosts restrict the growing season, it is possible in the tropics with irrigation to extend the growing season over the entire year, and thereby enhance the productivity of land enormously. This, for example, is the situation in India where irrigation comes first, power second, and flood control third.

The ideal arrangement exists when both reservoir and power sites are found upstream from the large irrigable areas, such as occurs on the Nile. In this case it is possible to generate a maximum of primary energy.

When the power reaches of a river lie below the irrigable areas or are found in the drops of the irrigation canals the quantity of water available for power is reduced and the supply may be variable. In such cases much of the hydro-electric energy is secondary and must have the backing of thermal generating stations. This has happened in a number of cases in India. On the big Damodar River scheme, for example, the base load is carried by hydro for only 15 weeks of the year and by steam for the remainder of the time.

Hence in appraising the overall development of a river in a tropical or sub-tropical region it is usually necessary to consider the effect of present and future irrigation, and if the water is to be shared with irrigation then costs should also be shared. While the cost attributable to hydro may be thus reduced, utility for generation of primary energy is also impaired and duplication of generating capacity in thermal stations may eventually be required.

The sharing of costs between hydro and irrigation, however, is usually confined to multiple purpose structures on large scale river developments, and these have been relatively few in the tropics. Most developments to date have consisted of small plants devoted entirely to hydro and operating under such restrictions as irrigation requirements may impose.

The importance of the small hydro plant in the tropics is well illustrated by the case of Brazil which is usually thought of as a country of large scale hydro-electric development owing to the prominence of the big power plants diverting the headwaters of the Parana River to the Brazilian Atlantic Coast. In fact, in the 1948-50 Statistical Year Book of the World Power Conference, Brazil reported a total of 1,091 hydro plants with an average installation of 1,400 kw. per plant—a lower average plant capacity than reported by any nation except Greece. It is probable that such small plants will continue to play an important role in tropical economy.

A recent development that will continue to make small plants profitable in the tropics is the introduction of automatic and remote controlled operation. The equipment involved has two functions, first to protect the installation against mechanical or electrical failure of the most vulnerable parts, and second to control plant operation. The protection consists of relays to give alarm and close down the units in event of trouble.

while the control is open to several alternatives. Control can be transmitted from a remote centre; it can be automatic; or it can be a combination of both types.

Remote control is normally used for a power system depending primarily on hydro. An excellent example is found in a small plant recently constructed on the Umtata River in Cape Province, South Africa, and controlled by push button from an office at the load center in the town of Umtata 4 miles distant.

On the other hand, automatic operation is well suited for small hydro plants operated in conjunction with thermal plants, particularly if the ratio of hydro to steam capacity is small. For example, a 280 kw. plant on the Guariquito River in Venezuela is interconnected with a 12,000 kw. diesel generating station in Barquisimeto and equipped with float-controlled automatic operation which keeps the turbine gates full open during periods of excess flow and adjusts gate position to use all the water available during dry periods.

An advantage which all tropical power plants, both large and small, enjoy over plants in higher latitudes is the complete freedom from ice. In many cases, this advantage is at least partially offset by the substitution of silt and high flood troubles but none-the-less it permits greater flexibility in layout of hydro structures than is possible in a northern region such as Canada.

For example, in the tropics there is no particular difficulty in diverting water for hydro purposes from a swift stream by means of a low dam, providing that the diversion structure is designed to avoid the intake of silt. Such is not the case in colder climates where continuous diversion from a swift stream can only be effected if storage volume is provided to hold back the slush ice in winter.

Nor is there any particular difficulty with the use of high velocity flumes and canals in the tropics, whereas they may be out of the question in low temperature regions. These advantages account in part for the popularity of small hydro-electric plants in tropical and sub-tropical regions.

Reservoirs

The problems of silting and evaporation are usually much more serious in the design of tropical reservoirs than in the design of reservoirs for temperate climates.

Theoretically, all reservoirs tend to decrease in volume through sedimentation and ultimately to disappear from use. In regions not seriously effected by soil erosion, however, the process is so slow that it has little or no effect on hydro-electric design.

This is not the case in the tropics, and only when storage is created on a natural lake such as Lake Victoria in Africa is it safe to ignore the silting problem. Usually, it is necessary to take such measures as are available to extend reservoir life to an acceptable period, say not less than 100 years. Fortunately, the creation of Lake Mead in the United States focused attention on the problem and subsequent studies have lead to a better understanding of these corrective measures.

The more important ones are summarized as follows:

1. The volume of a storage reservoir should be sufficiently large in relation to upstream drainage area to extend reservoir life to the required length of time. Preferably the volume should be such as to result in a reduction through silting of less than one half of one per cent per annum.

2. If surplus water is available it may be possible to pass 10 per cent or more of the incoming sediment through a reservoir by venting of density currents through low outlets at the dam. The muddy water entering a reservoir drops its bed load and the heavier suspended particles at the upstream end of the reservoir, but the finer particles are carried under as a muddy current of greater density which follows the bottom of the reservoir downstream to the dam.

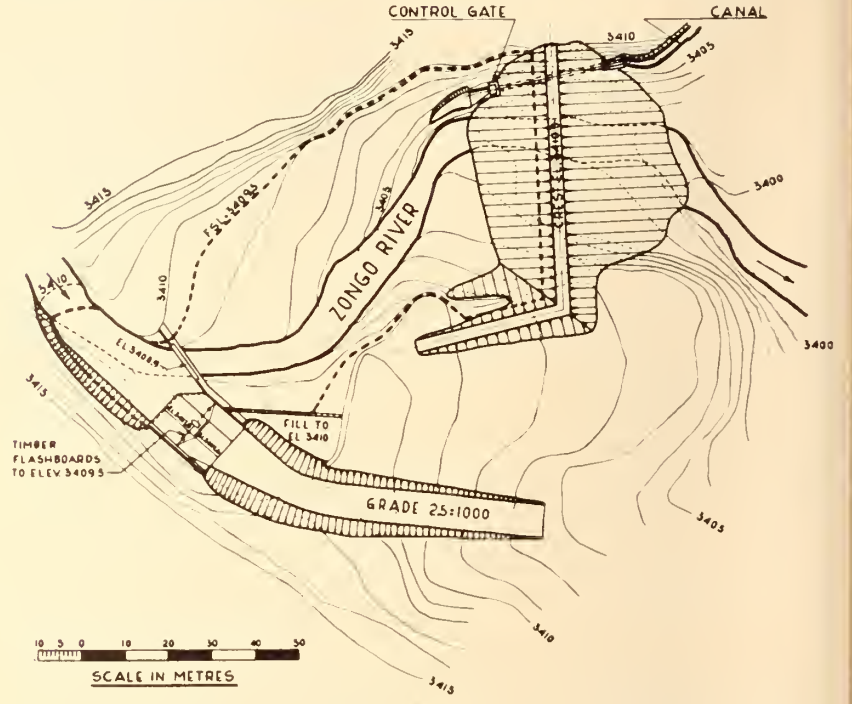


Fig. 4. Cuticucho dam and bypass canal on the Zongo River, Bolivia.

3. Pondage reservoirs can be restored to at least partial capacity and their life prolonged indefinitely if they are drained and flushed periodically through cleanout sluices of adequate capacity near the bottom of the dam. All low dams on silt carrying rivers in the tropics should have this provision.

4. In the case of small pondage reservoirs it is possible to keep the bed load and much of the heavier sediment of the stream from entering by constructing a bypass canal around the reservoir. The canal and the pond are connected by a submerged weir, and in the canal downstream from this weir there is a control structure which is used to discharge flood water during the rainy season or to flush out the accumulated sediment from in front of the submerged weir at intervals during the dry season. Figure 4 shows a pondage reservoir with bypass canal constructed for the Cuticucho Plant on the Zongo River in Bolivia.

Evaporation also has a serious effect on tropical reservoirs and

tends to lower their efficiency, i.e. the ratio of discharge to inflow volumes. In tropical regions the average rate of evaporation from lake surface may vary between 0.06 and 0.10 cu.m./sec. per square kilometre. Thus when a lake is raised and its area increased for storage purposes the gain in regulated flow will be at least partially offset by increased evaporation losses.

It has been calculated in the case of Lake Kivu in the Belgian Congo that potential power output could be increased by tapping the lake with a deep tunnel and lowering the range of regulation level, thereby reducing surface area and evaporation losses so as to more than offset the loss of head. This feature must be kept in mind when increasing reservoir volumes either for streamflow regulation or silt retention.

The evaporation from water surfaces downstream from reservoirs must also be taken into account when planning the development of a tropical river. An extreme example of this occurs on the Nile which receives the greater part of its supply from the White Nile rising in the Lake Victoria region. The White Nile loses 4,500,000,000 cu.m of water annually, or 55 per cent of its total flow, in the swamps of the Sudd region between Mongalla and Malakal. In the meantime, Egypt and the Sudan are short of water in dry years — a situation that could only be corrected by some form of canalization through the Sudd.

Dams

The design of dams in tropical and sub-tropical regions is usually featured by the high flood discharge capacity that must be provided and it is not uncommon to find both high level crest gates and low level sluices required.

The absence of freezing temperatures makes for greater freedom in selection of flood discharge equipment, and advantage is occasionally taken of this fact to install automatic regulating gates of types that would not be practical in northern climates. For the most part, however, the tainter gate and the wheeled gate are most commonly used for discharge control.

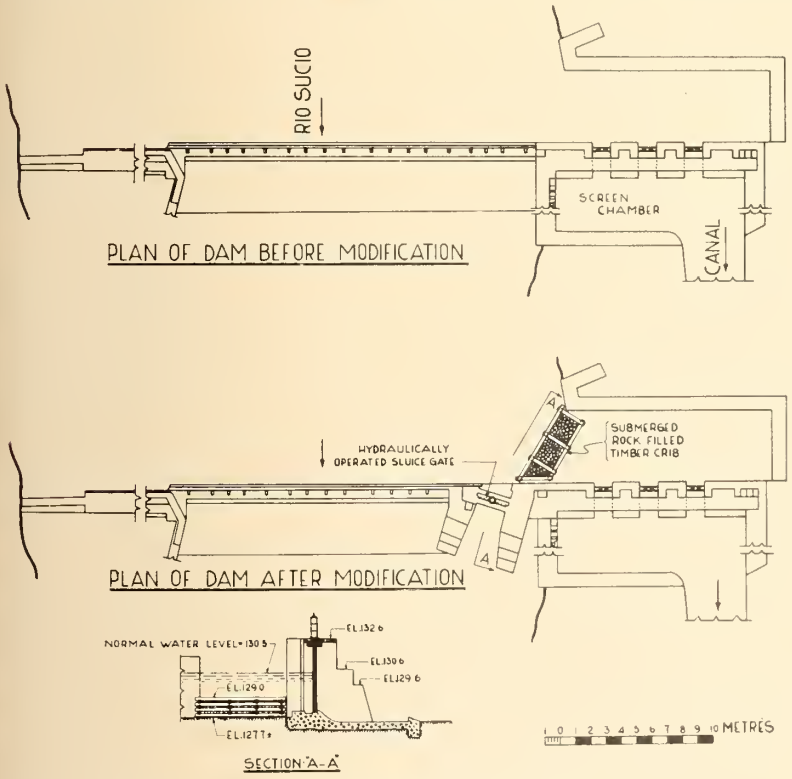


Fig. 5. Rio Sucio dam in El Salvador, before and after modification.

Special care must be taken to provide adequate flood discharge capacity if earth fill dams are used in the tropics. On the other hand, an earth fill side dam of small size compared to the main structure can be used as an emergency relief or "fuse plug" designed to fail by overtopping in the event of a super flood.

Such an earth fill "fuse plug" has been constructed at the Guayabo Dam in El Salvador. The drying and cracking of earth dams during periods of storage drawdown may cause trouble in climates with a long dry season of low relative humidity. This difficulty has been reported from India and Indonesia.

The freedom from freezing temperatures allows a wider choice of concrete structures in the tropics. Disintegration of concrete surfaces at the water line is more or less eliminated and the spalling of exposed downstream surfaces due to seepage is greatly reduced. These circumstances favour the use of the hollow buttress dam constructed with reinforced concrete. The fact that this type of dam has not had wider acceptance in the tropics is probably due to the high cost of formwork, reinforcement, and high strength concrete as compared with stone masonry and cyclopean concrete.

Another feature in the design of concrete (or masonry) dams in the tropics is the absence of thrust from an ice sheet on the reservoir. This may amount to 15 metric tons per linear metre of dam in cold climates. On the other hand, the design of tropical dams should frequently make allowance for the thrust of submerged silt deposits against the upstream face in addition to water pressure.

Intake Structures

Intake works in the tropics can frequently be of somewhat simpler design than in higher latitudes. No ice chutes or protective curtain walls in front of screens are required. Moreover, it is possible to use unprotected intake towers standing in the reservoir upstream from the dam, a type of construction seldom feasible where an ice sheet exists.

Intakes from low head diversion works in the tropics, however, must usually be designed to protect against entry of silt, and experience has led to the adoption of a more or less standard layout of structures.

1. Water is drawn into the intake normal to the direction of the stream. To accomplish this the intake is located in the bank upstream from one end of the dam and as near to it as possible.
2. Sluice gates are located in the dam next to the intake, and the sills are set near river bed level.

3. The sill of the intake should be elevated several feet above the sluice gate sills.

During periods of excess water the sluice gates adjacent to the intake are kept open to keep the bed load moving past the front of the intake and retain the main channel of the stream at that side of the river. During periods of low water the sluice gate nearest the intake is either kept open a very small amount to prevent build-up of silt in front of the intake or it is opened at intervals to sweep out the accumulated silt before it can build up to intake level.

Figure 5 shows the modifications made to a small intake on the Sucio River in El Salvador to conform with good practice.

Variations of the standard design are introduced wherever it is not possible to locate the intake high enough above the discharge gate sills. These variations usually consist of submerged training walls or conduits located in front of the intake and upstream from the sluice gates. A recent example of such variation is the intake for the Santa Cecilia pumping station on the Paraiba River in Brazil. Based on tests made at the Iowa Institute of Hydraulic Research an arrangement of three concrete baffles in front of the pump intakes successfully conducts bed load to the sluice gates downstream.

Canals and Flumes

The absence of frost makes it possible to use high velocity canals and flumes in the tropics, whereas in cold climates velocities must be kept low enough to permit formation of an ice cover. Likewise, it is possible to use lower freeboard allowance for canal embankments where there is no danger of frost penetrating the ground.

On the other hand, the higher rates of runoff in the tropics may make canal design more difficult. Flood waters must be kept out of the canal by entrance control structures, and adjacent hillside drainage must be passed over or under the canal by suitable conduits, whereas in colder climates it is frequently possible to let such drainage enter the canal. Capacities as high as 340 cu.m./sec. are required for the underpasses and overpasses of the new Nangal canal in India to keep out the adjacent drainage.

Another feature, occasionally affecting earth canal design is the prevalence of small burrowing animals. In Indonesia, for example, the juju, a kind of crab, digs holes through dikes. Protective coverings or membranes are required to keep them out.

High-Line Conduits, Surge Tanks and Penstocks

There is little difference in pressure conduit design between the tropics and temperature regions. The planning of such conduits may be simplified by absence of frost in the tropics but, on the other hand, greater allowances for corrosion and erosion may be required.

Surge tanks in hurricane areas require special consideration. After having determined the maximum wind velocity to be expected in the region it is advisable to add a factor of safety to design by omitting any reduction of wind pressure due to curvature of tank surface.

Powerhouse Structures

There is little variation in power house building design in temperate and tropical climates excepting the additional emphasis on ventilation in the latter. Probably the most common problem of the tropics is the necessity of providing protection against high flood water, and more attention is now being given to underground powerhouses on this account. These may be constructed as underground chambers excavated out of the rock or as open pits in the high ground beside the river.

The underground powerhouse of the Guayabo Project in El Salvador designed by the Harza Engineering Company to keep out flood water is a unique example of the former. The power station in this case is in a chamber in the rock below the intake. The penstock shafts drop vertically down from behind the headgates to the spiral case inlets of horizontal Francis turbines on the downstream side of the power station. The draught tubes are horizontal conical tubes discharging into a free-flowing tailrace tunnel.

Mechanical and Electrical Equipment

There is a tendency to greater use of renewable wearing rings in Francis turbines in the tropics than is found in installations further north, but, on the whole the specification and design of mechanical and hydraulic equipment is not materially affected by climate. Electrical equipment on the other hand, should have special design features.

Mid-day temperatures in the tropics may exceed 50° C and the temperature of metal exposed to the sun may go as high as 75° C. Thus a 50° C rise above these ambient conditions would result in equipment temperatures higher than 100° C. Generators, motors and transformers must be provided with adequate ventilation and special insulation if they are to retain their rated capacities under such circumstances. Moreover, if equipment is subject to temperature drops below dew point it should be protected by special tropical impregnations against condensation, and should not contain porous insulating materials which may absorb moisture.

Generators of major installations of say 10,000 kw. capacity or over should be provided with closed circuit ventilating systems. Small machines should have ventilation discharge ducts to exhaust the hot air outside the building. Metal-clad switchgear should have ventilation openings at top and bottom of the housings to permit vertical circulation of air, and these openings should be screened against rodents and lizards.

Summary

Hydro-electric design in tropical and sub-tropical regions as compared to practice in temperate regions is influenced by the high temperatures, extremes of humidity, hurricane winds, high floods, wide variation of streamflow, scarcity of natural storage, and the silt laden river water, frequently encountered in the tropics.

Water power in the tropics is usually subordinated to irrigation and most large projects are jointly developed to serve both purposes. However, the greater part of tropical hydro-electric development to date has consisted of small single purpose plants whose popularity is due in part to the greater simplicity of design that is possible when there is no freezing to contend with. Introduction of automatic and remote controlled operation may further improve the position of these small plants.

The design of the various hydraulic structures comprising a power plant—the reservoirs, dams, intakes, canals, flumes, pressure conduits, and surge tanks—is simplified by absence of ice but com-

(continued on page 1372)

From Fire Sticks to Jet Engines

The study of combustion is traced from the middle of the seventeenth century to the present day. Progress was erratic to the beginning of the present century, became steady up to the last war, and has expanded rapidly since.

by

J. M. F. Vickers,

*Lecturer in Mechanical Engineering, University of Toronto**

A paper read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

Early knowledge of fire is buried in the primaeval history of man. Probably the first contact with burning materials for primitive man was a forest fire, started by lightning or by volcanic lava. At some very early stage the production of fire by rubbing two sticks together was discovered, the first manifestation of the mutual dependence of work and heat, which was to be neglected until the time of Rumford and Joule.

The early Greeks considered that fire was one of the three elements of which all physical bodies were composed, the other two being earth and water. This error, which persisted until the middle of the 17th century, was probably due to the fact that the ancient Greeks were philosophers rather than experimentalists. The Romans, who did believe in experiment rather than argument, appear to have accepted the earlier ideas on combustion, as did many succeeding generations.

Boyle[1] and Hooke[2], in the middle of the 17th century, were the first to question the Greek philosophy of the structure of matter. Boyle stated that "There may be dispersed thro' the atmosphere, some odd substance . . . on account whereof, the air is so necessary to the subsistence of the flame", also that he thought that a "ponderable fire stuff" was taken up in the burning of metals, which would account for the gain in weight which had been observed by Jean Rey in 1630.

Hooke carried this theory much further, and put forward a series of propositions which gave a new view of combustion and a definition of flame which is very close to much more modern ideas on the subject. He said [2] "It seems reasonable to think that there is no such thing as an Element of Fire . . . but that the shining transient body which we call flame, is nothing else but a mixture of air and volatil sulphureous parts of dissolvible or combustible bodies, which are acting upon each other whilst they ascend". Hooke also produced eleven other hypotheses on fire, many of which, in the light of present knowledge, are remarkably accurate.

Mayow[3], a pupil of Boyle, described a large number of experiments carried out before 1674, in the course of which he actually came very close to the discovery of oxygen, thus nearly antedating Priestley by a century. He postulated "nitro-aerial particles", which in some ways were very implausible and complicated; they were, however, present in air, were necessary to support combustion and also to support life. Mayow thought, however, that the particles produced flame due to conflict with the burning substance rather than combination with it.

The period immediately following these three remarkable individuals may be termed the dark ages of combustion theory, though it is more generally known as the "phlogiston era". In spite of the experiments and theories of Boyle, Hooke and Mayow, the phlogiston theory was to hold sway for 120 years, starting in about 1680. The theory was originally put forward by Becher,[4] and was then elaborated by Stahl,[5] Priestley[6] and many others. The theory stated that all combustible bodies contained two "principles", terra pingnis, or phlogiston, which escaped during combustion, and incombustibility which remained behind. The fact that metals increased in weight had already been noted by other workers, so phlogiston was credited with "negative weight"; this was in spite of the fact that, at the very beginning of the phlogiston era, Newton[7] had published his law of gravity, which precluded the concept of negative weight. The theory was carried to fantastic lengths in order to account for the chemical and physical phenomena discovered during the period, and many eminent men were firm believers of the theory in spite of its obvious limitations and disagreement with other accepted theories, particularly those of Sir Isaac Newton.

Many important discoveries were made during the period when the phlogiston theory predominated in the minds of the major experimentalists, particularly the discovery of many of the gases. Until this time "air" had been considered to be an invisible, elastic fluid, upon which certain special "qualities" could be imposed, which did not change its fundamental nature, but which gave it different properties. Certain gases were known, particularly hydrogen and carbon dioxide (under different names), but these were merely considered to be air with various "admixtures".

Black[8] was the first of the investigators to suspect that there existed in the air a peculiar species, fixed air or carbon dioxide, which was dispersed in small quantities throughout the atmosphere, and differing from ordinary air in that it was possible to dissolve it in caustic alkalies, and also to liberate it when a mild alkali was dissolved in acid or burned. Many other discoveries were made, the most important being the first attempts at gas analysis; one of the

*Now Associate Professor of Mechanical Engineering, University of Nebraska, Neb., U.S.A.

most remarkable results being obtained by Cavendish[9] who established the composition of air as 20.8 volumes of dephlogisticated air (oxygen) and 79.2 volumes of phlogisticated air (nitrogen); when this result is compared with the results of modern gas analysis the accuracy of Cavendish's experimental technique with crude apparatus can be appreciated.

Priestley discovered, as had Mayow before him, that air was vitiated both by combustion and the breathing of animals, and in addition that on exposing this vitiated air to the action of living plants and sunlight that its former qualities were restored and that it could again support life and combustion. He also discovered the formation of water when hydrogen and oxygen were burned together, but did not realize that the water was actually composed of these gases. Cavendish later repeated Priestley's experiments on the combustion of hydrogen and concluded that "this dew is pure water, and consequently that almost all the inflammable air, and about one-fifth of the common air, are turned into water".

Lavoisier[10] was the first person really to attack the phlogiston theory, and he completely disproved it. He based all his work on the axiomatic assumption of the principle of the conservation of mass, and in 1778 wrote of "l'air pur" or "l'air vital", which he proposed to call "oxigene", which was the constituent of the air which combined with various substances during their combustion. His main statements were that: (1) inflammable substances would only burn in oxygen or where oxygen was present; and (2) oxygen was consumed in combustion and, uniting with the substance burned, caused an increase in its weight and a corresponding decrease in the weight of air used. The exponents of phlogiston had believed that heat was something that had weight, but Lavoisier showed experimentally that there was no change in weight between reactants and products when the containing vessel was kept sealed. Lavoisier, with Laplace, also founded the science of thermochemistry by enunciating the theory that the same amount of heat was required to resolve a substance into its constituents as was liberated originally in its formation.

The next step forward of major importance was due to Dalton[11] who published his atomic theory of matter in 1808. Until 1776 "inflammable airs" from different sources had not been recognized as separate compounds or elements, but from then on a number of workers in France and England began to detect differences between the various gases which had been discovered. Marsh gas was shown to be different from hydrogen and carbon monoxide and, within a few years, methane and ethylene were identified. The study of the combustion of these gases led Dalton to his atomic theory of matter and to the law of multiple proportions which was evolved from it. Dalton also carried out two experiments and enunciated two equations which were to be ignored for nearly a century, these were connected with the burning of methane and ethylene. In each case the combustible gas was burned with its own volume of oxygen, and the resulting reactions were described by Dalton as

$$CH_4 + O_2 = CO + H_2O + H_2$$

and $$C_2H_4 + O_2 = 2CO + 2H_2$$

These two results were then forgotten until 1891, when they were rediscovered in Manchester, the city where Dalton had carried out his work, and became the vital link that disproved the Bunsen theory of "orders of combustibility" which will be discussed later.

The short period from 1815 to 1819 is famous for the work of one man, Sir Humphrey Davy,[12] who in that time established that a fuel-air mixture was only explosive within limited range of mixture strengths and that different fuels required different temperatures to ignite them; from these facts he first deduced and then proved that it was possible to make an explosive mixture safe by cooling it sufficiently. Davy found that it was impossible to explode a mixture of gas and air "in metallic troughs or canals when their diameter was less than 1/7 inch and their depth considerable in proportion to their diameter", and further that "explosions could not pass through very fine sieves or gauzes of wire". The latter discovery led to the development of the Davy miner's lamp, which was first tried in an explosive atmosphere in a British coal mine in 1816. Davy also became interested in the luminosity of various flames and decided that the luminosity of the flame was caused by "the production and ignition of solid matter" thus explaining the intensity of the light given off by phosphorus or zinc burning in oxygen compared with "the feebleness of the light of those flames in which gaseous and volatile matter alone is produced such as those of hydrogen and sulphur in oxygen, or of phosphorus in chlorine, etc."

Davy also attempted to estimate the temperatures of flames, though he himself said that the accuracy was not great; he also made a study of preflame reactions, that is the formation of water from mixtures of hydrogen and oxygen at temperatures far below those associated with flames. As a result of the latter research he also discovered catalytic combustion particularly the effect of fine platinum wires on mixtures of coal gas and other gases which were too rich to support combustion under normal circumstances at room temperature. He was led to remark that "the chemical changes in general produced by slow combustion appear worthy of investigation", which, while it was not realized at the time, is now known to be the basis of one of the most important lines of investigation into the behaviour of the combustion wave. The original investigation of catalytic combustion leads naturally into the modern study of surface combustion, while the development of the miner's lamp leads to the modern investigation of quenching distances of various flames and many forms of flame trap.

Immediately after the discovery of catalytic combustion a number of workers, including William Henry and Michael Faraday, became interested in the mechanism involved and many heated discussions took place. This interest died down in about 1836, and the results were completely ignored in the period that followed, with disastrous consequences.

Combustion research during the period 1836 to 1880 was largely concentrated in Germany, particularly in the school set up in Heidelberg by Bunsen[13], who, in addition to inventing the burner which still bears his name, undertook a series of experiments on the law of mass action, the determination of flame speeds, and the investigation of the pressures set up by gaseous explosions. Unluckily, although

Bunsen was an ardent experimenter, many serious flaws existed in his experimental techniques, particularly in his work on the law of mass action. He completely ignored the work of Dalton on the combustion of methane and ethylene, and was a firm believer in the preferential combustion of one gas over others in a mixture, particularly in thinking that hydrogen would always combine first in any reaction, and that the combustion process consisted of a series of discontinuous steps. His main experiments in this field are largely invalidated by the fact that, so far as can be ascertained, he neglected to dry out his apparatus before carrying out his experiments, even though one of the products which he was seeking was water. His work on the pressures developed during gaseous explosions was very accurate considering the relatively crude apparatus at his disposal, but his theoretical calculations of flame temperatures neglected flame radiation, of which very little was known at the time. Bunsen accounted for the fact that his calculated flame temperatures were three times as high as those he actually measured by assuming that three stages of combustion occurred, with cooling taking place in between; however his method of determining flame speed is still used, with suitable refinements, as is some of his experimental technique on flash-back effects in burner tubes.

The preferential combustion theory was bolstered still further by the work of Landolt,[14] a pupil of Bunsen, who sampled the combustion products at various positions along the axis of a flame. He found that hydrogen was apparently burned first, then methane, and finally the heavier hydrocarbons if these were present. The objection now raised to these results was that not only was the work of Dalton neglected, but also the much more recent work of Davy and the other investigators of catalytic combustion, since a platinum tube was used to take the samples. This platinum tube must have been red hot due to the close proximity of the flame front, and would act as an excellent catalyst for the hydrogen, thus completely invalidating the experiments.

The Bunsen theory persisted until the beginning of the present century. This period of dominance of the German school and the preferential combustion theory did not strangle all research in other branches of combustion; dissociation was studied actively in France, and the science of thermochemistry, or more particularly the study of heats of combustion, was being developed in many centres in Europe, with extremely accurate and refined apparatus.

From 1880 to 1938 the analysis of the combustion wave became more and more exact. The thermal theory of flame propagation, in which the flame was considered to proceed through an inflammable mixture by the successive heating of the layers of gas ahead of the flame front was developed and refined. This theory, however, was unable to account for the behaviour of even the oxygen-hydrogen reaction, which was at that time considered to be one of the simplest possible, or the peculiarities of the combustion of the higher hydrocarbons.

Theoretical Approaches

During this same period many other theories were put forward, most of which have since been discarded. The only two of these theories to survive are the nuclear drop theory of Callendar and the chain reaction theory. The former theory, summarized by King[15], was put forward originally to explain the phenomenon of detonation in the internal combustion engine cylinder, and stated that the higher hydrocarbons tended to form minute droplets, which acted as active centres for the spontaneous combustion which takes place ahead of the flame front when detonation occurs. This theory also explained the action of minute quantities of metallic dopes, which were thought to congregate on the drops, inhibiting the spontaneous oxidation and decomposition effects which gave rise to detonation. The nuclear theory was not dependent solely on the existence of drops of liquid, since any dust particles remaining in the end gas or fluffy carbon residing in the engine cylinder would have a similar effect. The latter theory, originally collected together by Semenoff,[16] is summarized in the preface to this reference "Recent experiments . . . show that a comparatively small amount of active particles (oxygen atoms, for instance), admitted into a chemically unstable system, is able, leaven-like, to call forth the reaction at temperatures which are much below the reaction temperature corresponding to normal conditions. . . . The above active particles enter the reaction and form branching chains."

The increasing use of the internal combustion engine, both diesel and gasoline, tended to produce a concentration of most of the engineering research during this period on the behaviour of burning fuels inside engine cylinders; this was mainly directed into the investigation of the refining of fuels, and producing new additives which would allow higher compression ratios and suppress the phenomenon of detonation. At the same time chemists and chemical engineers in Europe and the United States of America were improving the techniques used to measure burning velocity, flame temperature and ignition temperature, and were examining the reactions which occur just ahead of the flame front.

This period is dismissed very briefly solely because it is so recent that it is very difficult to assess properly; much of the work done at this time is of great importance to the present study of combustion, and many of the people who started their research during this period are still extremely active at the present day, either in work started then or on other branches of the combustion field.

The outbreak of the second world war saw the advent of the gas turbine in Great Britain and Germany, which caused a change in the main emphasis of engineering research in the combustion field. While the search for efficient anti-knocks continued, together with the investigation of the causes of detonation, a second main line of research developed rapidly — the investigation of the behaviour of continuous flames to find efficient methods of stabilizing combustion in high-velocity gas streams. Detonation effects are not involved in the design of gas turbines, but it was rapidly discovered that far too little knowledge was available on the true nature of the combustion wave, and that methods of measuring flame temperature were either too cumbersome or too inaccurate.

In Germany, during the same period, a further line of research was being actively pursued, the study of rocket propulsion, which had only received sporadic atten-

tion since the Chinese had invented the rocket as a weapon before the time of Ghengis Khan. The outcome of this research was twofold, the V1 intermittent pulse jet, and the continuous combustion rocket motor, with very large heat releases in extremely high velocity gas streams, for the supersonic V2.

Due to the gas turbine research and also the rocket research in Germany, many new schools studying combustion sprang up after the end of hostilities, and many of the existing schools and government research establishments were expanded. The investigations now take in the mechanical engineer, the aerodynamicist, and applied mathematician instead of being the sole prerogative of the chemist and chemical engineer. It is impossible to describe the present state of knowledge of the subject, since there are many active centres of researeh in the United States of America, England, Germany, France, the Low Countries, and Canada; it is, however, interesting to consider the main lines which are being pursued.

While the true mechanism of flame propagation is not yet fully understood, the results obtained in the various fields of investigation have led to an almost complete interlinking of the thermal and chain reaction theories, though many gaps still exist. At the same time Von Karman and Penner[17] and Hirschfelder and his collaborators[18], each group working independently, are making a theoretical analysis of the behaviour of the combustion wave, starting with the behaviour of the individual molecules.

The problem of detonation is still being actively studied both in North America and Europe, due to the steady demand for greater and greater horsepower in the automobile engine. The aeroplane has, however, virtually withdrawn from this race, having apparently reached a logical conclusion of its development when the 24-cylinder Sabre engine was fitted in the single seat Typhoon aircraft near the end of the war. The work on the internal combustion reciprocating engine seems to be so complicated by the inherent difficulties imposed by the reciprocating process, particularly the variation of temperature during the cycle and the very short period of time that the flame exists, that it appears unlikely to be able to provide very much information at present concerning the actual mechanism whereby a continuous flame is propagated through a gaseous medium.

The work on continuous flames falls into three main groups, the investigation of the speed at which a flame can propagate under various conditions, and the mechanisms by which this propagation is achieved; the spectrographie investigation of flames, both by means of the mass spectrograph and the light spectrometer, both of which are means of determining the reactions which take place immediately ahead of the flame front; and the investigation of various methods of flame stabilization, particularly the stabilization of the flame in the gas turbine afterburner and the rocket. It will thus be seen that combustion, which embraces chemistry, physics, heat transfer and gas dynamics, can no longer be associated with one type of investigator, but involves the co-operation of many different groups, each of which contributes vital links in the rapid growth of knowledge in this field.

To sum up, fire, originally considered to be an element forming a portion of everything else in the universe, has now been recognized as one of the most complicated phenomena which are now under investigation, embracing more branches of pure and applied science than any other single field.

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The Influence of Tropical and Sub-Tropical Factors in the Design of Hydro-Electric Plants

by J. K. Sexton, M.E.I.C.

(continued from page 1368)

plicated by high floods and the prevalence of silt in the water.

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Low-Frequency Radio Communications and Engineering

by
R. S. Thain,
Defence Research Board, Ottawa, Ont.

paper presented at the 69th Annual neral and Professional Meeting of he Engineering Institute of Canda, Toronto, May 1955.

This paper discusses the present role of the low frequencies in radio communication in Canada, summarizes the present state of our knowledge of the propagation of these radio frequencies, and outlines briefly some of the engineering problems encountered in systems design.

Low radio frequencies have been used for communication since the advent of wireless telegraphy. Although, in general, the extent of their usage has declined in the past twenty years, this is not the case in Canada. Factors peculiar to our geographical location contribute to the continued importance of the low frequency band for radio communication in Canada. This fact is not generally realized with the result that insufficient attention has been paid in this country to research in this important and useful field.

The portion of the low-frequency band allocated in Canada to fixed point-to-point communication is from 14 kc. to 200 kc. Economic considerations impose a lower limit at about 70 kc. and for this reason this discussion will be limited to the frequency range from 70 kc. to 200 kc.

Historical

The frequency used by Marconi in 1901 in his initial Trans-Atlantic transmission is unknown but believed to have been about 300 kc. Later experiments showed a decided preference for the use of lower frequencies for long distance communications and, as a result, a considerable number of very low frequency transmitters were built throughout the world. These transmitting installations were constructed only at great expense and thus, with the development of the "beamed" high frequency systems in about 1924, there was a tendency to discontinue the use of low frequencies for long distance communication.

Considerable advances have since been made in radio-communication techniques and in communication theory, but there has been very little serious effort to apply this knowledge to low frequencies with the result that there have been only minor advances in the engineering of low-frequency systems in the past two decades. Recently there has been a revival of interest in the low-frequency band for radio navigational systems. It is considered worthwhile at this time to review Canada's interest in this portion of the radio spectrum.

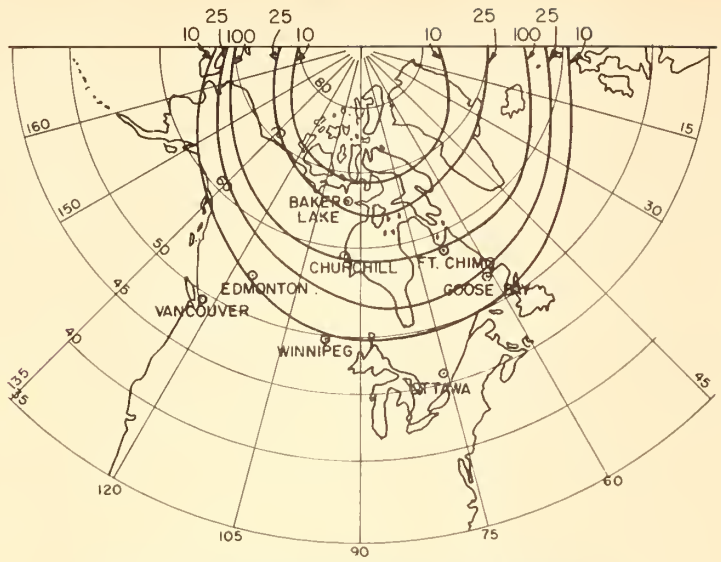


Fig. 1. Estimated percentage-frequency of days with occurrence of Aurora (nightly basis).

Low-Frequency Communications in Canada

It is well known that high-frequency circuits are often interrupted by the occurrence of ionospheric storms. There is considerable evidence that the frequency of occurrence of radio 'blackouts' of a high-frequency circuit is dependent on the position of the ionospheric reflection point with respect to the auroral zone. The position of the auroral zone in Canada, averaged over a sunspot cycle, is shown in Fig. 1.

It can readily be seen from inspection of Fig. 1 that the auroral zone can thus influence a large number of high frequency circuits in Canada, particularly those having terminals in Northern Canada. There is also considerable evidence to support the belief that low radio frequencies are not affected by ionospheric storms in the same manner as the high frequencies. In fact, there are indications that the amplitude of the sky-wave component at low frequencies is enhanced during periods of ionospheric disturbances. Present methods of forecasting ionospheric conditions have greatly increased the reliability of high-frequency circuits but it is not yet possible to forecast the 'sudden ionospheric disturbance' type of phenomena. Therefore, in many applications, low-frequency circuits can provide an order of reliability that cannot be achieved by high-frequency circuits.

One of the most serious disadvantages in the use of low radio frequencies is due to the necessity, in general, of overcoming high noise levels of atmospheric origin. At low geographic latitudes atmospheric noise is particularly intense at low radio frequencies resulting in the requirement of high transmitter power. Little precise information exists concerning atmospheric noise levels in Canada. However, the available data indicate that in Northern Canada there are relatively low amplitudes and rates of occurrence of the impulsive noise, characteristic of nearby thunderstorms, and relatively low amplitudes of random atmospheric noise, characteristic of thunderstorms located in equatorial regions.

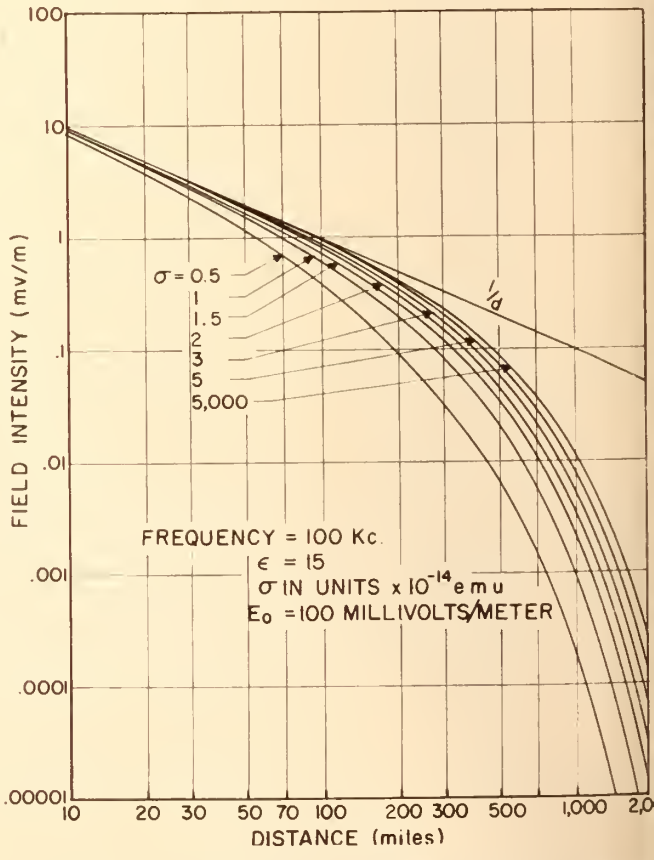
Another important disadvantage of the use of low frequencies is the limited available channel capacity due principally to bandwidth restrictions. This point will be discussed in detail in a later section. However, as regards radio communication circuits in Northern Canada, the present amount of traffic on any one circuit seldom exceeds the capacity provided by a single channel.

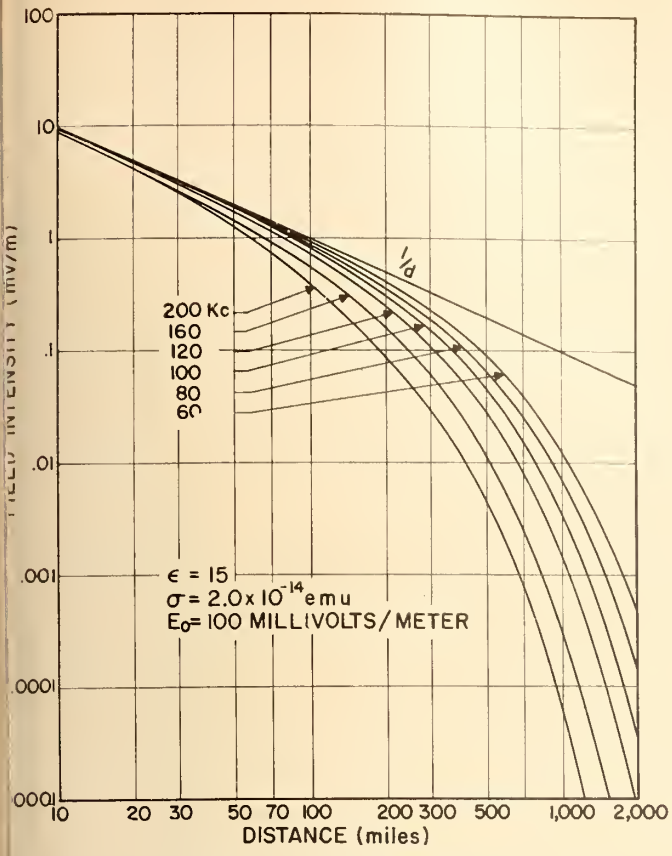
The advantages offered by the use of low frequencies in Canada have resulted in rather extensive use of the band of frequencies between 70 kc. and 200 kc. The actual extent of usage of this band is shown in Table I which lists the number and classes of Canadian assignments for transmitters of 0.5 kw. or greater power.

Propagation of Low Radio Frequencies

Before discussing the problems encountered in the engineering of a low-frequency radio circuit it is considered necessary to briefly review our knowledge of the propagation of low-frequency radio waves. If a ra-

Fig. 2. Ground-wave field intensity as a function of distance and ground conductivity.





g. 3. Ground-wave field intensity as a function of distance and of frequency.

iver is located at a distance, d, easured along the earth's surface om the transmitter, the received gnal will consist of a contribution e to the ground-wave and conbutions due to sky-wave comnents.

The field intensity at the receiver e to the ground-wave may be expessed, simply, by the following:

$$E_{GW} = \frac{m\,E_o}{d} \qquad (1)$$

where E_o is the unattenuated ield intensity over the ground at nit distance from the transmitter;

m is the ground-wave attenuation actor and is a function of frequency, polarization, distance, arth's curvature, and of the conductivity and dielectric constant f the intervening terrain.

The variation of ground-wave nsity E_{GW} with distance and conductivity is illustrated in Fig. 2 f a frequency of 100 kc. and for tical polarization. The field intsity values of Fig. 2 refer to an sumed value of E_o of 100 millivts per metre at one mile from the nsmitter, corresponding to a radted power of about 730 watts. The variation of ground-wave intsity with distance and frequency s illustrated in Fig. 3 for propagation over ground of conductivity 2.0 x 10^{-14} e.m.u. The curves of Fig. 2 and Fig. 3 have been constructed using the method given by Norton [1].

Considering the case of a single sky-wave component only, and assuming perfect reflection at the earth's surface, the signal voltage induced in a vertical antenna of effective height equal to 1 metre, can be expressed by the following:

$$E_{SW} = 2\,E_s \sin i \qquad (2)$$

where E_s is the intensity of the field due to the sky-wave, vertical to the direction of propagation;

i is the angle of incidence of the sky-wave with respect to the normal to the ground-plane at the receiver.

The field intensity of the sky-wave, E_s, may be expressed as

$$E_s = \frac{D\,E_o}{L} \cdot R \sin i \qquad (3)$$

where D is the divergence coefficient of the ionosphere.

R is the coefficient of reflection of the ionosphere.

L is the length of the sky-wave transmission path.

$\sin i$ is a term related to the radiation pattern of a typical low frequency transmitting antenna.

Combining (2) and (3)

$$E_{SW} = \frac{2\,D\,E_o}{L} \cdot R \sin^2 i \qquad (4)$$

Expressions (2), (3), (4) are derived from simple geometry assuming reflection of the sky-wave from a mirror-like surface at a fixed height above the ground.

Considering expressions (1) and (4) the phase of the sky-wave relative to that of the ground-wave is given by the following:

$$\phi = 2\pi \frac{(L-d)}{\lambda} - \phi_R \text{ (radians)} \qquad (5)$$

Where ϕ_R is the phase change of the sky-wave at reflection at the ionosphere;

λ is the wavelength.

At the receiver, the resultant signal will be dependent upon the relative amplitudes of the components and their phase relationship. Since the latter varies with height of reflection, variations in signal amplitude will occur due to changes of the reflection height. For example, at a receiver located 350 miles from a transmitter, at a frequency of 100 kc., a change from the day-time reflection height of about 70 km. to the night-time reflection height of 95 km. results in a change of phase of ϕ of 10π radians. The received signal will thus vary in amplitude through a maximum of $E_{GW} + E_{SW}$ and a minimum of $(E_{GW} - E_{SW})$ five times during

Table I. Numbers of assignments in Canada for transmitter powers of 0.5 kw. or greater.

Frequency Range	Class of Emission A1 (on-off keyed telegraphy)	Class of Emission F1 (Frequency-shift keyed telegraphy)	A1F1
70 kc.-100 kc.	1	—	3
100 kc.-150 kc.	55	17	6
150 kc.-200 kc.	141	28	—
Total	197	45	9

this transition of height. Also, it should be noted that the coefficient of reflection, R, in equation (4) is not a constant and it is subject to fluctuation, particularly during the night-time. Typical records of the fluctuation of signal strength at a distance of 400 miles from a transmitter at frequencies of 97.1 kc. and 153 kc. are shown in Fig. 4. These particular records were obtained over a test circuit Ottawa-Kingsville in March, 1955.

The term $(L\text{-}d)$ in equation (5) varies with distance, d, from the transmitter resulting in variations in the phase difference, ϕ, of the two components. The resultant variation of signal amplitude with distance, d, assuming a fixed height of reflection of 95 km., is shown in Fig. 5. The graph of Fig. 5 has been prepared for a frequency of 100 kc., assuming propagation of the sky-wave with a coefficient of reflection of 0.60 (night-time), and for propagation of the ground-wave over ground of conductivity 1×10^{-14} e.m.u. and of dielectric constant = 15.

As a result of detailed theoretical studies, (e.g. 1, 2, 3) the propagation of the ground-wave at low radio frequencies is fairly well understood. Unfortunately, our knowledge of the propagation of the sky-wave is in a much less satisfactory state. Theoretical studies of sky-wave propagation at low frequencies are made difficult since the variation of the ionospheric coefficients within a wavelength is appreciable. Our knowledge is, therefore, largely dependent upon experimental results and, apart from the work carried out at very low frequencies at Cambridge University, the experimental studies in the low frequency band have been confined to a relatively few isolated investigations at particular frequencies and over particular path-lengths. The results of some of these studies are tabulated in Table II.

Table II. Experimental results of sky-wave propagation.

Author	Frequency (kc.)	Distance (km.)	Time	Reflection coefficient	Reflection height (km.)
Caradoc Williams[4]	85	620	July night	.25	72
		500	April day	07	
		600	April day	05	
		620	April day	.06	73
	113.3	540	July night	.25	88
		640	July night	.21	92
		500	April day	04	71
		550	April day	.05	72
Weeks & Stuart[5]	70 83	300	Summer day	.02	70
		800	Summer day	.09	70
	85 37	800	Summer day	.05	
	113 8	800	Summer day	.05	

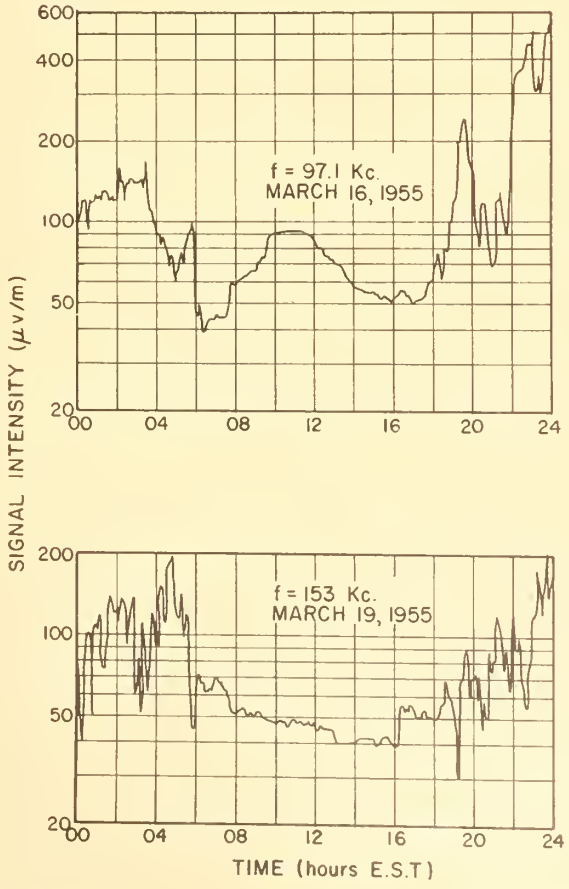


Fig. 4. Signal intensity at Kingsville, Ont., from transmitter located at Shirley Bay (Ottawa), Ont.

Engineering Problems of Low-Frequency Radio Circuits

The chief objective in the desig of a low-frequency radio circuit to satisfy the traffic requirements as economical a manner as possibl It is the purpose of this section show that the economy of cost an the economical use of the lo frequency radio spectrum are an logous considerations.

The cost of a low-frequency c cuit is determined almost entire by the transmitter power requir ment. Thus, the engineer's effor must be directed toward minimizi this requirement. This involves t consideration of the following fa tors which will be discussed se arately:

(*a*) the communications syste to be employed;
(*b*) the signal level required the receiver;
(*c*) the propagation condition and
(*d*) the transmitting antenna e ciency.

The choice of the type of co munication system to be employ in a low-frequency circuit is usua dependent upon the amount f traffic that is to be passed by t circuit. In the low-frequency ba the choice is usually confined t either that of continuous wave te graphy (morse code), or that f frequency-shift telegraphy (5-u start/stop).

The minimum signal level r quired at the receiver to provide t desired reliability is dependent up such factors as the noise level at t receiving site and the signal-to noise ratio required at the input t the receiving equipment. The no level can be reduced, to a certa extent, by the suppression of lo sources of man-made noise and the employment of a directio type of receiving antenna. Howev

the required signal-to-noise ratio is determined completely by the type of system and the type of equipment.

The factors affecting the propagation of low frequencies have been briefly discussed in the previous section. Lack of precise knowledge prevents the realization, in the design stages, of an ideal circuit and makes it necessary to calculate the

where $R_T = R_r + R_g + R_c + R_i + R_w$

R_r is the radiation resistance.

R_g is the ground terminal loss resistance.

R_c is the resistance of the antenna tuning inductance.

R_i is the equivalent insulation-loss resistance.

R_w is the equivalent conductor-loss resistance.

Since the bandwidth of the electrically short radiator is proportional to the total antenna resistance, R_T, it is not possible to obtain high efficiency and large bandwidth. The order of bandwidth obtained from a typical low-frequency antenna is illustrated in Fig. 6. The particular antenna of Fig. 6 is located at Shirley Bay, near Ottawa, and has a bandwidth between the upper and lower points of 3-decibel attenuation of 225 cycles/sec. and an efficiency of 20 per cent at the frequency of 97.1 kc.

At the Radio Physics Laboratory, several investigations have been carried out during the past few years in an attempt to reduce transmitter power requirements. These investigations have included studies of propagation, of transmitting antenna design[7], of receiving antenna design[8], and of communications systems[9]. Detailed descriptions of most of this work has been given elsewhere and mention of the work in this paper is made only in order to qualify a rather important conclusion reached by our group. We believe that the greatest advance in the engineering of low-frequency circuits can be brought about merely by intelligent restriction of bandwidth and that this statement is validated by the following facts:

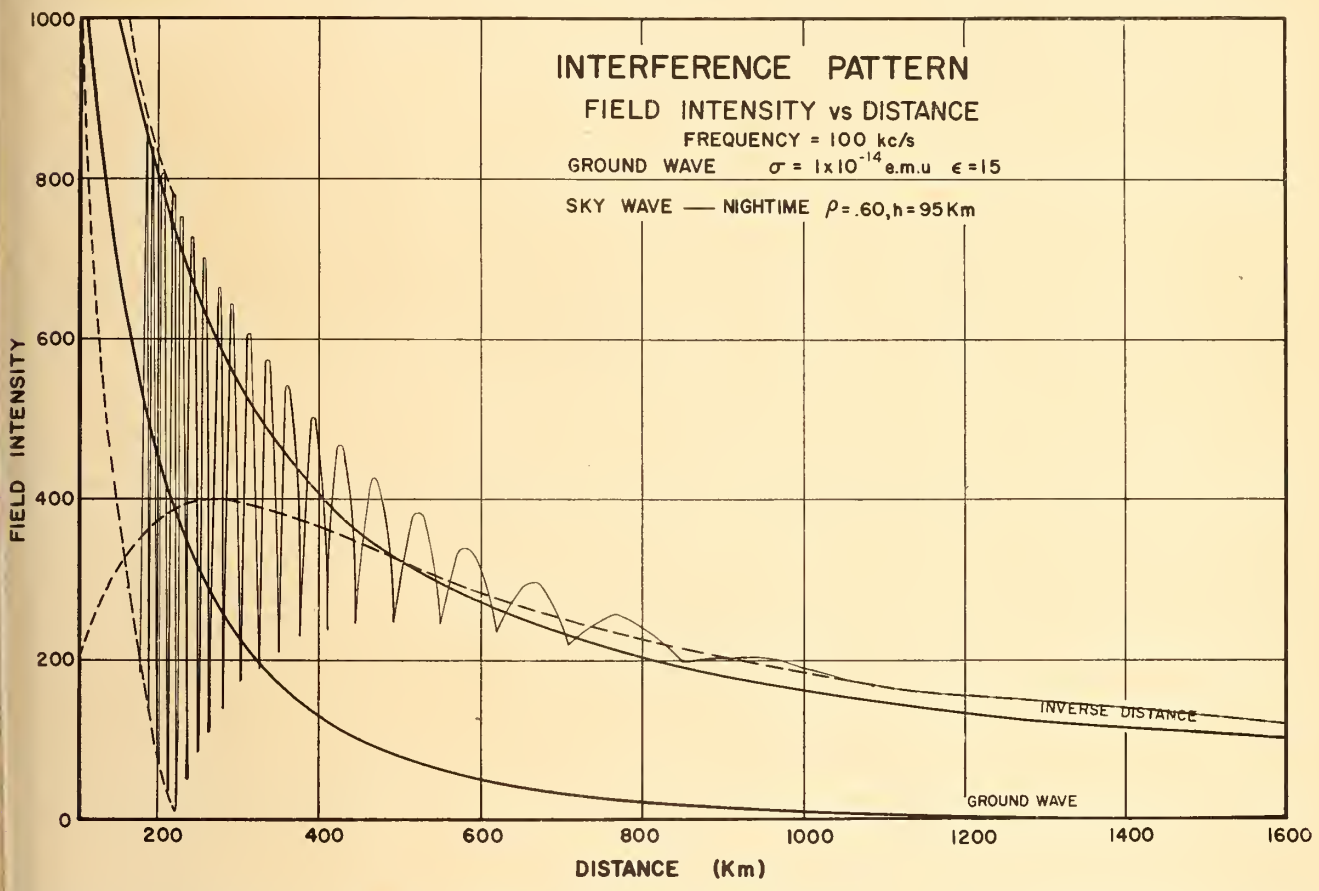


Fig. 5. Variation of signal intensity with distance from transmitter.

(*a*) an increase of the transmission bandwidth of a low frequency radiator can be obtained only by sacrificing radiation efficiency;

(*b*) since random noise power is proportional to bandwidth, the reduction of receiver bandwidth permits the reduction of signal voltage required at the receiver to provide a given signal-to-noise ratio, providing essential signal elements are not lost in the bandwidth reduction; and

(*c*) efficient usage of the available low-frequency band requires restriction of bandwidth in addition to power.

Concerning the last statement, the low-frequency band is described as being congested in Canada at this present time. Inspection of the allocation records, however, indicates that a minimum frequency spacing of from 1 kc. to 3 kc. depending on

adiated power required on a basis f existing knowledge and past experience. Improvement of this situation can be made only by continued xperimental and theoretical research.

The choice of the provision of a ighly efficient antenna together ith a transmitter of moderate power or of an antenna of lesser efficiency together with a transmitter f higher power is often determined y the available types of transmitrs. In any case, the order of effiency of a low-frequency antenna such that very careful attention ust be paid to its design. The raation efficiency, η, of a transmitng antenna is determined by the lationship[6]

$$= \frac{R_r}{R_r + R_g + R_c + R_i + R_w} \times 100\% \quad (6)$$

$$= \frac{R_r}{R_T} \times 100\%$$

the transmitter emission, is usual for circuits operating in nearby areas in Canada. Where there are more than one assignment of the same frequency the transmitters either constitute a communication 'net', or are widely spaced geographically. The spacing is due entirely to the need for prevention of single-channel interference.

It is well known that for Class A1 emission the bandwidth, in cycles per second, should be equal to 2.5 times the signalling speed in bands[10]. For morse code at 25 words per minute this corresponds to a bandwidth requirement of 50 cycles per second. However, one finds in current use at low frequencies communication receivers with bandwidth of the order of 3 kc. In most cases the receivers are equipped with bandwidth limiting devices but, in practice, remote operation of the receivers to reduce man-made noise interference usually prevents the use of such filters due to receiver frequency instability. With a very few exceptions, the communication receivers manufactured in North America for the low-frequency band are receivers that have been designed primarily for operation at high frequencies and have had additional radio-frequency-tuned stages provided to permit the detection of low radio frequencies.

Considering the frequency-shift equipment that exists today, it is apparent that there is a great need for further development if such equipment is to meet the requirements of operation in the low frequency band. Communications theory indicates that the commonly used frequency shift of 425 cycles per second is not optimum and that the extent of the frequency shift can be considerably reduced without impairing circuit reliability. Certainly the use of a narrower frequency shift is highly desirable at low frequencies if one considers transmitting antenna efficiency.

At the Radio Physics Laboratory we have investigated the use of narrow band frequency shift telegraphy at low radio frequencies. In order to conduct tests it was found necessary to construct our own equipment, since it was found that the keyer units and receivers commercially available at that time did not provide the required frequency stability. This is rather surprising since the stability required was only of the order of one cycle, in 10^5 cycles per second. The completed system[9] utilized a shift frequency of 40 cycles per second (± 20 c/s.) and a receiver bandwidth of 70 cycles per second. Successful tests were carried out over circuits Ottawa-Churchill and Ottawa-Goose Bay, at a frequency of 97.1 kc. using a 5-kw. transmitter and conventional teleprinter equipment. The results of our investigations convinced us of the need for future work in this field.

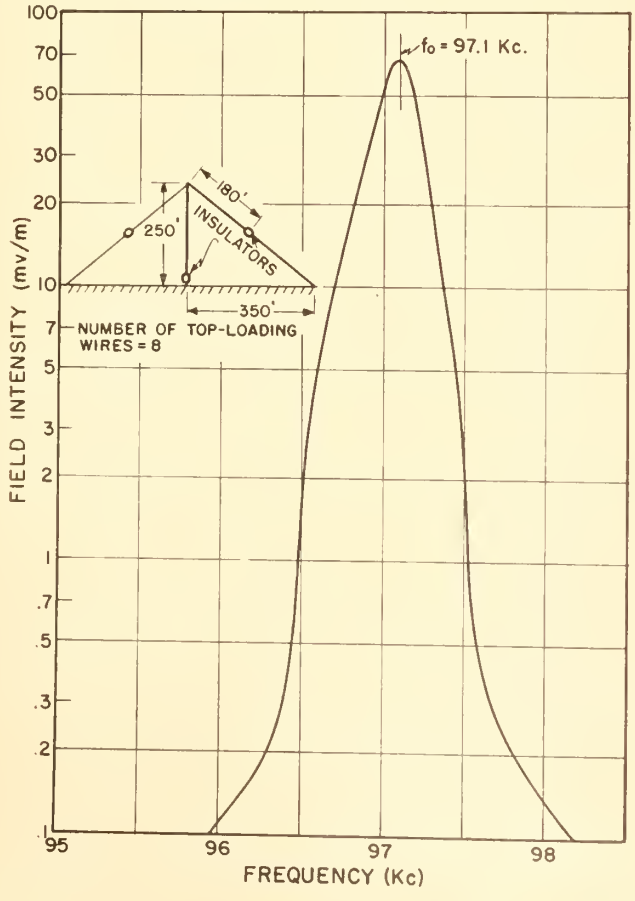


Fig. 6. Field intensity at 3.1 miles from Shirley Bay antenna (f_o = 97.1 kc.) as a function of exciter frequency.

Conclusions

The use of low frequencies for radio communication in Canada will continue due to the present large investment in transmitting installations and also to the comparative reliability of the existing circuits. Current research has shown that our knowledge of low-frequency propagation, particularly the propagation of the sky-wave, is far from complete. It has also been shown that, in general, existing communications equipment is not entirely suited to use in low-frequency communication systems.

The possibility of increased usage being made of the low-frequency band is considered, by this author, to depend almost entirely on the development of commercial equipment which will meet the requirements of the low-frequency band. Improved engineering of low-frequency communication systems and the introduction of equipment of improved design could well result in a large increase of efficiency at a cost small in comparison to that of the existing installations.

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Strengthening Steel Structures by means of Prestressing

by

Rudolph Szilard, Jr.,

Senior Structural Designer,
Amman & Whitney,
Consulting Engineers, N.Y.C.

The article deals with the design equations covering the problems connected with strengthening by means of prestressing. The author submits that, in spite of the additional study required for this technique over conventional methods, it should become more widely used because of economical and other advantages.

The structural designer is often aced with the problem of strengthning an existing steel structure hich has become inadequate to pport increased dead or live loads. tructural steel has in this respect n advantage over reinforced conrete, since it is readily reinforced y means of riveting or welding. To he designers these methods are well nown. The fact that prestressing an offer new and more economical ays of reinforcing existing steel tructures is, as a rule, overlooked, ainly because of a lack of knowlge and experience with such a ethod.

In order to understand the basic tructural behaviour of a prestressed steel structure, let us investigate first the simplest case, a rismatic member under working oad condition. The properties of he member are:

A = area of the member.
E = modulus of elasticity.
l = length.

The prismatic member is subitted to a tensile force (P_{DL}) and compression force (P_i) due to the itial prestressing force exerted by high-strength alloy cable. The roperties of the cable are:

A_{cb} = Area.
E_{cb} = modulus of elasticity. See ig. 1.

The stresses in the prismatic ember and cable are:

$$\sigma_{initial} = \frac{P_{DL} - P_i}{A};$$

$$\sigma_{cb,\ initial} = \frac{P_i}{A_{cb}} \quad \ldots\ldots(1)$$

Now let us exert an additional tensile force P_{LL} on the prismatic member. This force will cause an elongation of Δl in the member as well as in the cable. A Δl elongation of the cable, however, will add a ΔP additional prestressing force. (Fig. 2.)

$$\frac{P_{LL} - \Delta P}{AE} = \frac{\Delta P}{A_{cb} E_{cb}} \quad \ldots\ldots(2)$$

Final stresses in the cable are:

$$\sigma_{cb} = \frac{P_i + \Delta P}{A_{cb}} \leqslant \sigma_{cb,\ allowable} \quad \ldots\ldots(3)$$

Final stresses in the prismatic member are:

$$\sigma = \frac{(P_{DL} + P_{LL}) - (P_i + \Delta P)}{A} \leqslant \sigma_{all} \quad (4)$$

From these simultaneous equations the unknowns P_i, ΔP, A_{cb} and σ can be computed. It must be borne in mind that if $P_i > P_{DL}$, the equation $\sigma_{init.} \leqslant \frac{\sigma_{critical}}{Factor\ of\ Safety}$ must be satisfied. In other words the elastic stability, in our case buckling, must be investigated also.

It is required, of course, that the structure have the same ultimate load capacity as one which is welded or riveted. Introducing the safety factor $\nu = \frac{\sigma_{yield}}{\sigma_{all}}$, the design has to be checked for ν times dead and live loads. Although the load is increased the initial prestressing force remains the same, only the ΔP part of the prestressing force will increase in the same ratio as the load, hence a larger initial prestressing force will be needed to satisfy the condition $\sigma_{final} \leqslant \sigma_{allowable}$.

The four basic equations derived above are to be modified in cases of beams subject to bending. Figure 3 shows a simply-supported prestressed beam under the influence of working loads.

We can assume that the lower flange is overstressed. This is always the case since specifications usually request the use of net section modulus when computing stress in the lower fibre,

$$\sigma = \frac{M_{max}}{S_b} > \sigma_{all} \text{ and } \Delta\sigma = \sigma + \sigma_{all}.$$

Since the stress in the lower fibre is greater than the allowable, a prestressing force $Pi + \Delta P$ is required to bring it back to the allowable.

$$P = \frac{\Delta\sigma}{\frac{1}{A_b} + \frac{y_o}{S_b}} \quad \ldots\ldots(5)$$

Under the live load s increased by Δs and P_i by ΔP in a manner similar to the behaviour of the prismatic bar. But for the determination of ΔP the equations of statics, $\Sigma M = 0$; $\Sigma V = 0$ and $\Sigma H = 0$, are not sufficient, because the structure is statically indeterminate like a simply-supported tied arch. (See analogy Fig. 4.) Thus one additional equation of elasticity must be used.

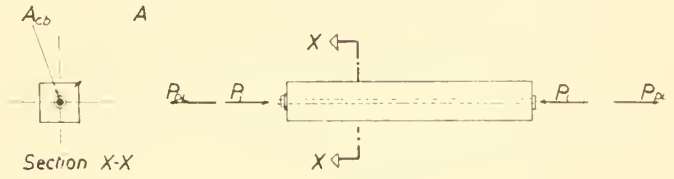


Fig. 1. Prismatic member under working load condition.

Fig. 2. Effect of elongation on prismatic member.

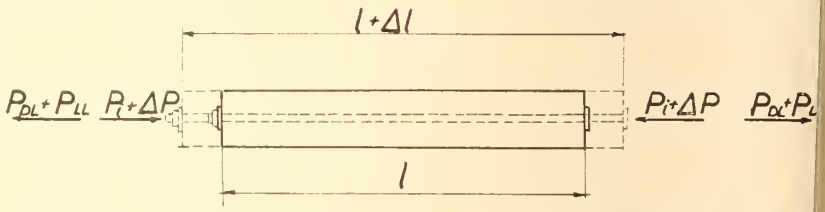
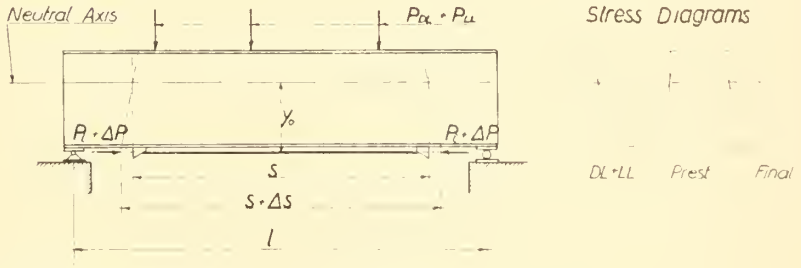


Fig. 3. Simply-supported prestressed beam under the influence of working loads.



Cutting the cable virtually at point (1), we may express in equation form that the horizontal displacements due to the live load (δ_{01}) and due to ΔP prestressing force increment are 0. $\delta_{01} + (\Delta P)\,\delta_{11} = 0$, hence

$$\Delta P = -\frac{\delta_{01}}{\delta_{11}} \qquad \ldots\ldots (6)$$

Utilizing the "Virtual Work" method, the displacements are:

$$\delta_{01} = \int_o^s \frac{M_o^{LL+I} \times m_1}{E_b \quad I_b}\, ds + \int_o^s \frac{N_o^{LL+I}\, n_1}{E_b \quad A_b}\, ds \qquad \ldots (7)$$

where the second member is negligible (Fig. 5.) And

$$\delta_{11} = \int_o^s \frac{m_1^2}{E_b \quad I_b}\, ds + \frac{s}{E_{cb} \quad A_{cb}} \qquad \ldots\ldots (8)$$

E_b = modulus of elasticity of beam
I_b = moment of inertia of beam
A_b = area of beam
E_{cb} = modulus of elasticity of cable
A_{cb} = area of cable
s = length of cable
M^{LL+I} = LL moment + impact
N^{LL+I} = axial force due to LL + impact
m_1 and n_1 moment respectively axial force caused by $\Delta P = 1$ force.

The numerical evaluation of the integrals is readily done by means of Simpson's method.

Finally the equation,

$$A_{cb} = \frac{P_i + \Delta P}{\sigma_{\ cable\ \ allowable}} \qquad \ldots\ldots (9)$$

gives the needed cable area.

In addition to the working load design the ultimate load capacity of the structure must be proved. (The subscript u will indicate in the following investigation the ultimate load condition.) Assuming again a ν times increased dead and live load effect on the structure the maximum fibre stress is:

$$\sigma_u = \frac{\nu M^{DL+LL+I}}{S_b} > \sigma_{\ yield,} \quad \text{where}$$

$$\nu = \frac{\sigma_{\ yield}}{\sigma_{\ all.}}$$

This stress must be brought back to the yield point by means of prestressing the cables. If the bending moment stresses reach the yield point the moment capacity of the section cannot be computed using the Navier hypothesis, but it can be evaluated knowing the stress distribution of the interior forces. In spite of the fact that in the extreme fibre the stress reached the yield-point, there are no large deformations since the interior fibres have smaller stresses than $\sigma_{\ yield}$ and prevent further yielding. (Fig. 6a)

The location of A and B can be determined from the stress-strain diagram of the ideal plastic steel, as shown in Figure No. 6b.

$y_A : y_{max} = 0.9 : 2.0$; hence $y_A \cong 0.45\ y_{max}$.

The stress distribution is linear between the points A and B.

The moment capacity of the section can be determined in the following way.

$$M_{capacity} = \int_o^A y\ \sigma dA = \sum_o^A y\ \sigma \Delta \qquad \ldots\ldots (1$$

The section will be divided in small areas. Over each area t stress can be assumed to be uniform. Stress times area gives the intern force which multiplied by y, t distance of the centre of gravity the area from the neutral axis, giv the moment of the internal force. The sum of these moments is t moment capacity of the section plastic range just reaching the yi point. The ultimate load desi equations are:

$$\Delta M_u = M_u - M_{cap} \qquad (\ )$$

$$\Delta \sigma_u = \frac{\Delta M_u}{S_b} \qquad \ldots\ldots (\ )$$

$$P_u = \frac{\Delta \sigma_u}{\left(\frac{1}{A_b} + \frac{y_o}{S_b}\right)} \qquad \ldots\ldots (\ )$$

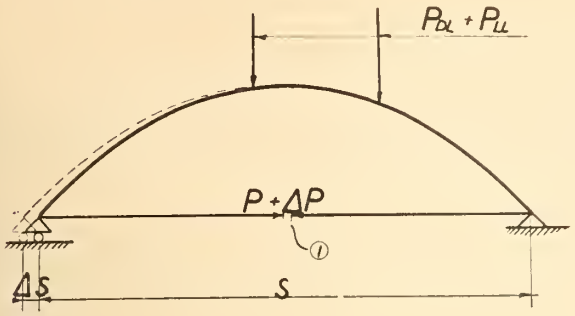
$$P_{iu} = P_u - \nu \Delta P_{LL} - (\nu - 1)\,\Delta P_{DL}$$

$$\ldots\ldots (1$$

If $P_i > P_{iu}$ the ultimate load g erns.

In this case

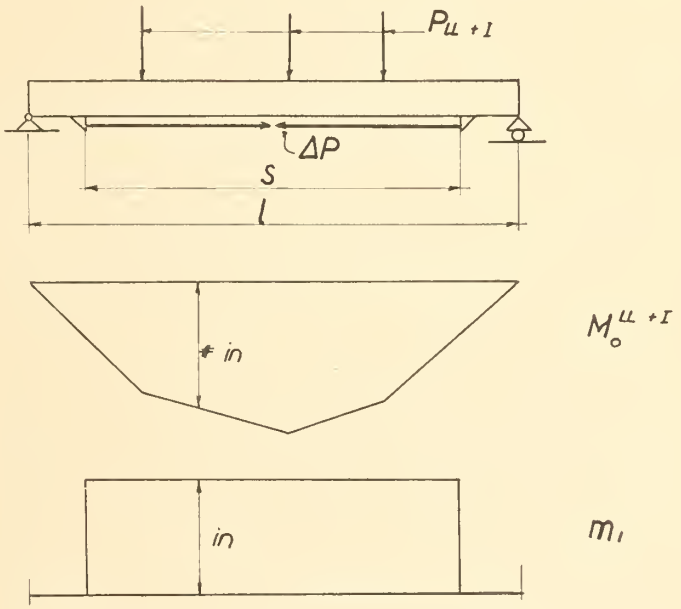
$$A_{cb} = \frac{P_{iu} + \Delta P_{LL}}{\sigma_{\ cable}}$$



Analogy

Fig. 4. Analogy of simply-supported tied arch.

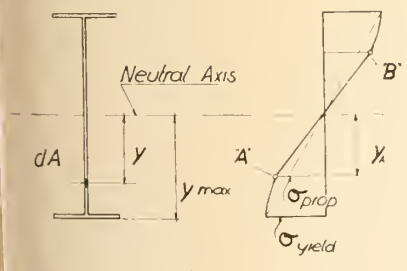
Fig. 5. Diagram illustrating bending moments due to load and due to prestressing load.



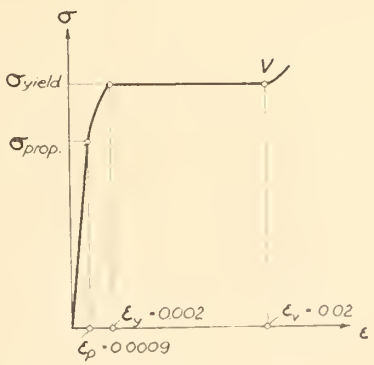
Naturally the elastic stability of the lower flange under dead load and initial prestressing force is to be checked as is the buckling of web in the neighborhood of the anchorage. (For practical computation "Buckling Strength of Metal Structures" by Bleich is recommended as a handy reference book.)

If the tensioning operation is done in one step for each cable and if the prestressing force consists of "n" strands, then each cable will not carry $\frac{P_i}{n} = P_1$ force. The stressing of the second cable relaxes the first one by cP_1, and so on.

Fig. 6. (a) Stress distribution of interior forces; (b) ideal plastic steel stress-strain diagram.



(a)



(b)

It can be written also that

$P_1 - (n\text{-}1)cP_1$ = The force in the 1st cable.

$P_1 - (n\text{-}2)cP_1$ = The force in the 2nd cable,

$P_1 - (n\text{-}n)cP_1$ = The force in the "n"th cable;

where "c" is a constant.

and $P_i = n\ P_1 \left(1\text{-}c\ \frac{n\text{-}1}{2}\right)$

Although, by using the equations of elasticity, the force of relaxation can be determined, it is recommended that the prestressing be done in two or more steps. In this way the effect of prestressing the adjacent beams, which are connected to each other by more or less rigid diaphragms, floor beams, etc., can be eliminated It means, for instance, that all cables be stressed up to 50 per cent of the initial prestressing force in the first step, then up to 100 per cent and finally every cable backchecked for the theoretical prestressing force.

The ease with which prestressing cables can be placed and anchored makes prestressing particularly suited for strengthening existing bridge structures where the maintenance of traffic during the construction is of great importance. Undesirable vibrations of the cables which can be caused by impacts of the live load or wind should be eliminated by placing vibration dampers at intervals required by computation or by the judgment of the designer.

Although the strengthening of steel structures by means of prestressing requires more studies and investigations than the conventional methods, it is believed that it will be of wide use in the future because of the economical and other advantages which this method offers. √

DISCUSSION of Technical Papers

The Silicones—A Family of New Engineering Materials

by

D. C. R. Miller, M.E.I.C., General Manager, Dow Corning Silcones Ltd., Toronto.

The Engineering Journal, October 1955, page 1339

B. A. Avery[1]

Mr. Miller has given us an excellent survey of the present silicone field and some idea of what we may expect in the future from these materials. He referred in some instances to the aeronautical field and to the gas turbine engine, in which my main interest lies.

As a point of discussion, I might elaborate on some of our particular problems which have been solved by the use of silicone materials, and where we hope new problems may be overcome by the use of newer developments.

The lubrication of the next generation of aircraft turbine engines for supersonic aircraft presents a formidable problem. At Mach 2 at 30,000 ft. for instance, the air entering the engine is at about 180°C and must be compressed and further heated to some extent at least before it can be used for pressurizing the bearing sumps in order to retain the lubricant. This means that the lubricant will be in intimate contact with the hot air as well as hot metal, and for starting purposes must flow readily at below —50°C. Silicone fluids, I will agree, have the flattest viscosity curves on temperature of any of the possible lubricants but they do tend to form 'jells' when oxidized in contact with hot air. You might say that the sealed lubrication system would be the answer, but rotational speeds and pressure differentials and the great variations in these two factors make the sealed system next to impossible. We, in the aircraft engine business, can only hope that a silicone fluid having the flat viscosity curve and the good lubrication properties of the new methyl silicones, can be developed with high oxidation resistance to temperatures of at least 300°C.

The silicone rubbers have been a great aid to aircraft engine designers and one example comes to mind in which the development of a silicone rubber to operate in air at 250°C has improved the mechanical design of the Orenda engine considerably. Originally each of the six combustion chambers was fastened by 14 bolts to the compressor outlet structure in order to obtain an airtight seal using a normal flat gasket. These chamber-to-turbine casing joints were normal clearance type sliding joints to allow for expansion. This naturally allowed some leakage of hot air during operation. A silicone rubber O-ring fitted in a groove in the face of one flange now replaces the flat gasket and two bolts replace the original fourteen. We experience no blowing of gaskets and manufacture, assembly and strip times have been decreased. A similar O-ring fitted in a circumferential groove on the outside of the combustion chamber has eliminated the air leakage problem at the turbine end. Silicone O-rings are now used on the combustion drains system of our engines and although they do come in contact with fuel which causes some swelling, leakage does not occur as it did when normal synthetic rubber compounds broke down due to the heat of engine operation.

The compressor stator blades of the Orenda engine originally were fitted tightly into their dovetail mounting slots to prevent the wearing and further loosening of the aluminum blade in the mounting structure. Tightly mounted blades, however, experienced little damping effect in the root and fatigue life was comparatively low. This problem was overcome by mounting each blade in an oversized slot with a layer of silicone compound between the blade and the slot. This material is vulcanized after assembly and has provided sufficient damping that stator blade life is now quite acceptable.

Silicone grease is used to lubricate the stator blade mounting rings for assembly into the "T" slots of the magnesium casings and retains its properties at the 250°C operating temperature so that engine strip is quite readily accomplished. This grease also assists in preventing corrosion of the mounting rings and casings.

Although thick sulphuric acid anodizing provides better abrasion and corrosion resistance for the aluminum compressor blades than does the thinner chromic acid anodizing, it does tend to crack at operating temperatures. These cracks form stress risers which decrease the fatigue lives of the blades. A clear silicone resin coating supplied over the chromic acid anodizing provides a degree of corrosion and abrasion resistance better than the sulphuric anodizing without the stress riser complication and is the only material that will withstand the operating temperatures successfully.

A silicone resin combined with a high percentage of aluminum powder has replaced the original aluminum metal spray coating on the mild steel combustion chamber casings. The corrosion resistance has been increased and even with the $20 per gallon cost of the paint, our processing costs have decreased.

I do not believe that Mr. Miller would want us to think that silicones are 'cure all' materials. They do have their shortcomings, but we must agree that in the medium temperature field, many difficult design problems have been overcome by their use. We designers are grateful.

The Author

Of all Mr. Avery's comments I agree particularly with his statement that the silicones have their limitations and are not cure-alls. In this connection I might point out that present indications are that the new high temperature lubricants for sliding ferrous s-

[1] Chief Design Engineer, Orenda Engines Limited, Toronto.

faces, such as the halogenated phenyl methyl silicones, in the process of achieving good lubricating properties have sacrificed some of the flat temperature-viscosity behaviour which is so outstandingly good in the straight methylsilicones. It appears likely that in order to achieve good lubricating properties and good heat stability at temperatures up to 300°C, it will be necessary to sacrifice at least some portion of the temperature-viscosity behaviour. Or to put it another way, it may be necessary to choose whether they would prefer to have high temperature performance or low temperature performance as it may not be possible to get both simultaneously. This is the universal problem of compromise in design.

Economics of the Nova Scotia Coal Mining Industry

by

Lionel A. Forsyth, President, Dominion Steel and Coal Corporation.

***The Engineering Journal*, February 1955, page 114.**

Dr. Adam Jaworski, M.E.I.C., A.F.C.A.I., A.F.I.A.S. [2, 3]

Mr. Lionel A. Forsyth in his article "Economics of Nova Scotia Coal Mining Industry" has pointed out several striking topics, but I would like to discuss only three of them:

1. American Penetration of The Canadian Coal Market

Mr. Forsyth has underlined that the volume of Canadian coal production had not changed significantly over the last twenty-five years, (it was practically equal in 1928 and in 1952, being 17.6 million tons) but the import of American coal had increased since 1928 by about 50 per cent, (13.4 million tons in 1928 and 21.0 million in 1952).

Nova Scotia, after carrying more coal to Ontario in 1939 than to Quebec, to-day had been practically forced out of the Ontario coal market by American competition, in spite of the fact that the maximum level of government subsidy during the period 1939-1954 has been doubled; from $2.00/ton to $4.00/ton. Twofold remedies are recommended by the author; a further increase in subsidies and a reduction of mining costs. The recommendations are crucial.

The magnitude of federal assistance can be only assessed from the absolute totals. Thus, a few rough figures are shown in Table I.

Actually only about one-fifth of the total domestic coal production had required a transportation subsidy and it may be added that in 1954 Nova Scotia coal production represents 57 per cent of Canada's total, where in 1939 it amounted only to 45 per cent.

By and large, the penetration of a home market by any foreign product is determined by three major factors; cost production; government assistance (dues and other forms of subsidies) and transportation costs. Between 1939 and 1954 the differential between the pithead cost of Nova Scotia coal and its American competitor (comparable in quality) has increased from about $2.15 per ton to $5.50.

To offset the relatively high level of Canadian coal mining cost in general and Nova Scotia's in particular, the Federal Government has imposed duties on imported bituminous coal and introduced transportation subsidies for the domestic product. In January 1948, when the GATT Agreement came into effect, the duty on imported bituminous coal was reduced from 75c to 50c per ton, but as already stated, the maximum level of transportation subsidies for Nova Scotia coal has been raised from $2.00 to $4.00 per ton.

Thus Canadian coal mines in 1939, to cope with the $2.15/per ton cost advantage of its American competitor, could count on federal assistance up to $2.75/ton (75c in duties and $2.00 in subsidies). But in 1954, although the maximum assistance was increased to $4.50, production cost differential jumped to $5.50/ton. Therefore, only where the total transportation cost was lower for Nova Scotia coal than for its American competitor, could the former move in.

However, there are no apparent reasons why the ratio of transportation costs in Canada for imported and domestic coal should change between 1939/54 in favour of Nova Scotia coal. Actually, before the Wars the movement of Nova Scotia coal had been assisted significantly by the lower water rates, because more ships were available.

Summing up, in 1939 Nova Scotia with the federal assistance (duty and subsidy) had about 60c/ton advantage over the American competitor on the pithead price, but in 1954 the 60c advantage turned into a 50c/ton handicap. Consequently, a significant penetration of Canadian market was unavoidable.

Bearing in mind that labour cost accounts for at least 50 per cent of pithead price, and that miners' wages are significantly higher in the States than in this country, it is obvious that only by a tremendous increase in coal output per miner could American bituminous coal foster its cost production gains over Nova Scotia. The comparison in tons produced per man day is as follows:

Obviously, the United States total unit bituminous output increase during 1939/52 was assisted greatly by the stripping method. The output by this method may be three times as high as in underground mining.

Considering underground mining, Nova Scotia's coal mining industry must face the issue of whether or not a decline—or even a status quo—of unit output during a score of years has been justified, bearing in mind the fact that underground production in British Columbia, that in 1952 mined less than one-quarter of Nova Scotia's total output, was able for the period 1939-1952 to achieve a 23

Table I. Federal Assistance for Bituminous Coal - 1939 and 1953

Year	Bituminous Coal (Mil. Tons)		Federal Govt. Assistance (Mil. $)	
	Total Domestic	American Import	Duty on Import	Transport Subsidy
(1)	(2)	(3)	(4)	(5)
1939	15.7	10.7	8.35 (F)	4.83 (F)
1953	15.9	20.3	6.94 (F)	10.23 (F)

(F) Fiscal Year.

[2] Air Transport Board, Ottawa.
[3] The opinions expressed in this discussion are those of Mr. Jaworski, and not necessarily those of the Air Transport Board.

Table II. U.S. and Canadian Output per Man Day

Year	Bituminous Coal Industry — Average Tons/Man/Day		
	U.S. — Exporting States*		Nova Scotia
	Total	Underground Mining	Underground Mining
1930	5.08	4.95	2.3
1952	6.83	6.31	2.0

*A weighted average from bituminous mines of Pennsylvania, West Virginia, and Kentucky, which are principal exporters to Canada.

per cent increase in unit output; from 2.6 tons/man-day to 3.2 tons/man-day.

Some solace may be drawn, however, from Mr. Forsyth's statement about the excellent results that have been obtained from installing a fully automatic "Dosco Continuous Miner". This being so, a significant growth of unit output should show up for 1954. Yet if that decline of unit output at Nova Scotia collieries cannot be arrested and reversed, then the verdict will almost certainly have to be: not lack of subsidies, but suicide in economics.

2. Nova Scotia Turns to Oil

Mr. Forsyth has rightly pointed out the serious adverse effect on coal consumption in Nova Scotia due to consumers switching over to oil heating. About one-half million tons of coal is lost yearly (almost 8 per cent of the total output) on that account. However, it is difficult to share Mr. Forsyth's wholehearted enthusiasm for a domestic stoker as a solution. The preference for oil heating over coal spells "convenience". Thus, the automatic stoker cannot be the answer, but only district heating — like at Winnipeg — because it offers several important advantages over oil: more convenience; saving on space, especially in the basement, and noiseless operation.

The current efforts of the British Ministry of Fuel and Power to raise coal burning efficiency of the English industry by conducting courses for the managers and by granting the industry loans on fuel saving equipment (about £1 million were allocated for that purpose) clearly indicates that there is still plenty of scope for improvement[4].

3. Dieselization of Canadian Railways

Last February, Mr. Stephen Harwood, vice-president, Montreal Locomotive Works, Ltd., addressing the Ottawa Branch on railway dieselization, stated that today dieselization is about 75 per cent completed in the United States, and 25 per cent in Canada where the final goal may be reached in 1968-1971. Even these figures seem optimistic, bearing in mind that in the United States as of October 1954, of a total of 27,483 locomotives 33.7 per cent were still ordinary steam raising movers. And it had taken more than 15 years of dieselization progress to reduce the number of steam locomotives to that level.

Mr. Forsyth is perfectly right in predicting that the coal fired turbine locomotive may be too late to save the day for coal. Even if the coal firing engine gets its well deserved awards, after more than a half century of futile attempts in many countries, it may find at railways service—besides diesels—oil burners to compete with. Such competition on this continent would be harder to overcome than in Europe, because here, price differential between oil and coal is not so significant.

The oil turbine locomotive, after its first test in September 1941, still struggles with difficulties in operational runs. And there are no apparent reasons why a coal firing turbine should be easier to handle.

Finally, it would be well to emphasize that a successful coal turbine would burn Nova Scotia coal and American coal as well, thus we may see the same picture again: Canadian railways burning American coal in coal turbines and the Federal Government helping with subsidies to offset crucial pithead price handicap of Nova Scotia's mines, once more.

It might well prove profitable to shift the emphasis in coal research from a spectacular coal turbine to the old problem; fuel saving devices, gasification underground or in vertical retorts (January issue of *The Engineering Journal*, p. 38). Furthermore, it may pay to revive the research on so-called "coal-in-oil" fuel, which has shown a valuable volumetric reduction on space for the same amount of B.t.u.'s; 26 per cent over coal and 12 per cent over oil. Both these lines of research—if successful—have in perspective significant savings on transportation cost, namely a possibility of carrying coal in pipe lines.

(Comment received March 17, 1955)

The Author

I am pleased to have an opportunity to reply to Dr. Jaworski's comments on my paper, "Economics of the Nova Scotia Coal Mining Industry", even though it is rather difficult to do so because the differences of opinion are, to a large extent, only a matter of degree.

I do not, however, think it is quite fair to say that I have recommended an increase in subvention payments and certainly I have never pressed for such action. My strong recommendation is that the cost of coal be reduced and that everybody should cooperate to accomplish this goal.

There does not appear to be any reference in the article to my whole-hearted support of any domestic stoker unit, but, Dr. Jaworski must have been reading my mind. I now endorse our new downdraft furnace, because it does like the domestic heating unit to which he refers, offer several important advantages over oil among which are, the convenience of fully automatic noiseless operation, a substantial reduction of the fuel bill and a measure of comfort which only even-burning solid fuel can provide.

The coal-fired gas-turbine locomotive is still in its formative stages, but results achieved, thus far, indicate that the capital investment required to build a prototype is warranted. If actual operations approach the performance indicated by present tests this locomotive unit could eventually be an important factor in the coal market.

Finally Dr. Jaworski suggests that it might be advisable to shift emphasis to coal research, to underground gasification, and to "coal in oil" fuel studies. We have never permitted these studies to lapse but, the fact of the matter is that in order to produce cheap chemicals or residual fuels, one must first have cheap coal and circumstances indicate that it would not be an economic proposition at this time.

[4] *The Economist*, issue of January 22, 1955, p. 302.

Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

HOW AIR CONDITIONING MAKES MONEY . . . FOR OFFICE BUILDINGS

Lewis Smith

Heating Piping & Air Conditioning, v. 27, n. 2, Feb. 1955, pp. 73-75.

When an office building in Denver is air conditioned one may well ask "How come?", Denver of all places is "air conditioned by nature."

The answer to that question is complex. It isn't just a matter of making the tenants more comfortable. That is a factor, but there are other and vital reasons extending into the building design, construction and operation. Air conditioning not only adds less to the cost of construction than is commonly supposed but can actually result in a cost reduction.

When the benefits aside from cooling are examined, they are found to be mainly economic and financial. Let's examine these factors.

Ventilate Interior Spaces

Suppose we start at the ground level. It has been commonly accepted that no rentable space could be more than 25 ft. from windows and, even so, space more than 15 ft. in was not too desirable. This was primarily on account of ventilation, and the impossibility of keeping the more remote spaces habitable, especially in summer. Therefore, we had the slab type of building or the use of many wings, with sometimes as little as 30 percent coverage of the land other than for stores on the ground floor.

With air conditioning, a block type building can be put up to occupy 100 percent of the plot, at least up to the height where setbacks are required by local building codes. Interior spaces can be made just as comfortable as perimeter areas. Modern lighting makes up to a large extent for the lack of natural light. Offices which formerly had to hug the exterior walls can now extend into the interior, and occupancy of such places is at a rental far higher than before.

Illustrating this factor is 380 Madison Ave., New York City. This building has a frontage of 200 ft. on Madison Ave.

A building like this is rented to tenants who usually take a whole floor or even more, except for a few cases where fractional floors are used to accommodate smaller firms. The space is arranged for the tenant's requirements on a long term lease; and the entire floor is rent producing except for the service areas. Because of air conditioning, the interior spaces are used for clerical work and reception rooms, even though they have no outside exposure.

Increase Operating Efficiency

Another advantage is that a large tenant using more than one floor in the older buildings can be accommodated very often on a single floor in these new block type buildings. This makes his operation more efficient.

All office buildings, except those put up by large companies for their own exclusive use, are in a sense speculative. Although in some cases profit may accrue largely to the original promoters and builders out of construction and resale, still the building finally has to pay its way. Obviously the cost of a block type building covering all the land doesn't go up in direct proportion to the floor area, so this gain in rentable area without proportional increase in cost goes a long way towards offsetting the extra cost of conditioning.

Lower Ceilings Save Money

Next take the ceiling height. Before the advent of air conditioning, it was considered necessary to go up to about 11 ft. for the sake of ventilation and for the reduction of heat at the occupancy level in summer time. With air conditioning, this height can be dropped to 8 or 9 ft. The only limit seems to be phychological. Although this reduction in height is not a clear gain since air ducts take up a foot below the beams, it does mean a gain of perhaps one floor in ten. It helps offset the cost of air conditioning equipment.

Another factor enters here. With hung ceilings lighting fixtures can be placed anywhere to suit the tenant needs rather than being set in regular patterns between floor beams.

Next take the walls. Glass is becoming cheaper than masonry and it puts less weight on the building frame and foundations. From the viewpoint of erection cost, all glass walls would be desirable, but without air conditioning they would be impossible. The heat gain from the sun would be too great in the summer, and even at times in the winter. Unfortunately, the other side of this picture is that the greater the use of glass, the greater the operating cost due to the extra heat loss in winter and heat gain in the summer. Heat resistant glass, sun louvers, fins, sun screens and other shading devices have been developed which offer one answer to the problem.

Meantime, a compromise is usually made by the use of continuous or "strip" windows, with ordinary sill heights of about 30 in. and not necessarily extending to the ceiling. With these strip windows, office space can be partitioned better to suit each tenant, with due regard to the location of the heating and cooling units if placed in the exterior walls, whereas in the older buildings the window spacing controlled the partitioning.

Savings Offset Cost of A.C.

The picture isn't all in favor of air conditioning, however. Whatever system is used, the walls or columns, or both, have to be furred out quite a bit to accommodate the

equipment. In block type buildings, space must be used in the center of each floor for ventilating equipment. A cooling tower must be built and that takes up space and adds to the construction cost to support it. But taken as a whole, a good part of the 15 to 20 percent often figured as the added cost for air conditioning evaporates when all the savings are taken into account.

Many office buildings with a fairly small floor area would not receive all the benefits of air conditioning which have been enumerated, so there would be a direct and substantial increase in construction cost which might run 15 to 20 percent and even more. The smaller the building, the higher this percentage of increase becomes. In view of the wide popularity of air conditioning today, it would be very difficult to put up a new office building in any city in the U.S. without this feature and fill it with tenants at the higher rental necessary to pay for the increased owning and operating costs, unless there happened to be locally a shortage of office space. Anyway, such a building would be obsolete before it was begun.

PRIVATE ENTERPRISE CAN MEET THE PARKING DEMAND

C. T. McGavin

Proceedings, American Society of Civil Engineers, v. 81, n. 599, Jan. 1955, p. 599.

Private Enterprise on Threshold of Rapid Advance

The young and rapidly growing parking industry, representing a three billion dollar investment, stands on the very threshold of tremendous progress. It is managed by men skilled in their business profession who are alert, progressive, resourceful and well aware of their responsibilities to the motorist, to the taxpayers, and to the economic principles upon which our country has grown and prospered.

If the question of the role of private enterprise in parking approached from the standpoint of the evolution of a typical American business there would be a much clearer understanding and certainly less difference of opinion as to which way to achieve the desired end most quickly and economically.

All business enterprises and industries go through years of evolutionary development. First, a topsy-like growth, then after a period of experimentation there emerge well-defined patterns of a planned development that adequately serves its market. The department store idea, for example, had its beginnings nearly 100 years ago. It has been going through evolutionary changes ever since. In the writer's professional library there is a photograph of one of the largest department stores of one of our major cities, with a sign painted on the side of the building announcing to the public that it has elevator service which is free to the public for business purposes only, and operates from 8 a.m. to 12 noon and 1 p.m. to 6 p.m. This new service feature was introduced about 50 years ago. The years since 1860 have brought a continuing flow of new concepts of service and operation, in the department store business. The same course of development is evident in the parking business, though its evolution began later.

Evolution of Off-Street Parking 1920-1930

The idea of off-street parking facilities had its real beginning about 1920. Parking lots were primarily off-shoots of some other automotive service. The first new parking garages designed as such came into existence about 1921. There was a substantial development of the multiple floor garage in all major cities throughout the land up to 1930. However, about 1926 the pattern of failure began to emerge. Project after project failed to pay the bondholders and well before the stockmarket crash that fateful day in 1929, multiple floor parking garages were financial failures simply because they couldn't operate successfully using only 40 percent of their capacities. The years 1930-39 saw no substantial construction of multiple floor parking garages.

But it was during this period that parking lots achieved a new and permanent status in the American scene. They provide "breathing spaces" between buildings and help to break up the dense compact mass of building development. They pay good returns on the property investment and successfully compete on the free market with other land uses. It is a fallacy to call these facilities "temporary".

Department Store Parking Facilities

Beginning in 1936 department stores recognized that there was a relationship between convenient customer parking and the jingle of the cash register. Some studies revealed that patronage of customers parking in store-provided facilities ran as high as $25,000.00 per parking stall per year. These studies formed the basis of a trend toward merchant-developed parking facilities, which is now quite substantial.

New Generators of Parking Required to Provide Own Parking Needs

While enlightened self-interest motivated the large merchants to recognize the business value of providing customer parking facilities, there was a growing recognition among city planning officials that in the development of new business structures the owners should be required through zoning law to provide at their own expense adequate facilities to serve the parking requirements generated by the proposed structure.

Municipal Parking Emerges - 1938

In 1938 the American Society of Planning Officials, and the International City Managers Association discovered through survey that there was a well-established trend toward municipal parking facilities. Based on replies to 147 questionnaires from selected groups of cities in the different population brackets it was found that one fourth of these cities had established municipal parking lots and additional cities were considering doing so. One third of the cities had established such facilities within the past three years so the beginning of the idea of parking as municipal responsibility can be fairly well nailed down to 1938.

Public Responsibility

During the War years research work on parking as a municipal responsibility was carried forward. With the advent of V-J Day, the research efforts resulted in the unfolding of organized campaigns to plunge the municipalities into the parking business.

From mid-1945 to 1950 there was a continuing succession of announced plans and programs based on the idea of parking as a public responsibility. Only now are we able to make a cold appraisal of the practical results of these municipal programs and to formulate an objective evaluation.

In Summary

The over-all situation for the 2[illegible] U.S. cities of over 50,000 popul[illegible]

tion is that the municipal parking averages 675 spaces per city, counting only the cities having municipally-owned facilities. Distributed over the entire 232 cities, the average would be about half that figure. In all cities over 50,000 population, municipal parking represents about 6 percent of the total downtown capacity. Parking lot capacity provides 2/3 of the total off-street capacity.

Transit Industry and Parking

The relationship of the transit industry to the general parking situation is an important one. Transit companies everywhere have contributed in large measure to the growth and development of valuable concentrated business areas. Yet now, cities are neglecting this industry. The transit service is being choked and forced to operate far below its capacity for service due to unjustified curb parking. Abolition of curb parking, where such restriction is needed, will speed transit service. This will encourage greater use of the mass transportation system and will relieve some of the pressure for additional parking. Curb-parking restrictions are invariably followed by the development of additional near-by off-street facilities when they are needed. Traffic congestion won't be cleared until curb parking is prohibited.

Private Enterprise Can Do It Better

Parking requirements can be met most quickly and most economically by private enterprise. A private operator must make a profit on his investment. This means that land must be acquired as cheaply as possible; construction costs must be as low as is practical; full advantage must be taken of improved construction techniques, improved layout and design, and improved operating techniques. If all current technological advances are to be combined with the progress that is now being made in the field of parking management private enterprise will be responsible for the advance, because it will be to the direct advantage of the private owner-operator.

Municipal Parking Costs More

Figures on garage construction costs, which are readily available to anyone interested in making the check, show that the cost of municipal parking is higher than the cost of private parking. Since the private operator loses his income if he takes a loss, he must hold his construction costs to $1,200 per car space and acquisition costs of properties acquired by city governments for parking are substantially higher than those acquired by private enterprise. There is a mistaken belief by many proponents of municipal parking that acquisition by condemnation is cheap. The reverse is true.

Mistaken Claims About Private Parking

The claim that private enterprise can't acquire property suitable for parking at the right locations is the principal argument in favour of the power of condemnation. This is simply not true. New developments in garage design have completely eliminated the need for large land parcels which cannot be acquired by purchase. What land the private operator needs he can buy in the same manner that any other business acquires necessary real estate.

Another mistaken claim which is made is that private enterprise cannot assure the permanence of parking facilities. This reveals only a lack of knowledge of our competitive enterprise system. A parking facility which has proved itself to be a good investment, which produces a good income is as stable as any other kind of business.

Parking Is Not an Extension of the Street System

Before we proceed to a discussion of the special disadvantages which are inherent in municipal parking, let it be made clear that parking cannot be considered an extension of the street system. Throughout the history of transportation, whether land, sea or air, three basic components are essential: The vehicle, the roadway, and the terminal facility. The highway component of automotive transportation is recognized as a matter of public undertaking, but it does not follow that the terminal facilities are an extension of the street system any more than the idea that the other component—the automotive industry—should be taken over because it is also one of the three components comprising the automotive transportation system.

Municipal Parking

Parking provided by business organizations to serve their own customers represents as much as one-quarter of the total off-street capacity in some cities. This will be abandoned in the face of municipal programs. Why should these organizations pay the bill to meet their parking needs if the city will meet their demands for them?

Subsidized municipal parking will reduce the yield of existing commercial parking and will eventually drive it out of business. The city, if it goes ahead with a municipal program, must be prepared to absorb these losses. The city must also make up for the progress lost by the halting of normal private enterprise advances due to the constant threat of municipal intervention. Any additional parking would have to be provided on top of recouping the above losses. Few city budgets can stand this drain.

Is a Little Public Subsidy Possible?

One of the most difficult questions to answer is this one frequently asked by reputable businessmen. During his years as Director of the Motor Vehicle Parking Agency in Washington the writer tried to find some basis for teamwork between private enterprise and government. After conscientious research he came to the conclusion that this team work can only extend to cooperative efforts—to guide, assist, and stimulate private enterprise—but it must stop short of financial participation by the city government. If the city goes beyond acting in an advisory capacity, then it becomes unwarranted encroachment in a field of private enterprise.

As the title of this paper suggests, the parking problem presents itself as either a private or a public responsibility. There is no middle road. There are no intermediate shades. It must be one or the other.

ADHESIVE BONDING COMPLEMENTS SOLDERING AND BRAZING

H. H. Simons, *The Welding Journal*, v. 33, n. 7, July, 1954, pp. 647-650.

Adhesive bonding, when used wisely, can help the engineer solve many problems. Together with soldering and brazing, the engineer has an extremely versatile kit of tools for almost all joining problems.

It is the purpose of this paper to help the engineer in his choice by: (1) Outlining the kinds of basic materials used in adhesives and listing their characteristics. (2) Discussing the principles of adhesive bonding.

(3) Comparing the advantages and disadvantages with respect to other joining methods.

Adhesive bonding may be defined as the joining of two materials by the use of a basically organic material as the bonding agent.

The organic materials from which almost all adhesives are compounded fall into four groups. Three of the four are synthetic, the fourth a natural protein group. They are the synthetic thermoplastic, synthetic thermosetting, rubber base and protein.

Adhesives are further classified by a bonding classification based on manner of use, and determined by the physical form and chemical properties of the adhesive. The bonding classifications are:

Solvent Release. The adhesives in this class are those dissolved or dispersed in a volatile solvent whose only function is to put the adhesive in a convenient application form.

Fusion. In this class the adhesive is used in solid form as a powder, film or rod. Heat is required to produce the bond.

Cured. The adhesives in this class complete the bond through a chemical or polymerization reaction. Bonds are made at room temperature or with heat.

A general description of the chemical types of materials within each group, the characteristics and best use of the types in the group and the bonding class is given below.

Thermoplastic Adhesives.

Chemical Types. (a) cellulose derivatives; (b) acrylic esters; (c) vinyl resins; (d) styrene resins; (e) alkyd resins; and (f) polyamide resins.

Characteristics. The bonds prepared with adhesives in this group are all thermoplastic in nature. As such they will soften and be weakened by heat. The temperature at which they will lose strength will, of course, depend upon the softening point of the material.

Fungus resistance of this group is excellent. Resistance to heat, cold, water and solvents is variable.

The materials in this group find their greatest use for nonmetallic bonds, particularly paper, textiles and wood; with the exception of several of the vinyl resins and the polyamide the bonds on metals are poor.

Bonding Class. All the adhesives in this group are in either the solvent release or fusion class.

Thermosetting Adhesives.

Chemical Types. (a) phenol resins; (b) resorcinol resins; (c) furane resins; (d) amino resins; (e) polyester resins; (f) silicone resins; and (g) epoxy resins.

Characteristics. The bonds made with adhesives in this group are thermosetting. Properly prepared they will not soften with heat. The bonds will therefore be stronger over a wider temperature range than the thermoplastic adhesives.

The resistance to heat, cold, water and solvents is uniformly high and superior to the thermoplastic adhesives. This group is more versatile for use on non-metals than the thermoplastic. In addition, a larger number give high-strength bonds with metals. The types most suitable for metals are the epoxies, silicones, phenolic polyamide and phenolic acetal compounds.

Bonding Class. The adhesives in this group are in the cured class.

Rubber-Base Adhesives.

Kinds. (a) natural rubber; (b) neoprene rubber; (c) reclaimed rubber; (d) butyl rubber; (e) thiokol; (f) cyclized rubber; (g) chlorinated rubber; (h) butadiene-acrylonitrile; and (i) silicone rubber.

Characteristics. The bonds in this group can be either thermoplastic or thermosetting. The strength at elevated temperatures will therefore fall between the thermoplastic adhesives and the thermosetting adhesives.

Solvent heat, cold and water resistance is also intermediate between the thermoplastic and thermosetting adhesives.

Bonding is good with all nonmetallics. The best types for metal bonding are the butadiene-acrylonitrile, thiokol and silicone rubbers.

Protein.

Kinds. (a) casein; (b) animal glue; (c) zein; and (d) soybean glue.

Characteristics. The adhesives in this group are more usually classed as glues. Their use is limited to special applications. They are all water soluble. This group is seldom used for joining metals.

An organic bond may be considered as two surfaces joined by an organic film. The chemical and physical properties of the joint will depend upon the chemistry of this film. The strength of the joint will depend additionally, upon the nature of the bonded surface, upon the manner in which the joint is made and upon joint design.

The strength of the film is determined by the cohesive forces of the components of the film. These are chemical and molecular in nature, and are properties of the material composing the film. The maximum cohesive strength can be obtained with any given material when the molecular size, shape, orientation and distribution is properly controlled. It is important that the engineer understands that the adhesive as received is compounded for this maximum, and that any changes he may make or any deviation from procedure may result in decreased strength. The strength of the film for the adherand surface is related to the specific cohesion of the film material for the surface material. The dominant influence seems to be the chemical similarity of the two materials, similarity in respect to polarity. Unless both are similar in polarity a strong bond cannot be made. Metals, although not polar, are easily polarizable. As a consequence, the adhesive materials containing the polar hydroxyl, carbonyl, amino and chloro group make the best bonds with metals.

The strongest bond will be obtained when the film itself and the film to adherand surface form a continuous, unbroken system. Any entrapment of foreign matter, solvent residue or gases will tend to lower the cohesive strength of the film, decrease the effective surface area of the adherand, and will result in a lower bond of strength.

For the adherand surface cleanliness is the primary requisite. The surface must be free of grease and dirt. Oxide films on metals, if the oxide is not strongly adherent should be removed. When porous surfaces are bonded, it is usually best to fill the pores, preferably with a material similar to the adhesive.

One of the major failings of organic adhesives is the poor peel strength of the bond. Joints are therefore designed to eliminate or minimize peel stresses. The lap, inset, butt strap and socket joint are the types of joints giving least peel stresses and are universally used. Overlaps are made so that ratio of thickness of section to length of overlap is 1:3.

The ideal adhesive:

1. Would cure to a maximum strength in a minimum time, preferably at room temperature.

2. Would have no shrinkage during or after cure.

3. Would have elastic properties similar to those of the adherand material.

4. Would not give off any volatile reaction products during or after cure.

5. Would maintain its properties over temperature ranges between −65 and 400°F.

6. The adhesive when cured would be able to resist chemical attack and

maintain its physical properties for long periods of time.

7. Would have high shear and peel strength.

8. Would be available in a form easy to apply.

9. The bonding method would be such that it can be adapted to available equipment and methods.

For joining nonmetals adhesive bonding is the only practical method available other than mechanical joining. Compared to the latter the adhesive bond is more uniform, neater, makes liquid and airtight joints and resists fatigue and buckling stresses better.

For joining metal to nonmetal it again offers the only practical method.

For joining metals it offers the advantages of less weight per bond. The corrosion resistance toward acid and bases is superior to soldering and brazing. Because joints can be made at room temperature and at temperatures lower than those required by soldering and brazing, it permits joining of metals that are affected by heat. The bond has high resistivity.

On the other hand, compared to soldering and brazing the limitations in design due to poor peel strength, the requirements for a different adhesive for each specific application, the poor peel strength and limited shear strength and the presence of volatiles in working are some of the disadvantages.

For extremely light gages of aluminum, adhesive bonding has often provided excellent solutions.

For extremely light gage of copper and heat-treated alloys such as beryllium copper, etc., adhesives will give satisfactory results even though the strength values will not be as high as on aluminum.

Adhesives are used in many instances where extremely light gages have to be bonded particularly on alloy steel or stainless steel.

BAUXITE MINING IN BRITISH GUIANA

The Times Review of Industry, vol. 8, n. 94 (New Series), Nov. 1954, pp. 99-100.

Bauxite was first observed in British Guiana in 1868, but it was not until the period 1897 to 1910, when Sir John Harrison determined the exact nature of the material, that it was recognized as a potential source for the metal aluminium. Mining companies were attracted by the possibilities of the deposits during the First World War when the Demerara Bauxite Company acquired a large area in the county of Demerara. Exports of bauxite have progressed steadily since 1924 except for a short interval during the last war, because of shipping difficulties. Since 1945 the graph of production has risen steeply, so that in 1952 an all-time record for the Demerara Bauxite Company (Demba) of 3,088,290 tons of crude bauxite was mined. At the moment there are two major mining concerns exporting bauxite, the Demerara Bauxite Company and Reynolds Metals Company. Harvey Aluminum Inc. has also started exploration and prospecting.

Bauxite in British Guiana differs from many other world sources in its relatively high average degree of purity. Average analyses show that most of the ore yields 50 to 61 per cent alumina, 3 to 12 per cent silica, and about 3 per cent iron. Demerara Bauxite Company authorities classify as ore bauxite containing less than 15 per cent SiO_2 and less than 10 per cent Fe_2O_3.

The exclusive permissions held by the two major bauxite companies are situated in Demerara and Berbice counties; the principal plants are located at Mackenzie and Everton respectively. The Demba mines are concentrated chiefly south of Mackenzie on both sides of the Demerara River and at Ituni, some 35 miles to the south-east. Reynolds Metals bauxite deposits are located at and near to Kwakwani, which is well over 100 miles up the Berbice River from Everton, near New Amsterdam.

The large concessions, led by the bauxite companies, are diligently searched, prospected, and finally drilled. When an ore body of workable size has been discovered and "proved" by exploration crews of geologists, surveyors, and drillers, the forests are cleared away by manual chopping, burning and bulldozing. Then the overburden of sand and clay—which may range in depth from 10 to 100 feet—is cleared by mechanical scrapers, draglines or hydraulic washing. Mining operations then proceed by the opencast method. The bauxite is blasted loose from beds 15 ft. to 45 ft. in thickness.

The walking dragline installed by Demerara Bauxite Company in the Mackenzie (Montgomery) Mines proved in 1952 that it was the quickest and most economic method of removing overburden from bauxite by mechanical equipment (approximately 260,000 cu. yd. being shifted a month). Loaded by power shovels into dump cars of a Diesel-powered railway, the pale pinkish to reddish brown ore is taken to Mackenzie. Here it is crushed and by means of a conveyor belt moved to the top of a four-storey washer building where the free clay is removed. Dried by the oil fuel kiln, it is stored ready for loading into ocean-going ships at the rate of 1,000 tons an hour. At Mackenzie is situated the largest known bauxite calcining kiln in the world.

Mackenzie has literally been built out of the South American jungle; started in 1916, it has become the second largest community in British Guiana and the site of the world's largest bauxite treatment plant with an annual capacity of two million metric tons of dried bauxite and 285,000 tons of calcined bauxite. Reynolds Metals Company and the Demerara Bauxite Company have made British Guiana the world's second largest producer of bauxite. Over 90 per cent of the colony's output is produced by the latter concern, most of the dried ore being exported to the Arvida plant of the Aluminum Company of Canada for conversion to metallic aluminium.

The high-grade bauxite found in British Guiana is specially adaptable to processing for the abrasive and refractory grades of bauxite after beneficiating and calcining locally. The abrasive grade requires 80 per cent alumina, 7 per cent silica, and 8 per cent ferric oxide; while the refractory grade requires 85 per cent alumina, 7 per cent silica, and 3.75 per cent ferric oxide.

Ore reserves of Demerara Bauxite and Reynolds Metals are unknown, although published reserves are stated to be 65 million tons for British Guiana, but this figure is only an approximation, and does not include any ore reserves estimated for Reynolds Metals Company. It is probably safe to say that the ore reserves are adequate to keep the industry at the present level of production for the next 30 years.

The bauxite industry is of major importance in the economy of

British Guiana, primarily from the point of view of production for export, its dollar earning capacity and its contribution to the revenue of the colony. It is estimated that the mineral industry contributes about 25 per cent of general revenue, and of this percentage roughly 75 per cent is contributed by the Demerara Bauxite Company.

The bauxite industry probably contributes about 80 per cent of the total, if not more, paid into the general revenue by the mineral industry or about 20 per cent of the colony's revenue.

The bauxite industry employs about 3,000 men and women, or about half the total employed in mining (including rock quarrying). The potential working population of British Guiana is about 150,000. Thus 4 per cent of those working in the mineral industry contribute about 25 per cent of the colony's revenue and, of this total, the 3,000 persons employed by the bauxite industry are responsible for 20 per cent of the colony's revenue. This remarkable yield is solely because of the value of the product mined and the vigour and efficient methods displayed by the private enterprises involved.

PAINT SOLVENTS THINNERS ARE DANGEROUS

L. G; Jones

Power Engineering, v. 58, n. 12, December 1954, p. 73

Handling paint thinners and solvents requires eternal vigilance. There is always danger of fire, explosion and poisonous fumes. Certain properties must be known:

1. Flash point, which is the temperature at which vapors arising from the surface of the liquid will ignite.

2. Explosive limit: the range of percentage of the vapors of solvents, mixed with air, which will explode violently when ignited. Below the minimum percentage limit, the mixture is too diluted with air to be combustible; above the upper percentage limit, the mixture is too rich, with insufficient air to burn. High percentage limit (lower) solvents are safest. In Table 1, the upper explosive limit is omitted because before this percentage is reached, other hazards are generally present, so that safety from explosion because of insufficient air does not make the atmosphere safe at all. The lower percentage limit is the really important one. These percentages are tabulated.

3. Boiling point: the temperature at which its own vapors leave the surface of the liquid freely and rapidly. It is really the point where the entire liquid takes fire, as contrasted to the "flash" point where some dissolved gases may be lost by the liquid, not its own vapors. Low-boiling point liquids are dangerous when flammable and toxic.

4. Toxic or poisoning effect: the parts of vapor per million parts of atmosphere in the room or chamber, i.e., ppm., that will kill or injure a person or animal. The fewer the parts per million that make a lethal concentration, the more deadly the solvent or thinner. Carbon tetrachloride and carbon monoxide require but 50 ppm. to be fatal to human beings, upon sufficient exposure. Some chemical gases are fatal in lower concentrations than 50 ppm.

It should be borne in mind that low explosive percentages or ppm. toxicity, combined with low flash point or boiling point (high volatility), form the most dangerous combinations. Table 1 gives specific values for these properties for the more common solvents and thinners used in the paint industry.

Some generalizations for quick memorizing:

1. Group I, linseed oil paint solvents and thinners are less toxic less flammable, and fairly explosive.

2. Group II, lacquer paint solvents are fairly toxic, more flammable and less explosive.

3. Group III, synthetic paint solvents are most toxic, fairly flammable and very explosive.

The proper attitude toward solvents and thinners is to consider them *all* toxic, flammable and explosive. Have plenty of ventilation around the job; avoid smoking, sparks from tools, electric equipment, etc., or flames in the vicinity. Practically all solvent and thinner vapors are heavier than air, so be doubly cautious in manholes, pits, boilers, tanks, or low places. Ventilate pockets well. Use compressed air masks when ventilation is limited.

Table 1. Properties of common solvents and thinners used in paint industry.

Solvent Thinner	Flash Point, deg. F. Closed cup	Boiling Point, deg. F.	Lower Explosive Limit, % volume in air	Toxicity in Air ppm
For oxidizing oil paints, Group I				
Turpentine	95	300	0.8	100
Stoddard Solvent	100-110	300-400	1.1	500
Mineral spirits	100-110	300-400	1.1	1000
Naphtha (safety)	100-110	300-400	1.1	1000
Naphtha V.M. & P.	20-45	212-320	1.2	1000
Hexane-n	—7	156	1.25	500-10
Gasoline	—50	100-400	1.3	500-10
For Lacquers, Group II				
Methyl alcohol	54	147	6.0	200
Ethyl alcohol	55	165	4.0	1000
Propyl alcohol	59	207	2.5	200-30
Isopropyl alcohol	53	181	2.5	200-40
Butyl alcohol	84	243	1.7	25-50
Amyl alcohol	109	243	1.2	100-20
Ethyl acetate	24	171	2.18	400
Butyl alcohol	72	260	1.7	200-50
Amyl alcohol	76	300	1.1	200-40
Cellosolve	104	275	2.6	25-50
Cellosolve acetate	124	313	1.7	25-10
For synthetic enamels, Group III				
Acetone	0	134	2.15	500
Cyclohexanone	147	313	...	...
Methyl ethyl ketone	30	176	1.81	250-30
Methyl n-butyl ketone.	90	262	1.22	100
Methyl iso-butyl ketone	73	244	1.34	100
Benzol (benzene)	12	176	1.4	100
Toluol (totuene)	100-110	300-400	1.1	200
Xylol (xylene)	63	291	1.0	200
Naphtha, coal tar	100-110	300-400	1.1	200

Data extracted from Amercoal Corrosion Control Reporter, April 1953, a from Handbook of Dangerous Materials, N. I. Sax, Rheinhold Publishing

An Engineer is Honoured

Tribute was paid to Lt.-Col. John By, builder of the Rideau canal and virtual founder of Canada's capital city, at ceremonies organized on October 5th, 1955, by The Engineering Institute of Canada.

"Today will long be remembered in the annals of the engineering profession in Canada." So said the president of The Engineering Institute of Canada, Dr. R. E. Heartz — and so it should be. It was a great day for the engineers, both civil and military. Here, at last, fitting recognition was being given to a great military engineer, whose final and most distinguished piece of work was of a civilian nature.

Although there are many memorials to engineers in many countries, it is doubtful if anything more outstanding than the fountain dedicated in Ottawa on October 5th, has ever been erected anywhere in memory of an engineer. In fact, there are not many memorials of any type more beautiful or more distinguished than this one.

The concept of the idea sprang up within the membership of the Ottawa Branch and the erection of the memorial itself, in all the myriad details associated with it, was the work of the special committee of the Ottawa Branch. The part of the Council of the Institute was simply to give encouragement to the proposal and to make available certain financial support.

Members of the Institute everywhere will appreciate the work of the committee — the work which not only gives credit at long last where it belongs, but also brings prestige to the Institute and to the profession.

The Luncheon

The dedication program began with a luncheon in the ballroom of the Chateau Laurier. The president welcomed the guests and read a cable message of congratulations and goodwill from the president of the Institution of Electrical Engineers. He then introduced R. F. Legget, chairman of the Ottawa Branch and acting chairman of the Memorial Committee, and asked him to introduce the speaker.

The luncheon was a colourful affair, with officers of the Armed Services in uniform. There were 400 people in attendance. Her Worship, Mayor Charlotte Whitton, was the speaker. No other person is so well fitted to speak on Colonel By and the early days of Bytown. Dr. Whitton has been a student of

Dr. R. E. Heartz, president of The Engineering Institute of Canada, speaking before he inaugurated the memorial fountain. To his left are: Hon. Robert H. Winters, Minister of Public Works (seated); R. F. Legget, chairman, Ottawa Branch, E.I.C.; and Brig. J. L. Melville, C.B.E., M.C., E.D., Honorary Col. Commandant, the Corps of Royal Canadian Engineers.

THIS FOUNTAIN HONOURS THE MEMORY OF
LT. COLONEL JOHN BY
ROYAL ENGINEERS
BUILDER OF THE RIDEAU CANAL 1826 - 1832
FOUNDER OF BYTOWN, RENAMED OTTAWA IN 185[illegible]

SPONSORED BY THE ENGINEERING INSTITUTE OF CANADA
WITH THE ASSISTANCE OF THE FEDERAL DISTRICT COMMISSION
THE HISTORIC SITES AND MONUMENTS BOARD
THE NATIONAL GALLERY, AND THE CITY OF OTTAWA

At the reception before the inaugural luncheon, Dr. R. E. Heartz greets Her Worship Dr. Charlotte Whitton, C.B.E., Mayor of Ottawa. Mrs. Heartz and R. F. Legget are also in the receiving line.

The first memorial plaque, reproduced in the lower picture, was unveiled by the Hon. R. H. Winters, Minister of Public Works, here flanked by Dr. R. E. Heartz and Mr. Legget.

the Ottawa Valley history and on this occasion she gave in humourous and in dramatic manner a thrilling picture of the days and the work of John By and his associates. It was a magnificent preliminary or "build up" to the dedication itself. Dr. Whitton spoke without a manuscript, but her talk was recorded and will appear in the next issue of the *Journal*.

Everything about the memorial and its dedication was outstanding. Even the weather was perfect, and a bad day could have ruined everything. The guard of honour of the Royal Canadian Engineers were "smart as paint". The band of the Royal Canadian Corps of Signals with their bright uniforms and appropriate music added more than a touch of colour to the scene.

In Three Parts

The three gentlemen who took the principal roles in the unveiling and dedication were well chosen. Under the master of ceremonies, R. F. Legget, chairman of the Branch, each did his part expeditiously and graciously. The Honourable R. H. Winters, M.E.I.C., unveiled the first plaque, which recorded the work of By and the fact that this memorial was dedicated on this day by The Engineering Institute of Canada. Mr. Winters is the Minister of Public Works, but on this occasion he was representing the Minister of Transport. The Rideau Canal now comes within the jurisdiction of this department although, as Mr. Winters pointed out, in an earlier day it was the responsibility of his department, therefore he nicely joined the past with the present.

Brigadier J. L. Melville unveiled the second plaque, which recorded the honourable history of the fountain. He, as Honorary Colonel Commandant of the Royal Canadian Engineers, represented the military engineer. The inclusion in his address of a message from the Colonel Commandant of the Royal Engineers was most appropriate.

Dedication

The last rite to be performed was the actual dedication of the fountain. Appropriately enough, this was done by the president of the Institute, Dr. R. E. Heartz. In a short address he expressed the Institute's thanks to the individuals and organizations

without whose collaboration and support the whole project would not have been possible. He touched on the significance of the fountain which for over a hundred years stood in the capital city of London, being transferred to the capital city of Ottawa. He hoped "that in some way it may bring us a message of goodwill from the great mother country, and that it will help to hold these two great nations together in mutual respect, admiration and affection.

The ceremony was completed when Dr. Heartz pressed the button, that started the motor, that started the pump, that started the water. The band played God Save the Queen and with the Guard of Honour marched off, leaving the memorial to the people of Canada for all time, as a reminder of what one engineer did for his country and as an inspiration to succeeding generations in terms of service to mankind.

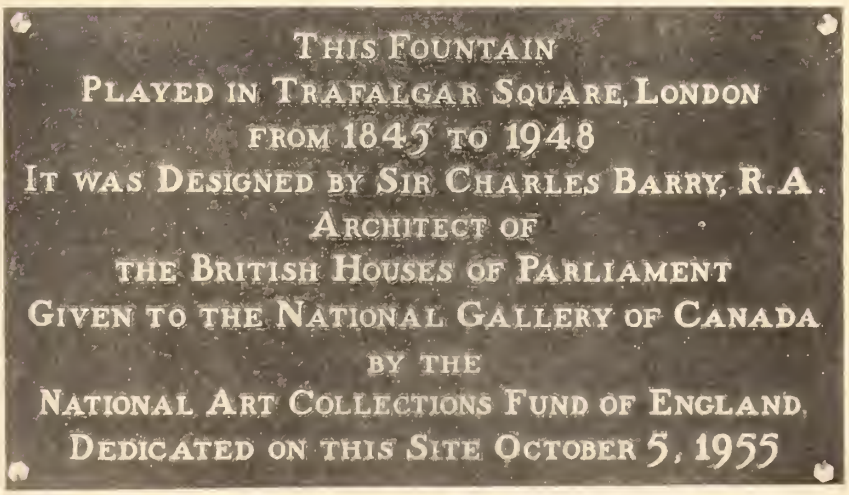
The Fountain

The fountain was one of two that stood for over a hundred years in Trafalgar Square, where it was known to and loved by millions of people from many parts of the world. Both fountains were removed in 1948 to make way for larger ones. They were presented to the National Gallery of Canada by the National Arts Collection Fund of England, and this one was made available to The Engineering Institute as a memorial to Colonel By.

The fountain is made of red granite, quarried at Peterhead, Aberdeenshire, Scotland. It was designed by Sir Charles Barry, R.A., (1795 to 1860) who was famous as the designer of the British House of Commons.

The memorial as finally unveiled represents the combined efforts of the City of Ottawa, the Federal District Commission, the Historic Sites and Monuments Board, and the Engineering Institute of Canada.

The City of Ottawa provided the water supply system and the flood lighting. The Federal District Commission and the Historic Sites and Monuments Board made financial contributions to the cost. As well, a substantial contribution was made by the Ottawa branch, and one other branch also contributed. The bulk of the cost was borne by The Engineering Institute.



The R.C.E. guard of honour (above) was inspected by Brig. Melville at the start of the dedication ceremonies. The guard, commanded by Capt. A. A. McPherson, was accompanied by the Band of the Royal Canadian Corps of Signals, directed by Capt. B. J. Lyons.

The second memorial plaque was unveiled by Brig. J. L. Melville, C.B.E., M.C., E.D., Honorary Col. Commandant of the Corps of Royal Canadian Engineers. R. F. Legget, Hon. R. H. Winters, Dr. R. E. Heartz, and Mayor Charlotte Whitton are also seen in the centre picture.

Biographical Notes

John By was born at Archbishops Walk, London, on August 10, 1779. He studied at the Royal Military Academy, Woolwich, and obtained his commission at the age of twenty as a second lieutenant in the Royal Artillery. In December of the same year, he was transferred to the Royal Engineers.

He served at Woolwich and at Plymouth and in August 1802 he was sent to Canada. He stayed until 1811 in Canada after which he was recalled for the Peninsular War in Spain and Portugal.

During this first stay in Canada he was attached to the Royal Engineers establishment at Quebec City and had much to do with the building and extension of the fortifications at Quebec and with the construction of the first small canal at the Cedars, on the St. Lawrence River. Later, in England he was placed in charge of the works at the Royal Gunpowder Mills at Faversham, Purfleet and Waltham Abbey, positions he occupied until 1821. During this period he was promoted to the rank of brevet major. He supervised the building of the new army small arms factory at Enfield Lock in 1814. He was promoted to lieutenant colonel in 1824.

Such demonstrated ability and his nine years of engineering experience in Canada made him an ideal candidate for the position of superintendent for the Rideau Canal, in 1826.

There are reports of his courage and endurance in the face of difficulties. It is reported he encountered all privations with wonderful patience and good-humour; was even too daring in some instances. His great stamina enabled him to survive several attacks of swamp fever.

Colonel By Memorial Advisory Committee

Dr. J. J. Green, M.E.I.C.,
Chairman of the Committee,
Defence Research Member, Canadian Joint Staff, Washington, D.C., U.S.A.

R. F. Legget, M.E.I.C.,
***Acting Chairman,* Director, Division of Building Research, National Research Council, Ottawa, Ontario.**

Major W. S. Lawson, M.E.I.C., Retired.

Brigadier J. L. Melville,
Honorary Colonel Commandant, Royal Canadian Engineers.

W. B. Pennoek, M.E.I.C.,
Pennoek Engineering Company, Ottawa, Ontario.

Major-General G. R. Turner, M.E.I.C., Retired

Major-General H. Kennedy, M.E.I.C., Consulting Engineer, Ottawa, Ontario.

Colonel V. S. Thompson, M.E.I.C., Bridge Engineer, Department of Public Works of Canada, Ottawa, Ontario.

G. A. Sutherland, M.E.I.C.,
Secretary of the Committee,
Radio and Electrical Engineering Divsn., National Research Council, Ottawa, Ontario.

In addition to Colonel By's responsibilities on the canal he was also required to serve for a time as first magistrate with municipal powers for the new community of Bytown. He was asked to survey the land around the canal works, to rent lots to settlers, to open streets, and to adopt regulations for the building of houses. A small school was also established. Colonel By was consulted too, about the building of the Grenville Canal. As superintendent Colonel By was called upon to deal with contractors' claims, some of them unfair and complicated, his reports being made in these cases to the Governor-in-Chief at Quebec.

He had in mind the role of the canal once completed, and considered ways and means by which he could facilitate its use. The wide possibilities were evident to him. He wished to keep navigation inside British Territory not only "to deprive the Americans of the means of attacking Canada" but also "to make Great Britain mistress of the trade of that vast population on the borders of the Great Lakes which would serve as so many outlets for British manufactured goods." He made detailed plans for maintenance and financing.

In 1832 the construction was completed and the canal officially opened. However, Colonel By had to return to England to defend his administration before a parliamentary committee. The committee exonerated him, though they did not commend him as they should have done in the light of the facts presented to them. He received no special recognition either from the government or the army for his engineering achievement.

Colonel By died in February 1836 aged 53 years.

Month To Month

JAN. FEB. MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

The Columbia

From time to time in these pages, reference has been made to the negotiations before the International Joint Commission concerning the immediate and future development of those rivers of British Columbia which cross the international boundary. The typical example is the Columbia, but there are other rivers to be considered as well. In fact, much of the discussion to date has centered around the proposed Libby (Mont.) development on the Kootenay, which would flood a considerable area in Canada.

Gen. A. G. L. McNaughton, M.E.I.C., chairman of the Canadian section of the IJC, stated on March 9 last before the External Affairs Committee of the House of Commons, that in the case of the Libby development, "The Canadian Commissioners had not been able to persuade our colleagues in the IJC to agree even to discuss any recompense whatever for the resources of Canada in the way of head and flow which were to be used in the project, if it were undertaken. I indicated also, I hope, that the Canadian Commissioners had been equally firm and that there would not be any consent to the dedication of the waters of the Canadian Kootenay under any such inequitable arrangement."

Controversy on Compensation

This does not mean that Canada is merely stubborn or playing dog in the manger. What she is asking is that she shall be allotted at least part of the power produced in the United States as the result of extra head and flow developed from Canadian storage, such power to be paid for, of course, at an equitable rate. She is entitled to this kind of compensation under the Treaty of 1909, which set up the IJC, and she has an excellent precedent in the decision of the IJC in the case of the power development on the Saint John river at Grand Falls, N.B., where Maine was allotted a block of power in compensation for flowage in that state.

United States interests agree that compensation for Canadian head and storage is in order, but they have so far refused to consider paying for it in the form of power, all of which they want for themselves. Their attitude is not hard to understand. There is an acute power shortage in Washington and in Oregon, which can most economically be relieved by the development of these international rivers.

Return to Canada *any* power developed in the United States? Certainly not! Pay for extra United States power developed by reason of Canadian storage? Of course—in money, but never in power!

In Gen. McNaughton's own words, " . . . We are invited to present, that is, to make a gift to, our friends to the south of the line, the rights in perpetuity to a large flow of Canadian origin capable of being used in Canada. By this action we would divert a resource of very great value to ourselves to the service of industry in another nation."

Certainly Canada should do nothing of the kind. Her representatives on the IJC should continue to insist that she get proper compensation in proper form for whatever she may contribute to the output of United States hydroelectric plants. And the action of our Commissioners in the Libby case is good evidence that they will do just that.

Prospect for Solution

Let nobody think that the problem of the Columbia basin are near solution. There are two years more of mapping to be done and then it will take at least a year and a half to study various schemes of development, some of which have already been submitted and some new ones which may arise before

Cover Picture

A memorial to Col. John By, founder of Ottawa, was unveiled on October 5. This *Journal* contains a full report of the dedication ceremonies, page 1391.

then. The Columbia problem will be with us for a long time yet. The IJC's excellent record for the settlement of difficult problems in the past gives promise that it will settle this one equitably, though probably not to everybody's satisfaction.

Winter Navigation on the St. Lawrence

For longer than we can remember, extending the season of navigation on the St. Lawrence, or making it navigable throughout the whole year, is a topic which has been discussed sporadically by engineers, by shipping companies, by harbour authorities, by pilots' associations and by others whose business depends upon the river.

Engineers are mainly concerned with the means by which this extended or complete navigability can perhaps be attained, others are interested for various reasons, mainly economic. Shipping operators would prefer to run over the same route the year around, rather than to lay up their ships during the winter or transfer them to open water routes, often far from home. Harbour authorities would like to see their large investments earning something twelve months in the year, instead of eating their heads off during the cold weather. Pilots and others who are dependent upon navigation for their livelihoods would certainly welcome all-year activity.

The urge for a longer navigation season will surely be increased when the Seaway is completed, if for no other reason than that it will represent the investment of many millions of dollars by the two governments concerned and in harbour improvements along the river and the Great Lakes to serve the increased water-borne traffic anticipated. This staggering sum must not be allowed to lie idle part of the year if it can economically be kept at work.

Within the memories of most of us the season of navigation on the St. Lawrence has been extended from Montreal to the sea by using ice breakers to open the channel as early as possible each spring, until now it lasts on the average from about April 15 to about December 20. In addition, of late, information on ice conditions in the Gulf has become more readily available. Ice there never shuts off St. Lawrence navigation completely; it only adds to its hazards, sometimes severely.

There seem to be no technical reasons why the river cannot be kept open as long as economically desirable, be it only a few weeks longer than the normal period or be it throughout the year.

NRC Study of St. Lawrence

Naturally enough, the Institute's members are interested in this matter and the *Journal* has published a number of papers on it; see the list at the end of this article. And now the National Research Council has issued a report (MD-42) in limited numbers, called "A Study of Wintertime Heat Losses from a Water Surface and of Heat Conservation and Heat Addition to Combat Ice Formation in the St. Lawrence River" and produced by a team composed of F. W. Pruden, R. L. Wardlaw, D. C. Baxter and J. L. Orr of the Division of Mechanical Engineering, under the general direction of J. H. Parkin, M.E.I.C.

At first sight this report is a rather fearsome document; it takes six pages merely to list the symbols used in its numerous equations. The first part, devoted to the calculation of the heat losses and gains from a water-air interface, will not be followed easily by any except those thoroughly familiar with the theory of heat transfer.

The authors are satisfied that Kerry's proposal to draw on the warm waters from the depths of Lake Ontario by means of a 60-foot deep and 500 foot wide channel is entirely practicable. But they think the cost of this channel would be excessive, so they base their study on a 35 by 500 foot channel.

It has been proposed that one way to keep such a channel open is to heat the water in it. This, it is thought, could best be done by injecting into it vertical jets of hot water; the cost of this scheme is investigated in this report. It is suggested that perhaps the cheapest way to keep the channel open will be to depend upon the heat of the lake waters for the upper section and to use artificial heating for the lower section.

Conclusions

The heart of any report is in its conclusions. Condensed, those of this report are:

1 The calculations of heat loss[es] are in reasonable agreemen[t] with observed data.

2 A 60-foot channel, as propose[d] by J. G. G. Kerry, M.E.I.C. would never freeze until fa[r] below Quebec, but it would b[e] very costly.

3 A 35-foot channel would remai[n] ice-free in average weathe[r] but there would be some ic[e] in very severe weather.

4 The use of oil films to redu[ce] evaporation and consequent[ly] heat loss is not practicable.

5 The cost of heating a five-mi[le] section of unconfined chann[el] through a median wint[er] would be about $3.5 million a year, using coal as fuel, whi[ch] figure might perhaps be r[e]duced by about half in t[he] distant future by using nucle[ar] heat. These figures might [be] reduced to $2.2 million a[nd] $1.15 million, respectively, [if] the channel were confined.

6 Waste heat from electrical ge[n]erating stations is not a pra[c]tical source of heat supply [for] an unconfined channel, thou[gh] it might be for a confin[ed] channel.

7 If ships could navigate in sa[fe] four inches of ice, heati[ng] costs would be cut by or[e] half; if 12 inches of ice we[re] permissible, heating co[sts] would drop by 75 per cent.

8 Extension of the navigation se[a]son by a few days or wee[ks] may be economically pref[er]able to attempting 12-mon[th] navigation.

There are ten appendices to [the] report, A to J, in which most of [the] calculations are concentrated. T[he] one of most interest to us is A[p]pendix I, in which are set fo[rth] the additional data required to [re]place the many assumptions wh[ich] had perforce to be made in the [re]port. They have to do with h[eat] loss calculations, heat flow co[m]ponents, the direct measurement [of] heat loss rate, the probability [of] failure because of extremely l[ow] temperatures, the calculations [of] the ratio of the length of chan[nel] to be protected by heat conser[va]tion (lake end) to the length to [be] protected by heating (downstre[am] end) for optimum economic resu[lts], problems of turbulent diffusion [in] a study of ice formation in [the] Gulf and in harbours, locks [and] canals.

Further Study Needed

It is fair to say that this rep[ort] shows that a good start has b[een]

made in taking the question of keeping the St. Lawrence open in the winter out of the realm of speculation or little better, and in putting it on a sound and scientific basis, but there is much more to be done, as the authors are careful to point out. Doubtless some of the moot points can be cleared up by further study at no great expense; others will require the collection of a mass of data.

It seems to us that the logical next step is an economic survey covering every field even remotely affected by navigation conditions in the St. Lawrence. If Canada alone is to pay for any works required, let the survey be confined to Canada. If toll operation of any works required is contemplated, or if the cost is to be met jointly by Canada and the United States, then let the survey cover the whole area affected in both countries. Much as we like our American friends, there is no reason why we should make them an annual present of several million dollars.

With the results of such a survey and with the rough estimates of this report and elsewhere, it should not be hard to decide whether the project is economically practicable at all, and if it be, whether the goal should be an additional fortnight or six weeks of open season or year-round navigability. Some of this work may have already been done; if so, we are ignorant of it.

Then engineers should take over and carry designs to the point where reasonably accurate estimates of cost could be made for the extent of service shown to be economically justified. At this stage there would perhaps be compromises between desirability and cost, but finally it should be possible to produce a scheme the annual returns, tangible and intangible, from which would at least equal its annual cost. Adoption under any other conditions would be folly; government has enough deficit-producing commercial services at it is.

erry, J. G. G., Winter Temperature Cycle of the St. Lawrence Waters; *Eng. Jour.;* January, 1946.

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nall, F. S., Ice in the Gulf, to be published *Eng. Jour.;* November, 1955.

Journal Papers in Japanese

Treating as it does of engineering matters covering a wide scope, the *Journal* frequently creates reactions of equally wide variation. The editors hear of these reactions from time to time with great interest.

Recently it was demonstrated that the interest in the *Journal* is "far" as well as "wide", and there is in the Institute office a copy of *The Sumitomo Electrical Review* in which two *Journal* papers are reprinted in the Japanese language. The papers translated by the *Review*, after permission was granted, were one from the Kitimat issue of November 1954, Design and Construction of the Transmission Line, by Bruce Cooper, M.E.I.C., and D. G. Dunbar, M.E.I.C.; and one from the April 1953 issue, Electrical Engineering and Operating Aspects of Alcan's B.C. Project, by J. T. Madill, M.E.I.C.

There is no way of measuring how widely the *Journal* is quoted and abstracted and to what extent it is a source of information on Canadian engineering developments. As a subscriber to the Fair Copying Declaration of the Royal Society, the *Journal* permits quotation provided exact reference is made to the source, and so there is use made of *Journal* material that we do not hear about. Certain publications carrying abstracts of articles, send clippings, and a good number of requests are received for permission to reprint or abstract.

The extent of interest in the *Journal,* therefore, is something only to be speculated upon, but any evidence of greater usefulness is a source of satisfaction to the editors, and must be equally so to the contributors on whom our success ultimately depends.

Nominees for office

The report of the Nominating Committee, as accepted by Council at the meeting held on September 17th, 1955, is published for the information of all corporate members as required by Sections 19 and 40 of the by-laws:

President .....

Vice-Presidents

*Zone B (Province of Ontario)	H. R. Sills	Peterborough
*Zone C (Province of Quebec)	G. M. Dick	Sherbrooke
*Zone D (Maritime Provinces)	H. W. L. Doane	Halifax

Councillors

†Cape Breton Branch	J. R. Wallace	Sydney
†Halifax Branch	O. Nelson Mann	Halifax
†North Nova Scotia Branch	D. J. MacNeil	Antigonish
†Moncton Branch	M. F. K. Leighton	Moncton
†Northern New Brunswick	R. C. Eddy	Bathurst
†Quebec Branch	C. H. Boisvert	Quebec
§Montreal Branch	Roger Brais	Montreal
	C. E. Frost	Montreal
	H. A. Mullins	Montreal
†Cornwall Branch	John M. Hawkes	Cornwall
†Ottawa Branch	R. F. Legget	Ottawa
†Peterborough Branch	A. J. Bonney	Peterborough
‡Toronto Branch	W. M. Huggins	Toronto
†Niagara Peninsula Branch	Paul E. Buss	Thorold
†Kitchener Branch	Wm. R. Roberts	Kitchener
†Hamilton Branch	L. C. Sentance	Hamilton
†Huronia Branch	H. C. Bates	Orillia
†Sarnia Branch	R. A. McGeachy	Sarnia
†North Eastern Ontario	G. G. M. Eastwood	Kapuskasing
†Sault Ste. Marie Branch	D. C. Holgate	Sault Ste. Marie
†Winnipeg	R. T. Harland	Winnipeg
†Saskatchewan	J. B. Mantle	Saskatoon
†Calgary	W. A. Smith	Calgary
†Lethbridge	James M. Campbell	Lethbridge
†Edmonton	H. L. Roblin	Edmonton
†Vancouver	E. L. Hartley	Vancouver

* One vice-president to be elected for two years.
† One councillor to be elected for two years.
‡ One councillor to be elected for three years.
§ Three councillors to be elected for three years each.

St. Lawrence Seaway and Power Project

The *Journal* reviews the news and progress of the St. Lawrence project

Below this cofferdam, between Barnhart Island and the Canadian shore, excavation progresses on the site of the two powerhouses to be situated west of Cornwall, Ont.

Progress by Ontario Hydro

Ontario Hydro announced the award on September 1 of a contract to Horton Steel Works Ltd., Toronto, for $49,675, for the fabrication, delivery and erection of the 125-foot high elevated steel water tank for the new village of Iroquois. Erection of the tank which will have a capacity of 208,000 imperial gallons is to be completed by April 1, 1956. The bid was the lowest of three tenders submitted.

Bids will be received up to September 27 for construction of the Cornwall dyke closure and diversion of the Cornwall canal. The work comprises dry excavation, construction of cofferdams, diversion structure and dyke closure. It involves 1,300,000 yards of earth, 1,100,000 yards of earth fill and 137,000 yards of concrete.

Headed by Lieut.-General Samuel D. Sturgis, Jr., chief of engineers, U.S. Army, and Lewis G. Castle, administrator, USSDC, both of Washington, D.C., a group of American officials inspected the Niagara River remedial works on both sides of the border on August 17.

The following day the group visited Hydro's A.W. Manby Service Centre at Islington, Ontario, where they viewed the Commission's Niagara and St. Lawrence power project hydraulic models.

During their visit in Toronto Mr. Castle and General Sturgis discussed with Ontario Hydro officials the length of time during which navigation would have to be closed while the headpond above the International Powerhouse and Long Sault Dam was being filled in 1958.

The original schedule called for flooding the headpond in December 1958, involving a seven day interruption to navigation. A faster schedule featuring earlier flooding is being studied, however, which would cut the interruption to a matter of 36 hours. When the flooding is completed, shipping will be routed through the Seaway Channel and locks at Iroquois, Robinsons Bay and Grass Island. Until flooding takes place the present 14 foot channel will be adequately protected.

Newsmen Inspect Hydro's St. Lawrence Power Project

A special inspection tour of construction progress on the St. Lawrence Power Project, extending over a 35-mile stretch of the great river "highway" and including the Ontario Hydro powerhouse site, Iroquois and Long Sault dams and the new 30-bed Hydro hospital for construction workers, was made September 19 by more than 10 press, trade journal, newspaper radio and television representatives. The group also saw a hom lifted from its foundations by massive house-moving machinery and transported to the new Iro quois townsite.

Participating in the day's tou were key officials from both th Ontario Hydro and the Toront hydro-electric system. They in cluded: Richard L. Hearn, Ontari Hydro chairman; Honourable Wil liam K. Warrender, Q.C., and W Ross Strike, Q.C., vice-chairmen Lt.-Col. A. A. Kennedy, commis sioner; A. W. Manby, general mar ager; Dr. Otto Holden, chief eng neer; Gordon Mitchell, director S Lawrence Power Project, Ontar Hydro; and officials of Toront Hydro.

The inspection tour began Iroquois. Here, the group witnesse the moving of a residence fro Wellington Street, 1½ miles to lot in the new townsite. This w the tenth home to be so moved, o of some 150-200 in Iroquois. As result of flooding for the pow project, the present Iroquois w completely disappear. Its 1,1 population will be re-establish on a selected site north of the pre ent community but still within i existing corporate limits. In all, t properties of some 6,500 Ontar residents in the St. Lawrence Va ley will be affected by floodi operations.

In the house-moving operatio two machines will be used — o capable of lifting loads up to 2 tons and the other capable of lif ing 100-ton loads. Both machin are electrically operated, havi their own 200-horsepower dies generator units. Perhaps the mo spectacular part of the machin are their wheels. The rear on stand nearly 10 feet high and a three feet wide. Huge pneumat tires are used which almost cor pletely absorb road shock caus by uneven surface.

A home is prepared for movi by first building a steel fra

under the sills and load bearing sections of the house. When this is completed the house, in effect, sits on a huge tray or float. The house-moving machinery is then backed into position to pick up the float and services are disconnected. To lift the house free from its foundations and to keep it perfectly level, three winches are positioned at the three load bearing points on the machine. A master control operates the three lifting mechanisms simultaneously to effect a balanced lift.

On reaching the townsite, the house is lowered onto its new foundation which has been prepared in advance with sidewalks built, and water, power and phone are connected up. The combination of a solid frame, together with being carried in suspension and the large shock-reducing tires, permits the home to be carried at its normally level position without twisting or jarring. The total time taken for the move is about one hour.

Later in the morning, the visiting newsmen had an opportunity to view the Iroquois Dam site, where a structure 2,540 feet in length and 67 feet high will be built in two stages by NYSPA to regulate the outflow of water from Lake Ontario. Here the first stage on the American side is being excavated behind a cofferdam. Excavation for the Iroquois Channel and Lock under construction for Canada's Seaway Authority was also observed. The Hydro job hospital, relocation of the C.N.R. main line, and the new transformer station were also seen.

Highlighting the tour was the afternoon visit to the work areas of the international powerhouse, Long Sault Dam and the Robinson Bay Lock. Much interest was shown in the 4,500-foot long steel sheet cofferdam which was constructed across the north channel of the river, between the Canadian mainland and Barnhart Island, to permit work on the two powerhouses to proceed in the dry. Contractors are now engaged on excavations in the powerhouse area. Overburden has been removed over much of the area about to the intake sill level. A further 30 feet depth has to be excavated for the powerhouse foundation below the turbines and for the tailrace.

By effective use of control structures, a headpond will be created immediately above the powerhouses to produce an average operating head of 83 feet. The Order of Approval for the power project by the International Joint Commission provides that the forebay water level will be operated at a maximum elevation of 238 feet above sea level for 10 years or less. Experiments may be carried out during this period and if they prove it advisable, the forebay elevation may then be increased above the 238-foot level.

Moving upstream from the site of the generating stations, the group viewed progress on the Long Sault Dam which is being undertaken by the NYSPA. This dam will extend from the western end of Barnhart Island to the United States mainland. The 2,250-foot long structure is being built in two stages. Inside the first cofferdam, now dewatered, 13 sluices will be built and left open to pass the flow, after the second cofferdam is built and completion of the remaining 17 sluices can proceed.

This dam will be a concrete gravity, curved-axis spillway structure, with a maximum height of some 145 feet above the foundation. The spillway section will have thirty, 50-foot wide vertical lift gates. The purpose of this structure will be to control the level of water in the headpond, allowing, as necessary, any excess amounts to bypass the powerhouses.

Approximately 14 miles of dykes and large-scale channel improvements, to meet certain navigational and hydraulic improvements, will be carried out on both the Canadian and American sides of the river.

Flooding

When construction of the project has advanced to the point where power can be generated, the tunnel diversion port gates of the Long Sault Dam will be lowered, forcing the river level to rise until a head of water sufficient to operate the huge powerhouses has been obtained.

This will mean that approximately 20,000 acres along a 35-mile stretch of the Canadian shore will be flooded, affecting some 6,500 persons and including the villages of Iroquois, Aultsville, Farran's Point, Dickinsons Landing, Wales, Moulinette and Mille Roches, and one-third of the town of Morrisburg. In addition, about 225 farms will be affected, while about 40 miles of railway line and 35 miles of highway will be relocated. All trees, fences, brush and buildings will be removed from the lands to be affected. Major flooding will not take place until 1958.

In June, 1955, dewatering of the powerhouse area was completed and excavation for the powerhouses begun: this will be virtually finished by the end of the year. Excavation for the two powerhouses requires the removal of some 3,300,000 cubic yards of earth and 318,000 cubic yards of rock. Ontario Hydro and its partner, the Power Authority of the State of New York, will share the work.

During the year, activity also moved upstream, above the village of Iroquois, to the Galop and Chimney Islands where work commenced on channel improvements, involving the dredging of some 18 million yards of earth and a million yards of rock at a cost of some $16 millions. This is necessary to obtain satisfactory hydraulic and navigational conditions. Other similar channel improvements, though

Excavations within cofferdam at Long Sault rapids area, the site of the future control dam.

on a smaller scale, will be undertaken at Sparrowhawk Point, Toussaint Island and in the vicinity of Point Three Points and Ogden Island.

Progress by Canada's Seaway Authority

A contract for the Cote Ste. Catherine Lock and approaches in the Lachine Section of the Seaway has been awarded to Canamont Construction, Limited, and Canit Construction, Limited, in joint venture. The successful bid, lowest of four tendered, amounted to $7,107,480. The work is to be completed by July 31, 1958. The description of this project appeared in the September issue of the *Journal*.

Atlas Construction Company Limited, of Montreal has been awarded two contracts of a total value of $900,165 for construction works in the Lachine Section of the St. Lawrence Seaway. The Atlas company was the lowest of four bidders in both cases.

One is for enlargement of Piers 1 to 11, of the Jacques Cartier Bridge at Montreal and is valued at $779,267. The work is to be completed not later than September 30, 1956. The other is for construction of a permanent water intake for the municipalities of Longueuil and Jacques Cartier. It is valued at $120,898. The work must be completed not later than December 15, 1955.

The work of enlargement of the Jacques Cartier Bridge piers is preparatory to the eventual raising of the southern span of the bridge, and is to be carried out in coordination with the channel excavation work now being done in the area. It is to commence immediately following the award of contract.

Options had been obtained by mid-August from two-thirds of the parties whose properties had then been expropriated for the purposes of the Seaway, at Cote Ste. Catherine, in the Lachine Section of the St. Lawrence Seaway, it was revealed by Seaway Authority officials. Cases of expropriation for Seaway purposes in the area to that time numbered 127. In 85 of these, final settlement had been agreed upon by former owners, and all had been paid their compensation except 12 cases now being dealt with.

Progress by NYSPA

In a progress report to end of August, issued September 7, 1955, the New York State Power Authority shows a total of 19 construction contracts, 44 sub-contracts and 30 major supply contracts awarded to date on the United States side, at a total cost of some $144,000,000. Employment for the month averaged 2216 U.S. and 1764 Canadian personnel.

At Long Sault Dam, stage one of the cofferdams was complete and erection of construction plant was in progress. Excavation of rock from the dam foundation had been started, together with grouting and pressure testing of drill holes. On the American half of the International Powerhouse, plans and specifications were completed, cofferdams completed and dewatered. Exploration of the foundation and south forebay dike stripping was completed. Foundation excavation was continued as grouting of cut off holes got underway. Installation of the construction plant was further advanced.

At Iroquois Dam, plans were 40 per cent complete, installation of construction plant and powerlines was forging ahead, along with completion of access roads and tracklaying in classification yard. Excavation had been started for the American abutment, one level of excavation being 10 feet below riverbed.

Elsewhere, the Robinson Tunnel access road was blacktopped. Equipment was assembled for the south Galop Channel improvement, while excavation was in progress on Red Mills Point. The contractor had started advance work for construction of the Massena Canal intake. Test runs were made at the project concrete aggregate plant as it neared completion. The Barnhart Bridge was being erected from both ends, as work continued on the north pier and abutment. Construction of piers for the Grass River bridge progressed.

In the general project area, construction of access roads and railroad was 65 per cent completed, dikes had been started, reservoir clearing had commenced, while on the work of land acquisition engineering data was 60 per cent completed and right of entry established on close to half the properties. Production of Power Authority drawings and specifications remained on schedule. Inspection and expediting of major items of essential materials and equipment were receiving top priority.

Defer Sightseeing, Urge U.S. Authorities

In a joint folder recently published for distribution, the New York State Power Authority and the U.S. Seaway Development Corporation urge visitors and tourists to wait until next year to visit the work in progress. The text reads in part as follows:

> Until the railroad and highways serving the site are completed and in use, the facilities for tourists must of necessity be limited. Because of construction operations there will be delays and tourists should not enter the construction area unless they are willing to accommodate themselves to construction conditions.
>
> During 1955 both the Seaway and Power Projects will be in preliminary stages of construction. By 1956 many of the preliminary construction projects features will have been completed, including an access road railroad, new bridge, etc., which will make access to the 'overlooks' easier and safer. Furthermore, the work in general will be out of the 'foundation stage' and of much more interest to the general public.

In a companion 3-colour folder the two U.S. Authorities have also published a concise description of the Seaway project, for the information of visitors, showing coloured diagramatic views of the proposed structures as they will appear when completed, with descriptions, dimensions, costs and other statistics for each. Maps of the Great Lakes and of the U.S. side of the development in the International Section are also shown.

Authority President Speaks at Edmonton

President Chevrier of The St. Lawrence Seaway Authority, speaking before the Canadian Club of Edmonton on September 6, said of wheat, "it has always been a serious contender for leading position in the export trade of Canada", is "extremely well suited to mechanized bulk handling" . . . and has a "transportation pattern very sensitive to freight rates". "A commodity as well adapted to water transport in bulk as grain will not fail to take advantage of the Seaway facilities," he declared.

Discussing the eastward movement of grain, Mr. Chevrier showed how the large lake carriers now carry grain in two circuits—one from Lakehead to ports on Georgian Bay for furtherance by rail to Lower St. Lawrence or Maritime points and the other to Sarnia. Lake Erie and Lake Ontario ports for transhipment into small canallers sailing to lower St. Lawrence ports via the 14-foot canals.

"In both cases there is involved the unloading of the lake carrier and the loading of either rail cars or canallers. The advent of the Seaway will reduce shipment costs through the elimination of transfer of cargo and reduction in rates for the span now covered by rail or shallow-draft canals," averred Mr. Chevrier.

"To sum up," said Mr. Chevrier, "it seems that Canada is in a favourable position in world markets for grain, in spite of the current relaxed condition of the international wheat trade. Even taking into account the recent trend toward more shipments of export grains through Pacific Coast outlets and the Port of Churchill, a considerable volume of grain will be moved on the new Seaway at a significant reduction in cost. This cannot help but benefit the Canadian grain growers and all their suppliers."

Toronto Port Will Rival Montreal

When the Seaway opens three years from now, Toronto will really become a direct competitor with Montreal for ocean shipping for the first time. Toronto's port will have five or six times as many berths for general cargo ships as will most of its U.S. competitors now have, and probably double what they will have then.

All the port planning is based on the Seaway. Piles for the piers have been driven far enough to allow deep dredging for the heaviest ships. The new terminal on Pier II was opened last spring, adding berths for four ships and almost two million cubic feet of covered cargo stocking space. Soon the Federal Government will be turning over the new area to the west, adding 26 acres to the harbour between Pier 12 and Parliament St.

The Toronto Harbour Commission is operating on the basis of keeping its planning three years ahead, its financing two years ahead and its building one year ahead of needs. There will be an aggressive policy to attract business. Its new trade development department already is contacting consignees and shippers to determine what further facilities and services will be required.

Indian Reserve on Path of Seaway

The United States government has asked Canada for permission to build a Seaway channel through Canadian territory. This curious reversal of last year's argument about where the main Seaway canals should be built in the International Section occurs at the northern end of Lake St. Clair, on the channel between Sarnia and Detroit.

This retractable Bailey bridge at Lock 19, just west of Cornwall, Ont., is designed to carry heavy construction equipment and machinery across the canal.

It is part of the plan being worked out in Washington for deepening all the upper lake channels so the 27 foot navigation may be continued right up to Lakehead ports. It would involve digging a new channel on the Canadian side of the border right through an Indian reservation.

The suggested channel would be shorter and much straighter. The major difficulty facing Canada is that it happens to cut right across the Indian reserve. The Indians now get handsome revenue by leasing their marshes to U.S. hunters. They also have good trapping grounds for muskrat. What Ottawa must decide are the terms and conditions of compensation payable by the U.S. if the work is authorized.

Canadian approval will also be required at later stages for considerable channel deepening and dredging elsewhere by the U.S. government where the channel location falls on Canada's side of the International Boundary.

"Keep Seaway Open to All", Urges London Times

Commenting on recent submissions to the Royal Commission on Coastal Shipping by T. R. McLagan for the shipbuilders and ship operators and by Harold Banks for the Canadian Seamen's Unions, asking that coastal routes be restricted to ships built and registered in Canada, the London Times in a recent editorial says:

The St. Lawrence Seaway will be of incalculable value to the Canadian economy. That value will be enhanced if Canada opens these new waterways to those whose traditions and natural talents will enable them to put them to good use, both in their own interests and in those of Canada. As Canada's economy burgeons it will be increasingly important to her that Britain, her best customer, should increase her earnings in Canada. British shipping circles, representing both owners and shipyards, have described any move to close the Seaway to outside interests as "regrettable discrimination". Submissions to this effect are being made to the Royal Commission in Canada.

Thirty-five Years Ago

Comment on the *JOURNAL* of October 1920

Sometimes it seems that we, as a group, are too little interested in the history of our profession, as compared, for example, with architects, all of whom are subjected to a good dose of the history of architecture as part of their undergraduate training. This means that we are not enough interested in the lives of our predecessors, for the history of any profession is made up of the experiences of those who practice it. But we must admit that engineers are reluctant to keep journals, at least in this generation, from which we might draw many of the data, important and irrelevant, which are the life blood of history.

Engineering History

There is the occasional engineer who did keep a written record of his professional life, however. Such a man was H. J. Cambie, M.E.I.C., whose "Reminiscences" are given pride of place in the *Journal* for October, 1920. Mr. Cambie was born in Ireland in 1836 and was therefore 84 years old when this article was written. He was brought up in an 800-year-old "castle," complete with ghosts and skeletons in the walls.

He and his family came to Toronto in 1852, via Philadelphia, New York, Albany, Buffalo, Chippawa and Queenston, travelling over the only railway then in operation in Upper Canada from Chippawa to Queenston. This road ran on strap rails spiked to wooden stringers and the motive power for its single-car trains was a horse.

Mr. Cambie was engaged in building the Windsor & Annapolis Ry., in Nova Scotia when the great "Saxby Tide" occurred. Saxby, a Greenwich astronomer, had calculated that on a certain day in October, 1869, the earth, the sun, the moon and Mars would "be in a straight line," which would cause a great tidal wave. Events happened as predicted; at the Wolfville end of the railway "the devastation was appalling." The roadbed, bridges, culverts, fences and dikes were swept away and hundreds of cattle were drowned.

In 1874 Mr. Cambie went to British Columbia and was engaged for the next four or five years in various railway surveys. One took him among the Chilcotin Indians, who in 1864 had massacred Waddington and his survey party of fifteen. Thanks largely to the good offices of Fr. Maréchal, a missionary priest, satisfactory relations were soon established with the Indians and Mr. Cambie was able to do the good father a favour, too. In his own words: "(The Indians) asked me if I believed in hell, as . . . described to them . . . by the priest. (He) had burned something in a . . . plate, which I afterwards found to be brandy, and as it was in a brilliant sun, they could not see the flame, though its burning power was good. I backed up (Fr. Maréchal's) description and gave them a similar exhibition, to their . . . satisfaction."

From 1879 to his retirement in 1903 Mr. Cambie was in the service of the Canadian Pacific Ry., first during its construction and then as engineer of the Pacific Division. He ran some of the surveys for the railway along the Fraser river. The Admiralty had reported to the railway's chief engineer, Sir Sanford Fleming, that there was no use in considering any Burrard inlet or Fraser river port as a terminus, because it would be quite impossible to reach any of them from the interior by railway. Naturally, Mr. Cambie was pleased when the railway reached Port Moody and was later extended to Coal Harbour, now Vancouver. Of the latter extension, Mr. Cambie said: "It was . . . gratifying to me, whose opinion as to this harbour and route had been treated slightingly by . . . the admiral on the station, that I should have charge of (this) extension of the line and the building of the . . . wharves and terminals."

A second paper with an historic flavour was "The Development of the Steam Engine in the Maritime Provinces . . . ", by D. W. Robb, M.E.I.C. It comes as something of a surprise to learn that from 1840 to 1890 there was a substantial engine building business in Nova Scotia and New Brunswick, largely in marine engines, which were even exported to Great Britain, Europe, the West Indies and South America. Mr. Robb said . . . " . . . Steam engines will continue to be built . . . for some time to come or until . . . (there is) something better or more efficient and economical."

A. S. Dawson, M.E.I.C., chief engineer, Department of Natural Resources, Canadian Pacific Ry., had a thoughtful and exhaustive paper on "Concrete in Alkali Soils . . ." in this *Journal*, a valuable contribution to the literature. This paper elicited a good deal of lively discussion.

Salaries

This *Journal* published Engineering Council's schedule of remuneration, recommended by the Institute's committee on that subject. Suggested minimum salaries ranged from $8,100 a year for chief engineer down to $1,080 a year for a junior aid. Council tentatively accepted this scale and ordered its own committee to prepare a schedule of fees for consulting engineers, which it had not done.

A newsy account of September's annual meeting occupied a large part of this *Journal*. The much talked of indoor baseball game between the Niagara Peninsula and Toronto Branches took place as planned, Toronto winning, 9 to 3. The only player whose name means anything to this writer was Grant R. Jack, M.E.I.C., now chairman of the Public Utilities Commission of Newfoundland; he is said to have made a "good left fielder." Registration at the meeting was 254 plus ladies and guests.

A note said that electrification of the Montreal harbour railway had recently been partly completed and that some sections were in service. We understand that electric operation was abandoned as too expensive; perhaps the introduction of diesel locomotives has something to do with this decision.

The Niagara Peninsula Branch lamented that its members "feel as if they were out of a job. The (seventh annual) professional meeting has gone off with a bang . . . Committee meetings of exasperating frequency and extending into the late hours are . . . forgotten . . . and only the . . . convivial evenings of the meeting have a place in our memories; at least, most of us remember them distinctly . . ."

This *Journal* had little room for news notes and personals, but the employment section and the mem-

bers' exchange were going strong. "Situations Vacant" and "Situations Wanted" were about evenly balanced. Salaries seem to have been somewhat on the upgrade.

The death of Dr. W. H. Ellis, M.E.I.C., was announced. Readers may recall that the Toronto Branch had honoured Dr. Ellis only a short time previously by presenting him with a gold badge of the Institute when he retired from the deanship of the University of Toronto's faculty of applied science and engineering.

Personals

People mentioned in the few personals were, among others, Donald Ross-Ross, now with the Howard Smith Paper Mills in Cornwall and always active in the affairs of the local branch; R. N. Coke, now chief engineer of the operating division of the Quebec Hydro-Electric Commission in Montreal; W. C. MacDonald, now with the Rayner Construction Company at Leaside, Ont.; A. W. G. Clark, now president of the British Columbia Concrete Co. in Vancouver; V. J. Melsted, now with the Reynolds Metal Co. at Sheffield, Ala.; I. M. Fraser, who is dean of engineering at the University of Saskatchewan; Edmund Grummitt, retired and living in St. Catharines; R. L. Weldon, now president of the Bathurst Power & Paper Co.; C. R. B. Macdonald, who is general manager of John Howard & Co. (Africa) Ltd. Northern Rhodesia; and C. E. Fowler, still living in New York, presumably retired. Few of these names mean anything to the writer, but this month he ran down everybody mentioned in the personals and still a member of the Institute, just to see how many are still with us. The score is 10 out of 26. Engineers seem to be a durable lot to have 40 per cent of them, or perhaps better, surviving after 35 years.

Elections and Transfers

At the meeting of Council held at Charlottetown, P.E.I., on Saturday, September 17th, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

J. Atkinson, *Ottawa*
C. C. Cheng, *Hong Kong*
E. R. Eberhard, *St. Johns, Que.*
S. Gramlewicz, *Montreal*
F. C. Hooper, *Toronto*
A. W. Jeckell, *Toronto*
A. C. M. Kerr, *Levis, Que.*
E. B. Lusby, *Toronto*
M. A. J. Matich, *Toronto*
O. Mooney, *London, Eng.*
F. H. Paulson, *Providence, R.I.*
W. H. Perrott, *Montreal*
R. J. Pryor, *Montreal*
J. W. Stachiewicz, *Montreal*
M. E. Venn, *Montreal*
D. G. Watt, *Toronto*
M. Wodzianski, *St. Catharines*
W. Wright, *Montreal*
F. W. Young, *Montreal*

Juniors:

E. L. Fowler, *Montreal*
N. C. Lind, *Montreal*
R. Mascolo, *New York*
J. C. Nicholls, *Kingston*

Transferred from the class of Junior to that of Member:

R. H. Carlyle, *Calgary*
T. H. Shillingford, *Dominica, B.W.I.*

Transferred from the class of Student to that of Junior:

C. E. Rochette, *La Malbaie, Que.*

The following Students were admitted:

H. Garfinkle, *McGill University*
J. D. Guiry, *B.Sc. Civil Univ. of Detroit 1955*
J. P. Vince, *B.A.Sc. Toronto 1955*
A. Zesbutek, *B.A.Sc. Toronto 1955*

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members:

E. G. Jones — K. Wiedner
C. G. Michie

Junior to Member:

I. G. Finlay — E. Rapp
R. F. Murfitt

Student to Junior:

J. H. Daniels

MANITOBA

Members:

C. M. Ioakimidis — G. Pietuchow

Junior to Member:

G. C. Booth

NOVA SCOTIA

Junior to Member:

C. H. Morris

NEW BRUNSWICK

Member:

D. C. Riley

Junior to Member:

P. J. Delicaet

Training Construction Technicians

A good many, probably the majority, of our construction firms are managed by engineers; see, for example, the roster of officers of the Canadian Construction Association, where ten out of twenty are members of the Institute. But for every top engineering executive in any contracting organization, there must be many in less responsible positions — superintendents and foremen, for example — and as a foundation to the structure, enough skilful tradesmen to carry out the company's work.

Most engineers in construction now come from the engineering faculties of the universities; if they show any signs of managerial ability they soon find themselves out of pure engineering and into administration. Superintendents and foremen usually come up from the ranks of the tradesmen, though in the larger concerns, where responsibilities are great and salaries correspondingly rewarding, it is not too uncommon to find superintendents who are engineering graduates and quite happy in their jobs.

Today a good many tradesmen enter the construction industry through the provincial apprenticeship schemes. Local groups of the C.C.A. have done much to help the provincial authorities to make their training as effective as possible, not only by advising when requested, but also by promoting the schemes among employers, by helping to recruit likely young candidates for the courses, by acting as general publicity agents and so forth.

The C.C.A.'s apprenticeship committee, with a representative from

Joint Action in Alberta

The membership of a joint finance committee of the Association of Professional Engineers of Alberta and the Engineering Institute of Canada has been announced.

Chairman of the Alberta committee studying financial aspects of Confederation is H. B. LeBourveau, M.E.I.C., of Calgary. Members of the committee representing the Association are: J. F. McDougall, M.E.I.C., Edmonton, and R. C. McPherson, M.E.I.C., Calgary; and representing the Institute, J. J. Hanna, M.E.I.C., Calgary, and J. A. Webb, M.E.I.C., Calgary.

each province, acts as a liaison group among the Association, the provincial officials and the local groups. It has already abundantly proved its value.

But the C.C.A. apparently feels that some of its members are still not too well informed regarding our apprenticeship schemes and perhaps that some are not as favourably disposed toward them as might be, so it has started to issue *Training Topics*, a few mimeographed, letter-size sheets, the contents of which are designed to keep the rank and file of its membership informed as to what is going on in the apprenticeship world.

It seems an appropriate time for such a venture. The pay scales of tradesmen of all kinds being what they are and trending upward, many a boy now thinks more favourably of learning a trade than he used to, when most youths, if not university material or for some reason denied university training, at least aspired to a white-collar job. A good scheme of apprenticeship training may also be a real help to the universities in that it may attract some of those who do not belong in academic halls, but whom it now seems impossible to debar.

The ASME Boiler Code

Interpretations

The Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in *Mechanical Engineering*.

The following revisions were formulated at the meeting of June 23, 1955.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N.Y.

Power Boilers, 1952

Par. P-310(b). May, 1955 issue of *Mechanical Engineering* and *Engineering Journal*, revise the working pressure to read "40 psi" instead of "50 psi".

Par. P-24, P-25, P-299, P-308, P-310 and P-311 and Table P-15 (6th Revision) Suggested revision regarding 1.25 factor on boiler feed and blow-off piping, valves and fittings.

Item 1. Revise Par. P-24(1) as follows:

For piping from the boiler to and including the required stop valve and the check valve, the value of P shall exceed the maximum allowable working pressure of the boiler by either 25% or 225 psi whichever is less. For an installation with an integral economizer, without valves between the boiler and economizer, this paragraph shall apply only to the piping from the economizer inlet header to and including the required stop valve and the check valve.

Item 2. P-24(2) Unchanged.

Item 3. Revise Par. P-24(3) as follows:

The S value used shall not exceed that permitted for a temperature corresponding to the temperature of saturated steam at the maximum allowable working pressure of the boiler.

Item 4. Revise Par. P-24(4) as follows:

The value of P in the formula shall not be taken at less than 100 for any condition of service or material, and shall never be less than the pressure required to feed the boiler.

Item 5. Revise P-24 (3rd paragraph) by deletion of "or 80".

Item 6. Revise Par. P-25 as follows:

Blow-Off Piping. The blow-off piping shall conform to the requirements of Pars. P-9 and P-300, except that galvanized wrought iron or steel, brass or copper pipe shall not be used.

The minimum thickness of all blow-off piping between the boiler, and the valve or valves required by Par. P-311 shall be determined by the formulas in Par. P-23, but with values of P and S as defined below.

(1) The value of P shall exceed the maximum allowable working pressure of the boiler by either 25% or 225 psi whichever is less. The value of P shall not be less than 100 psi in any case. The thickness shall not be less than listed for Schedule 80 pipe.

(2) The value of S shall not exceed that permitted for a temperature corresponding to the temperature of saturated steam at the maximum allowable working pressure of the boiler.

Item 7. Revise Par. P-299(c) (2nd paragraph) as follows:

Valves and fittings made of any material permitted by this section of the Code for primary service pressure ratings of 100 lbs. or more and marked as required by the Code may be used for saturated steam service up to their adjusted pressure-temperature ratings except that in no case shall they be used for temperatures exceeding those shown for stresses in Tables P-6 and P-7, or permitted by Par. P-12, for the materials used.

Item 8. Par. P-299(d) (1st paragraph) as follows:

All valves and fittings on all feed

Table P-15 Maximum Boiler Pressure for Use of American Standard Carbon Steel Pipe Flanges, Fittings and Valves.

Primary Service Pressure Rating	Type of Flange Facing[3]	Maximum Allowable Boiler Pressure, psig Except as Noted: Steam Service at Saturation Temperature[1]	Maximum Allowable Boiler Pressure, psig Except as Noted: Boiler Feed and Blowoff Line Service[2]
150	Class A	190	160
	Class B	180	150
300	Class A	630	515
	Class B	510	415
400	Class A	820	665
	Class B	665	540
600	Class A	1160	970
	Class B	960	785
900	Class A	1640	1450
	Class B	1360	1170
1500	Class A	2500	2325
	Class B	2100	1910
2500	Class A	3206 psia	3206 psia
	Class B	3150	2975

1. Adjusted pressure ratings for steam service at saturation temperature corresponding to the pressure, derived from Tables 2 to 15, incl., of ASA B16.5-1953.

2. Pressures shown include the factor for boiler feed and blowoff line service, required by Pars. P-299(d) and P-310(c), CORRECTED FOR SATURATION TEMPERATURE CORRESPONDING TO THIS PRESSURE.

3. Class A ratings apply to welding ends, ring joints, small tongue-and-groove facing with any type of gasket, large tongue-and-groove facing with any type of gasket, except flat solid metal, and other facings with gaskets which result in no increase in bolt load or flange moment over those previously mentioned.

Class B ratings apply to all facings and gaskets not specifically listed under Class A.

water piping from the boiler to and including the first stop valve and the check valve (Par. P-317) shall be equal at least to the requirements of any standard accepted by this section of the Code for a pressure that shall exceed the maximum allowable working pressure of the boiler by either 25% or 225 psi whichever is less except as otherwise stated in (c) and for a temperature corresponding to the temperature of saturated steam at the maximum allowable working pressure of the boiler. In no case shall the pressure be less than the pressure required to feed the boiler. For an installation with an integral economizer, without valves between the boiler and economizer, this paragraph shall apply only to the valves and fittings from the economizer inlet header to and including the required stop valve and check valve.

Item 9. Revise P-299(d) (Last part of second paragraph as follows:

. . . . and for a temperature corresponding to the temperature of saturated steam at the maximum allowable working pressure of the boiler.

Item 10. Revise Par. P-299(d) (Last paragraph) as follows:

Except as limited by other paragraphs, valves and fittings made of any material permitted by this section of the Code for primary service pressure ratings of 125 lbs. or more and marked as required by the Code may be used for feed line and blow-off line service provided their adjusted pressure-temperature ratings exceed the maximum allowable working pressure of the boiler by 25% or 225 psi whichever is less. (See table P-15). In no case shall they be used for temperatures exceeding those shown for stresses in Tables P-6 and P-7, or permitted by Par. P-12 for the materials used.

Item 11. Revise Par. P-308(f) as follows:

All water walls and water screens which do not drain back into the boiler, and all integral economizers shall be equipped with drain or blowoff valves conforming to the requirements of this paragraph, and Pars. P-309 and P-311.

Item 12. Revise Par. P-310(c) as follows:

In all cases the valves and fittings from the boiler to and including the required stop valves shall be equal at least to the requirements of the American Standards given in Tables A-5 to A-8 and A-11 for a pressure that shall exceed the maximum allowable working pressure of the boiler, by either 25% or 225 psi, whichever is less, (see table P-15) and for a temperature corresponding to the temperature of saturated steam at the maximum allowable working pressure of the boiler, except that for pressures not exceeding 100 psi, the valves and fittings shall be equal at least to the requirements of the American Standards given in Tables A-7 and A-11 for 125 psi.

Item 13. Revise Par. P-311(a) (Delete Last Paragraph Covered by P-308(f).)

Table P-15 (see revision of Table)

Errata

Table P-7. August, 1955 issues of *Mechanical Engineering* and *The Engineering Journal*, revise the factor to read "0.85" instead of ".085" in the last line.

TABLE UNF-23. Maximum Allowable Stress Values for GS11A (6061) Products, in Pounds per Square Inch

ASME Specification	Alloy	Temper	Specified Minimum Tensile Strg. p.s.i.	Specified Minimum Yield Strg. p.s.i.	Notes	Maximum Allowable Stress Values For Metal Temperatures Not Exceeding Deg. F. 100	150	200	250	300	350	400
Sheet and Plate												
SB178	GS11A	T4	30,000	16,000	(5)	7,500	7,200	7,000	6,700	6,400	5,600	4,000
		T6	42,000	35,000	(5)	10,500	10,200	9,900	9,400	7,900	6,200	4,400
		T6 Welded	24,000*			6,000	5,900	5,700	5,400	5,000	4,200	3,200
SB178	Clad GS11A	T4	27,000	14,000	(5)	6,800	6,500	6,200	6,000	5,800	5,100	3,600
		T6	38,000	32,000	(5)	9,500	9,200	9,000	8,500	7,200	5,600	4,000
		T6 Welded	24,000*			6,000	5,900	5,700	5,400	5,000	4,200	3,200
SB178	Clad M11A	O	13,000	4,500		3,000	2,900	2,700	2,500	2,200	2,000	1,700
		H112	14,500	6,000	(1, 4)	3,600	3,200	3,000	2,800	2,500	2,200	1,900
		H12	16,000	11,000	(1)	4,000	3,800	3,600	3,400	3,100	2,800	2,500
		H14	19,000	16,000	(1)	4,800	4,600	4,400	4,200	3,800	3,400	2,900
SB178	Clad MG11A	O	22,000	8,000		5,300	5,300	5,300	5,200	4,400	3,700	3,000
		H112	22,000	8,500	(1)	5,500	5,500	5,500	5,200	4,400	3,700	3,000
		H32	27,000	20,000	(1)	6,800	6,800	6,800	6,300	5,600	4,900	4,100
		H34	31,000	24,000	(1)	7,800	7,800	7,700	7,200	6,300	5,400	4,600
Bars, Rods and Shapes												
SB273	GS11A	T6	38,000	35,000	(5)	9,500	9,200	9,000	8,500	7,200	5,600	4,000
		T6 Welded	24,000*			6,000	5,900	5,700	5,400	5,000	4,200	3,200
Bolting Materials												
SB211	GS11A	T6	42,000	35,000	(5)	8,400	8,200	7,900	7,500	6,300	4,900	3,300
		T6 Welded	24,000*			4,800	4,700	4,600	4,400	4,000	3,400	2,600
Pipe and Tube												
SB274	GS11A	T4	26,000	16,000	(5)	6,500	6,200	6,000	5,800	5,600	4,900	3,500
SB234 & SB274	GS11A	T6	38,000	35,000	(5)	9,500	9,200	9,000	8,500	7,200	5,600	4,000
		T6 Welded	24,000*			6,000	5,900	5,700	5,400	5,000	4,200	3,200
Forgings												
SB247	GS11A	T6	38,000	35,000	(5)	9,500	9,200	9,000	8,500	7,200	5,600	4,000
		T6 Welded	24,000*			6,000	5,900	5,700	5,400	5,000	4,200	3,200
Copper												
SB152	Plate sheet strip and bar, Annealed Phosphorus, Deoxidized.		30,000	10,000			6,700		6,300	5,000	3,800	2,500

*Strength of full-section tensile specimen required to qualify welding procedures. See paragraph QN6.

Notes:

(1) For welded construction stress values for O material shall be used.

(4) For nominal thicknesses not greater than 0.500 in. the stress values for H112 material may be used; for thicker material the values listed shall be used.

Low-Pressure Heating Boilers, 1952

Par. H-1(5) — delete the word "approved" in the third line.

Par. H-21 — last paragraph, last sentence, revise to read:

A welded joint in a flat surface shall be between two rows of stays which are not over one pitch apart.

Par. H-24—add a new subparagraph as (e) to read:

A boiler head may be stayed as a flat surface.

Par. H-41—delete

Par. H-94—delete

Par. H-61—revise the first sentence to read:

Each steam boiler shall have one or more water gage glasses attached to the water column or boiler by means of valved fittings, with the lower fitting provided with a drain valve of the straightway type with opening not less than $\frac{1}{4}$ inch diameter to facilitate cleaning.

Par. H-62—delete

Par. H-111—revise the first sentence to read: (as given in Par. H-61 above)

Par. H-115—delete

Unfired Pressure Vessels, 1952

Par. UCI-35(b) (3) — revise to read:

Flanges conforming to the American Standards for cast iron given in Appendix O may be used at the pressures and temperatures permitted in these standards. Other flanges may be designed in accordance with the provisions of Appendix II.

Alternatively, the allowable working pressure of cast-iron dished covers with bolting flanges, with or without nozzles or internal ribs, may be established in accordance with the provisions of Par. UCI-101.

Par. UCS-56(c) (3)—add the following to the end of the second sentence:

. . . . except as otherwise provided in (d).

Add the following new subparagraph (d) and reletter the present subparagraphs (d) (e) and (f) as (e), (f) and (g).

(d) Vessels fabricated of material conforming to SA-353 shall be heated as provided in (c) to a temperature between 1025 and 1085F. The vessel shall be held for a minimum of two hours for thicknesses up to 1 in. plus a minimum of 1 hour for each additional inch of thickness. The rate of cooling shall be as provided in (c).

Par. UCS-57 — delete "(See Par. UW-11)" at the end of Par. UCS-57 and add:

. . . . and for each butt-welded joint in vessels built of steel complying with specifications SA-353 and SA-357 for all plate thicknesses.

Table UNF-23 — Maximum Allowable Stress Values in Tension for Nonferrous Metals, revise as shown in table herewith, and add stress values for Copper SB-152 as shown.

Fig. UG-118 Form of Stamping—Substitute the words "maximum design pressure" for the present wording "maximum allowable design pressure" in the parenthetical explanations. Substitute the words "maximum design temperature" for the present wording "maximum allowable temperature" in the parenthetical explanations.

News of Other Societies

Canadian Aeronautical Institute (304 Laurier Ave. West, Ottawa 4) and the **Institute of the Aeronautical Sciences** . . . international meeting, Chateau Laurier, Ottawa, Ont., November 3 and 4, 1955. Nine technical papers by Canadian and American authors; the W. Rupert Turnbull lecture, by T. E. Stephenson; principal speaker at dinner November 3, The Right Honourable C. D. Howe.

●

Chemical Institute of Canada (18 Rideau St., Ottawa 2). . . . the sixth divisional conference of the Analytical Chemistry Division, the Guildwood Inn Motel, Sarnia, November 14 and 15, 1955. The theme: mass, infrared, ultraviolet, visible and flame spectrometry.

●

Canadian Construction Association (384 Bank Street, Ottawa 4, Ont.). . . . the annual meeting, Winnipeg, Man., January 15-18, 1956.

●

Institute of Power Engineers (410 Bloor St. E., Toronto), . . . Canada's power show, November 8-11, The Show Mart Building, Montreal. Concurrently with this exhibition of power equipment, the Institute of Power Engineers will hold the annual convention with headquarters at the Sheraton Mount Royal Hotel.

●

Associate Committee on Soil and Snow Mechanics (Division of Building Research, National Research Council, Ottawa) . . . the ninth Canadian soil mechanics conference, Vancouver, B.C., December 15 and 16, 1955, in association with the University of British Columbia. Information from A. Peebles, civil engineering, U.B.C., or W. J. Eden, secretary of the Associate Committee.

●

Canadian Institute of Timber Construction (160 Laurier Avenue W., Ottawa 4) . . . a research program established to determine effective use of building components to resist fire, with Hugh E. Thompson in charge of the project.

●

Engineers Joint Council (29 West 39th St., New York 18), . . . a nuclear congress and atomic exposition, December 12-17, 1955, in the public auditorium Cleveland. The congress represents the biggest single project yet undertaken by the combined engineering and scientific societies of the United States, the objective being to launch a continuing program of interchange of information on the developing applications of nuclear science.

●

Society of Automotive Engineers (29 West 39th St., New York 18) . . . the annual meeting, at the Sheraton Cadillac Hotel and Hotel Statler, Detroit, Michigan, January 9-13, 1956.

●

American Society of Mechanical Engineers (29 West 39th St., New York 18) . . . the diamond jubilee annual meeting and exposition of power and mechanical engineering, Chicago, November 13-18, 1955 The theme: "The Engineer and the World of Commerce and Industry".

●

Society for Experimental Stress Analysis, P.O. Box 168, Cambridge 39, Mass.) . . . the 1955 annual meeting, Hotel Sheraton, Chicago, Ill., November 16-18, 1955.

●

American Institute of Chemical Engineers (25 West 45th St., New York City) . . . the annual meeting November 27-30, 1955, the Statler Hotel Detroit, Mich.

●

Building Exhibition (Olympia, London) November 16-30, 1955. The 26th exhibition of progress in building methods, this year featuring Timber in Building.

●

Institute of Metals (4 Grosvenor Gardens, London S.W.1, England) . . . symposium on "The Mechanism of Phase Transformations in Metals", in London November 9, 1955.

●

Society of Naval Architects and Marine Engineers (74 Trinity Place New York 6) . . . the 63rd annual meeting, the Waldorf Astoria Hotel, New York City, November 9-12, 1955.

Correction

The section "Thirty-Five Years Ago" in the September, 1955, issue of the Journal (Page 1237), contained references to Dr. T. H. Hogg, M.E.I.C., and Mr. M. V. Sauer, M.E.I.C., giving an inaccurate report of their present activities. The following corrected information is recorded here and at the same time apologies are tendered to the gentlemen concerned:

Mr. Sauer, who had been serving as consulting engineer to the special projects branch of the Department of Transport, was appointed in November 1953 one of the Canadian members of the St. Lawrence River Joint Board of Engineers. He has his office at the St. Lawrence Seaway Authority headquarters in Montreal.

Dr. Hogg has been fully engaged for the past several years with his consulting practice as a hydraulic engineer in Toronto. He is advisor to several major hydro-electric authorities and companies. He is also director of numerous industrial and contracting companies.

NEWS OF THE ASSOCIATIONS & CORPORATION

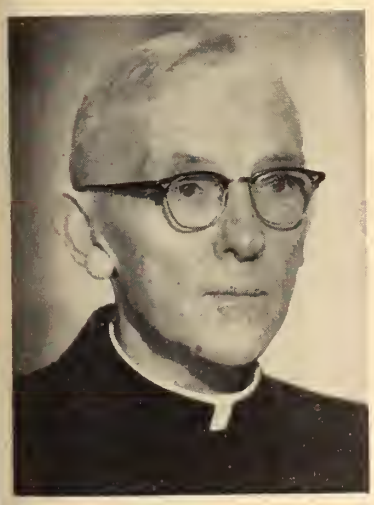
Information received through co-operation with the provincial organizations

Nova Scotia

Honorary Degree Granted

Rev. M. W. Burke-Gaffney, S.J., was recently honoured by the Nova Scotia Technical College with the award of a Doctor of Engineering degree.

Professor of engineering and head of the Department of Applied Mathematics of St. Mary's University in Halifax, Father Burke-Gaffney was born in Dublin. He was educated at Belvedere College and University College there and received his degree in civil engineering from the National University of Ireland in 1917.



Rev. M. W. Burke-Gaffney, S.J.

After his arrival in Canada he undertook classical studies in Guelph and Montreal. From 1928 until 1933 he was engaged in theological studies in Dublin and Amiens, France; and in 1933 he undertook post-graduate work in astronomy at Georgetown University, Washington, obtaining his Ph.D. degree in 1935.

During World War II Father Burke-Gaffney was connected with the War Office (London) and at the conclusion of the war was associated for two years with the Air Ministry. He was appointed assistant bridge engineer by the Manitoba Highway Commission in 1920.

After teaching chemistry and astronomy at Campion College, Regina from 1926 until 1928, and serving as examiner in these subjects for the University of Manitoba, he was later ordained as a priest in 1930. From 1935 until 1940 he taught astronomy at the Jesuit Seminary in Toronto, served as acting director of the Georgetown University Observatory during the summers of 1936 and 1937, and taught astronomy and mathematics at St. Paul College in Winnipeg, acting at the same time on examining committees in astronomy and mathematics of the University of Manitoba.

In 1940 he was appointed dean of engineering of St. Mary's University in Halifax, serving in this capacity until 1948 when he was named professor of engineering and head of the Department of Applied Mathematics.

Father Burke-Gaffney was elected in 1950 a member of the International Academy of the History of Science. From 1940 until 1947 he was a member of the Board of Governors of the Nova Scotia Technical College, and during 1947-48 served on the Senate of the College.

He is honorary president of the Halifax Centre of the Royal Astronomical Society of which he is a life member, and a member of the National Council of the Royal Astronomical Society of Canada. He is a charter member of the Renaissance Society of America and a member of the Association of Professional Engineers of Nova Scotia, the Canadian Mathematical Congress, and the Association for the Advancement of Science.

Father Burke-Gaffney is the author of *Kepler and the Jesuits*, an introduction to Kepler and the astronomy of Kepler's time. Articles by him have also appeared in *The Scientific Monthly, Isis, Studies* and *Traditio*.

Uniform Examination Syllabus

The Council of the Association reports the adoption of the Uniform Examination Syllabus, approved by the Dominion Council and already approved by a number of the other provincial associations.

This new syllabus represents a radical change from the syllabus formerly in use by the Nova Scotia Association. Now, an applicant who is required to sit for a complete examination will write fourteen papers, whereas, under the former syllabus, only four examinations were required.

The effective date for the new syllabus is May 26, 1955 and all candidates applying for examination after this date will be required to write examinations as outlined in the Uniform Syllabus. Those candidates presently in progress of study toward the present examinations of the Association will be allowed to complete their exams under the present system.

Engineer-Architects' Liaison Committee

Some years ago there was an active committee of representatives from the engineering and architecture associations which met periodically to discuss co-operative measures to be taken by each of these two professional organizations in problems of mutual interest. Recently this committee has not been active but steps are now being taken by the executive officers of each association to make this a working committee.

There has always been understanding and co-operation between the members and councils of these two professional associations in Nova Scotia. It is sincerely hoped that this liaison committee will continue to foster the proper professional relations between these two associations.

Schedule of Fees for Professional Engineering Services

In 1946 the Council of the Association recommended a schedule of fees for professional engineering services and has printed this schedule in its annual year book. Since that time various provincial engineering associations have approved similar schedules and others have amended their schedules of that date. The Dominion Council has been studying the possibility of a uniform schedule for adoption by all the provincial associations.

A special committee for the Nova Scotia Council has been studying this matter for some time and recently its report was approved by the executive committee of the Council.

The report proposed a schedule very similar to the one now used by the Associations in Ontario and Quebec. It further recommended that Dominion Council urge all member associations to adopt a uniform schedule and publish it under the seals of all associations, similar to the schedule of minimum salaries. The report urged publication of the new schedule by the Association for immediate use by the members concerned.

Engineers' Wives Club

1955 will be remembered as the year of organization of the Engineers' Wives Club of the Halifax area. Three business meetings were held during the year, each with an average attendance of 100, to discuss organization, membership and

future social activities. A short entertainment period followed each meeting.

The ladies entertained their husbands at a delightful spring dance at the Med-O-Club, just outside Halifax. About eighty couples attended and the ladies reported a profit from this venture.

In early September the Club entertained over 100 of their members at a buffet luncheon at the summer home of Mrs. Ira P. Macnab, at Seabright on Saint Margaret's Bay.

The Club is now planning a tea for the wives of the Institute's presidential party dance during the president's visit to the Halifax Branch. The tea will be held in the Citadel Tea Room, atop historic Citadel Hill.

Special Financial Committee

J. R. Kaye, Dr. A. E. Cameron and **L. D. Hopkins,** all past-presidents of the Nova Scotia Association were recently appointed by Council as a special committee to study the possible uses of the Association's cash reserves.

This question was raised from the floor at the last annual meeting of the Association and many suggestions were proposed to bring into active use the Association's reserves.

This committee, with Mr. Kaye as chairman, will report at the next annual meeting.

Random Jottings

John E. Clarke, immediate past-president of the Association, was elected vice-president of Dominion Council for the coming year.

The A.P.E.N.S. has taken out corporate membership in the Atlantic Provinces' Economic Council. **O. Nelson Mann,** a member of the Association, recently resigned his position of Administrator in the Provincial Department of Trade and Industry to become secretary-manager of this new Council.

Some of the members of the executive of the Halifax Engineers' Wives Cl are pictured here. Left to right, Mrs. O. Nelson Mann; Mrs. John R. Ka (president); Mrs. D. E. Sawyer (treasurer); Mrs. Gordon Dunphy (secretary Mrs. B. A. O'Leary (entertainment chairman); Mrs. O. K. Smith (2nd vic president); and Mrs. W. O. Sorby (1st vice-president).

Other members of the executive not shown here are Mrs. J. D. Kline and Mr A. J. E. Smith (Refreshment Committee); Mrs. D. C. Johnson (Publicity Con mittee); Mrs. E. L. Cameron (Membership Committee); and Mrs. C. P. Flem ming (Entertainment Committee).

Quebec

Plan of Action for 1955

(Excerpt from C.P.E.Q. Bulletin, July, 1955.)

1. Continue and intensify the studies undertaken last year of the basic principles which should govern the practice of engineering and establish as early as possible a philosophy of the profession which will provide a sound basis for future action.

2. Enforce strictly the provisions of the Professional Engineers' Act regarding the illegal practice of the profession and the illegal use of the titles reserved to members of the Corporation.

3. Enforce more strictly all the provisions of the Code of Ethics in order to raise to the highest possible level the ethical standards of the profession.

4. Endeavour to reach satisfactory agreements with the architects and other professional associations regarding the fields, rights and privileges of each.

5. Complete proposed revisions to our Code of Ethics, particularly with a view to clarifying and strengthening the sections dealing with relations between the engineer and clients or employers.

6. Intensify our studies and adopt a program of action in connection with the professional training of engineering students and young engineers.

7. Implement a broad program of counselling and guidance to attract to our engineering faculties an adequate number of students well suited for an engineering career.

8. Continue the preparation of necessary amendments to the Professional Engineers' Act so as to clearly establish the rights and privileges of professional engineers in all fields in which they are qualified to practice, and to eliminate unnecessary interference or limitations in their practice.

9. Further consolidate the profession by implementing a broad policy of regional and local group organization, revising the composition of Council, if found advisable, and intensifying the membership campaign.

10. Revise and bring up to date the recommended Schedule of Minimum Salaries. Obtain the authority to issue a new Schedule of Fees, and enforce its use.

11. Co-operate to the fullest possible extent with the other engineering bodies in Canada to achieve a greater degree of unity and, for this purpose, give most careful consideration to the plan for confederation which will be submitted in the near future.

12. Continue the program of public relations.

13. Undertake a broad study of the numerous problems relative to the engineer in industry.

14. Establish a committee to study the problems of the engineers in consulting practice and to recommend ways and means of solving these problems.

G. Lorne Wiggs, P.Eng.,
President

Ontario

News of Members

Announcement has been made by **A. Ward** and **Frank B. Ham,** of th new partnership in the business of t Durham Construction Co. Ltd., and al the formation of their new company, A. Ward and Associates, consulting e gineers, in Port Hope.

Frank B. Ham is a graduate in ci engineering of the University of Toron and served with the R.C.N. during Wo War II. He began his engineering care with the Consumer Gas Company Toronto, and later was with the Found tion Engineering Company of Cana Ltd. Prior to entering into the partn ship of Durham Construction Co., a A. A. Ward and Associates, he was to engineer of Port Hope.

Mr. Ward is a native of Ottawa a a graduate in civil engineering of Quee University, Kingston. During the l World War he served overseas with t Royal Canadian Signals. Mr. War engineering career began with the O tario Department of Highways wi which he was assistant to the munici engineer.

Huber R. Sills, supervisor of design e gineering a-c. machines at the Pet borough works of Canadian Gene Electric Co. Ltd., has been made a F low of the American Institute of El trical Engineers. This honour comes Mr. Sills after some 35 years' memb ship in A.I.E.E. and in acknowled ment of outstanding work in synchr

ous machinery. He is recognized as one of the leading authorities on the design of waterwheel-driven vertical shaft generators and large synchronous condensers.

Mr. Sill was born in Kingston, Ont., and graduated in electrical engineering from Queen's University in 1921. He joined the C.G.E. Test Course in 1922 and was assigned to design engineering with the a-c- group. Since 1945 he has served in a supervisory capacity. His reputation is world-wide and he is currently Canadian representative on the generator committee of Conférence Internationale des Grands Réseaux Electriques of Paris, France. Since 1947 he has also been active in municipal affairs in Peterborough and is a member of the City Planning Board, of which he was chairman in 1953-54.

Lieut.-Col. A. W. Y. DesBrisay has recently retired from the Royal Canadian Corps of Signals, Canadian Army, and has joined the staff of Domac Technical Sales Ltd., 1950 Bank Street, Ottawa, in the capacity of technical sales engineer. Col. DesBrisay will also be acting for an affiliated company, Northern Radio Manufacturing Co. Ltd., at the same address.

Col. DesBrisay is a graduate in electrical engineering of McGill University and later obtained the degree of Ph.D. in communications engineering from the University of London, England. He joined the Royal Canadian Signals in 1931. Latterly he has been the deputy superintendent, Canadian Signals Research and Development Establishment, Department of National Defence, Ottawa.

At Orenda Engines

For the summer months eight professional engineers on the teaching staff of Canadian universities have been associated with Orenda Engine Ltd., Malton, Ont. All were engaged in the several sections of the company's experimental and engineering department.

They were **Professors P. B. Hughes, I. W. Smith, R. J. Waines** and **F. C. Hopper,** of the Department of Mechanical Engineering, University of Toronto; **Professor W. G. Stinson,** Department of Engineering Drawing, University of Toronto; **Professor A. Kravetz,** Department of Electrical Engineering, University of Toronto; and **Professor F. M. Wood,** Department of Mathematics, Queen's University.

In the company's magazine appears the following comment: "The presence here of all of them is mutually advantageous. The company gets the benefits of their specialized talents and they get the opportunity of maintaining their first-hand contact with industry."

Professors Hughes, Smith and Stinson are at Orenda for their second summer.

D. P. Lazarevich is continuing his consulting practice under the name of Dusan Lazarevich & Associates, 332 Glenholme Avenue, Toronto. The earlier partnership with M. A. Konforti, which operated under the name of Tesla Technical Company has been dissolved. Dusan Lazarevich and Associates offer a complete line of professional engineering services.

Robert F. Legget, director of the division of Building Research, National Research Council, Ottawa, has been elected as the Canadian member of the Council of The Institution of Civil Engineers, whose headquarters are in London, England. Mr. Legget succeeds Edgar A. Cross, Toronto consulting engineer in this post of Canadian councillor.

Dr. Tyrrell Honoured

At the Annual General Meeting of The Institution of Mining and Metallurgy, held in London, England on May 26 last, an award of honorary membership was made *in absentia* to **Dr. Joseph Burr Tyrrell,** of Toronto. Dr. Tyrrell was elected a member of the Institution in 1900. Mr. R. P. Brown, of the Office of the High Commissioner for Canada in London, accepted the certificate of honorary membership on Dr. Tyrrell's behalf.

During the presentation, the president of the Institution, Brig. R. S. G. Stokes, read a letter from Dr. Tyrrell which, in part, was as follows:

"Since my first assignment (of exploring and developing mineral resources of Canada) in 1883, it has been a great privilege for me to be so closely associated with Canada's immense development of her mineral resources, and although I have now grown old in my work — being in my 97th year — I am optimistic enough to believe that she still has a wonderful future, not only with her minerals, but with her many other natural and industrial resources."

In his remarks Brig. Stokes recalled that Dr. Tyrrell has, during the present century, received many academic awards including the Wollaston and Murchison Medals of the Geological Society of London and the Professional Engineers Gold Medal awarded by the Association of Professional Engineers of the Province of Ontario in 1954.

C. A. Norris, chief engineer of International Resistance Co. Ltd., Toronto, is general chairman of the Convention Committee of the Canadian Institute of Radio Engineers Convention, taking place in Toronto in October, 1956. This will comprise technical sessions and upwards of 200 exhibits related to the electronics field. It will take place in the new ultra modern building to be erected at the Canadian National Exhibition which will contain an auditorium, theatre, committee rooms and restaurant facilities.

Other committee chairmen named for this convention include **E. O. Swan,** Ernie Swan Television Co. Ltd., Toronto, exhibits and registration; **R. C. Poulter,** Radio College of Canada, Toronto, advertising, publicity and program; and **Dr. George Sinclair,** University of Toronto, technical program.

John Sylvester has moved to Cornwall, Ont., where he is employed by the St. Lawrence River Joint Board of Engineers,, Canadian Section, in the hydraulics department.

Prior to moving to Cornwall Mr. Sylvester was with the engineering department of Spruce Falls Power & Paper Co. Ltd., at Kapuskasing, Ont.

Brown Company President

Earlier this summer **A. F. Harold Fair** was elected to the office of president of Brown Company, Berlin, N.H. His office is located at 150 Causeway Street, Boston. Prior to leaving Toronto in October of 1954, to join Brown Company as executive vice-president, he was president of Alliance Paper Mills Ltd., and Don Valley Paper Company, Toronto.

A graduate of Royal Military College and of the University of Toronto in chemical engineering, 1922, Mr. Fair has been associated with the paper industry for over 30 years. From 1930 to 1939 he was manager of the Merritton division of Alliance Paper Mills Ltd., and for the next six years was manager of the Cornwall division of Howard Smith Paper Mills, Ltd. In 1945 he was made vice-president of Alliance Paper Mills and Don Valley Paper. The next year he was made president of these companies and a director of Howard Smith Paper Mills. In 1954 he moved to the States to join the Brown Company.

J. S. L. King, until recently president of King Coons Ltd., has severed his connection with that firm and has opened private consulting offices at 1216 Yonge Street, Toronto, where he will continue to undertake commissions in the field of municipal engineering, industrial development and land development.

Roy A. Saari is division engineer on automation for the Sparks-Withington Company's automotive plant in Jackson, Mich. A graduate in electrical engineering of the University of Manitoba, 1946, Mr. Saari was earlier with Commonwealth Associates, Inc., also of Jackson, Mich.

Earlier this year **William A. V. Irwin** assumed the responsibilities of chief engineer of Black-Clawson (Canada) Ltd., and is located in the Dominion Square Building, Montreal.

Mr. Irwin, who graduated from Queen's University in 1943, was previously on the engineering staff of The Alexander Fleck Ltd., in Ottawa.

W. A. Trotter who has been with the City of Kingston as deputy city engineer, has accepted a position with the Township of East York as assistant commissioner of works. He is located at the East York Township municipal offices, Mortimer and Coxwell Sts., Toronto.

Mr. Trotter is a graduate of Queen's University, Kingston, and joined that city's engineering staff early in 1950.

It has been announced by **Norman G. McDonald, John W. Argo,** and **John G. Powell,** that the consulting engineering practice of Gore & Storrie of Toronto, will be continued under the name of Gore & Storrie Limited. The offices will continue at 1130 Bay Street, Toronto. This change follows the recent death of the other director, **William Storrie.**

D. C. Symes is employed by the Anglo-Canadian Pulp & Paper Mills, and is now located in Sillery, Quebec City. Before moving to Quebec, Mr. Symes was employed at Ontario Paper Co. Ltd. in Thorold, Ont.

D. E. Jones has moved from Toronto to Baltimore, and has accepted a position with the Westinghouse Electric Corporation there. Previously he was employed in research work with the Hydro-Electric Power Commission of Ontario.

E. O. Lafontaine has accepted a position as civil engineer with **C. G. Russell Armstrong,** consultant and land surveyor in Windsor, Ont.

Mr. Lafontaine, who is a graduate in civil engineering of the University of Toronto, was formerly employed as

township engineer of the Township of Atikokan, Ont.

A. T. Cairncross has recently resigned from the staff of Aluminum Company of Canada Ltd., after nearly 15 years of service, and is managing and operating the Armstrong Foundry and Machine Shop of Orangeville, Ont., having purchased this business earlier in the year.

At the International Conference on Lighthouses and other Aids to Navigation, which took place recently in Scheveningen, Holland, there was presented a paper on "A System for Remote Control of Fog-Alarm Stations" which had been prepared by **F. R. Park.** Mr. Park is with the engineering staff of the National Research Council in Ottawa.

Arthur M. Toye has succeeded the late **Harry N. Lamont** as bridge design engineer of the Ontario Department of Highways. His appointment was recently announced by **M. A. Elson,** deputy minister of the Department.

Mr. Toye, who graduated in engineering from the University of Toronto in 1925, joined the Ontario Highways in 1931. In 1954 he was appointed assistant chief bridge engineer. During the war years he served in Ottawa as inspecting officer for the Inspection Board of the United Kingdom and Canada. He returned to his former duties as design engineer with the Highway Department in late 1946.

Water Resources Committee

Two members of the Association have been named by the Hon. Leslie M. Frost, Premier of Ontario, to the five-man Ontario Water Resources and Supply Committee. They are **A. Melville Snider,** vice-president and general manager of Sunshine-Waterloo Co. Ltd., Waterloo, and **James A. Vance,** of Woodstock.

Mr. Snider is chairman of the new committee which also includes **B. L. Bedford,** Chatham; **W. D. Conklin,** Kingsville, and **Dr. C. H. Reason** of London. Mr. Snider is a mechanical engineering graduate of Toronto University '17 and has long taken a deep interest in water supply problems. At present he is also chairman of the Water Resources Committee of South Western Ontario.

Mr. Vance is a graduate in civil engineering of Toronto University '15 and is widely known as a contractor and industrialist. In 1953 he was president of the Engineering Institute of Canada and like Mr. Snider, has been active in public service, particularly in conservation matters.

The duties of the Committee, in brief, are to study water supply needs in Ontario, with particular reference to the southwestern area, and to ascertain means, probable costs and necessary legislation to provide water to municipalities, industries, agriculture and other uses in the areas concerned.

Life Membership Granted

A member of the Association of Professional Engineers of B.C. since its institution in 1920, **E. P. Herwood,** B.C.L.S., of Victoria has been made a life member of the organization.

Mr. Heywood was born in Dorchester, England, coming to Canada early in the century and graduating from McGill University in 1909 with the degree of B.Sc. in civil engineering.

Now a consulting engineer, he began his career as an engineer with Canadian Pacific Railway and in 1911 made preliminary surveys and plans for a dry dock at Esquimalt, B.C.

British Columbia

Engineers in the News

J. T. B. Williams has resigned from the position of plant engineer of Columbia Cellulose Co. Ltd. and has accepted the position of sales manager of Alexander Fleck Ltd. at Ottawa.

E. L. Bartlett has been promoted from assistant plant engineer of Columbia Cellulose Co. to plant engineer, the position left vacant by J. T. B. Williams. Mr. Bartlett joined Columbia Cellulose in 1951.

G. F. Winterburn has joined the Bay Company of Vancouver as a mechanical engineer and estimator. He had previously been with the Canadian Comstock Company.

C. W. Leek was elected president of the National Association of Master Plumbers and Heating Contractors of Canada at the national convention held recently at Marray Bay, Que. It is the first time in the Association's 15-year history that the son of a past president holds the presidency. The late Walter Leek held the post from 1945 to 1947. Mr. Leek is president of both Leek and Co. Ltd., Vancouver, and R. H. Ormond (1953) Ltd., Nanaimo, as well as being first vice-president of the Building and Construction Exchange of B.C.

N. A. De Lisle has left the employ of B.C. Power Commission and taken a new position with the B.C. Engineering Co. in Vancouver.

G. M. Nixon has joined the firm of Racey, MacCallum and Associates in their branch office in Vancouver. He was formerly local branch manager for J. H. Lock and Sons Ltd.

G. S. Sanders has been engaged as the city engineer at Trail on a six months' trial basis. Mr. Sanders has been at Golden, B.C., as a district engineer for the B.C. Department of Highways.

R. G. Mulcaster, B.C. Department of Highways, has taken over the position of district engineer at Golden; he previously held a similar position at Kamloops.

G. W. Walkey has taken a new position as superintendent with Heath Steel Mines Ltd., Newcastle, N.B. He was assistant general manager, Canadian Exploration Ltd., Salmo, B.C.

O. C. Edwards who was formerly a design engineer with Alaska Pine and Cellulose Ltd., has accepted a new position as project engineer with the Clayburn Company, effective October 15.

J. R. Wallis recently completed all requirements for his master's degree in forest engineering from Oregon State College and will be taking up permanent residence in West Vancouver.

J. F. M. Douglas has been transferred to the head office of the Consolidated Mining and Smelting Company in Montreal with the appointment of administrative assistant. Mr. Douglas, who has served the company as supervisor of budgetary control at Trail since 1952, will be taking up his new duties on September 1. J. E. McMynn will succeed Mr. Douglas as supervisor of budgetary control.

H. H. Baxter has left the employ of Vancouver Equipment Corporation Ltd. and has taken a new position with Ritchie Equipment Co. Ltd. of Vancouver.

R. O. Cutler has accepted a position with the Conveyair Company in North Vancouver. He was previously with Marwell Construction Co. Ltd.

H. M. Hunt has taken up residence in Victoria and assumed a position with the B.C. Power Commission. He had previously been with the B.C. Engineering Company in Vancouver.

R. H. Fenton has accepted a position as mechanical engineer with Kaiser Aluminum Corporation in Tacoma, Washington. He had previously been employed by Rosco Metal Products in Vancouver.

S. T. Fall, of Cobble Hill, B.C., who graduated from the University of British Columbia in electrical engineering this spring, was the first recipient of an annual fellowship established by the Northern Electric Company. The $1,200 award is for graduate study in the fields of electrical, mechanical, chemical engineering and engineering physics.

G. A. Wilson of Vancouver received the $600 undergraduate scholarship recently donated to the University of British Columbia by the West Coast Electronic Manufacturers' Association. Mr. Wilson, who has completed the first two years of engineering, will continue with electrical engineering at the university this fall.

E. G. Harrison has accepted the position of assistant district engineer, water rights branch, Department of Lands and Forests, Kelowna. He had been with Swan, Wooster and Partners since 1951.

J. B. Carswell has been appointed general manager of Canada House (New York) Ltd., and will divide his time between New York and Toronto, where he is engaged in private practice as a consulting engineer. Mr. Carswell was chairman of the Fraser River Dyking Board in 1948 and later was chairman of Kitimat Constructors.

J. C. Cant has accepted a position as area engineer with H. G. Acres and Co. Ltd. He will be working on dam construction in Vancouver. He was formerly with Canadian National Railways.

A. T. Kinnie who has been with the B.C. Power Commission, has accepted a position with P. R. Sandwell and Company of Vancouver.

R. E. Wells who has been with Canadian National Railways at Terrace, is now working with Associated Engineering Services Limited of Vancouver. He will remain at Terrace for a short while to work for his new employer.

D. H. Patrick has taken a new position as sales engineer with B. Greening Wire Company of Hamilton, Ont. He was formerly with American Fabricator Ltd. in Burnaby.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Alexander Joseph Grant, HON. M.E.I.C., past-president of the Institute and former engineer in charge of the Welland Ship Canal for the Department of Railways and Canals, died July 2, 1955 at St. Mary's Hospital in Montreal, Que.

Dr. Grant was born in Scotland on May 10, 1863, at Dufftown, Banffshire, and came to Canada in 1872. He was educated at the University of Ottawa and St. Mary's College, Montreal.

His professional career began in 1880 on a survey party for the Canadian Pacific Railway, west of Winnipeg. In 1883 he worked on the Baie des Chaleurs Railway, and in July 1886 he entered government service and joined the staff of the Department of Railways and Canals, working on the construction of the Cape Breton Railway. In 1891 he was transferred to the engineering staff of the Soulanges Canal, remaining as assistant engineer until the completion of the canal in 1903. His next appointments were engineer in charge of the improvements at Port Colborne and superintending engineer of the Trent Canal. In the latter position he was responsible for the construction of the Ontario-Rice Lake Division and the improvement of the navigation of the Severn river, work which had to be suspended in 1916 owing to war conditions. From January, 1919 to his retirement in 1934, Dr. Grant was engineer in charge of the construction of the Welland Ship Canal.

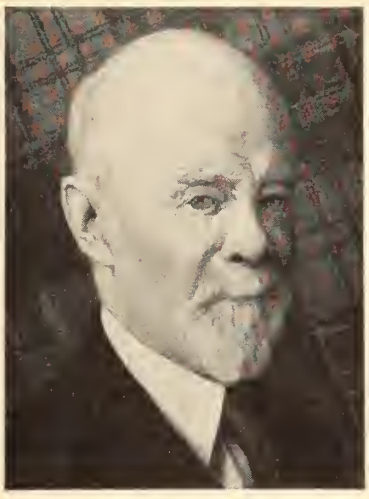
Dr. Grant joined the Engineering Institute before its change of name, having been elected an Associate Member in 1891 and a Member in 1901. He was made an Honorary Member in 1953. Dr. Grant was active in the formation of the Niagara Branch of the Institute in 1919. He served on Council as vice-president in 1928-1929, and was elected president of the Institute in 1930. He received both the Sir John Kennedy and the Julian C. Smith medals of the Institute for outstanding achievement in the engineering field.

Dr. Grant was awarded an honorary doctorate of Law in 1939 by Queen's University. He also was made a Knight Commander of St. Gregory—a pontifical decoration—in 1941.

Douglas Gould Anglin, M.E.I.C., president and managing director of Ross and Anglin Limited in Montreal, died in Montreal General Hospital on June 4, 1955.

Mr. Anglin was born in Kingston, Ont., on May 31, 1891. He graduated from Queen's University, obtaining a B.Sc. degree in 1911 in mining engineering and a B.Sc. degree in civil engineering in 1912. During the summers of his university course he was engaged in surveying work in northern Ontario and on the International Boundary around Detroit.

Following graduation he became assistant engineer in the Department of Public Works at Ottawa until 1915



A. J. Grant, Hon.M.E.I.C.

when he joined the Royal Canadian Artillery and served overseas as an officer until the end of the war. In 1920 he entered the firm of Anglin-Norcross in Montreal as assistant to the manager and subsequently became vice-president. Mr. Anglin left the company in 1946 and formed his own contracting firm of Ross and Anglin Limited, Montreal.

Mr. Anglin became a Student member of the Engineering Institute in 1912, transferring to Associate Member in 1920 and to Member in 1940. He attained Life Membership in 1955.

George C. Clarke, M.E.I.C., former vice-president in charge of engineering for Fraser-Brace Engineering Company Ltd. in New York, died on September 5, 1955 in New York City.

Born in Pittsburgh, Penn., on January 16, 1870, Mr. Clarke graduated from Pennsylvania State College in 1891 and returned in 1902 to obtain a civil engineering degree.

He entered the engineering department of the Pennsylvania Railroad in 1891 and rose to the position of engineer in charge of construction of the Pennsylvania terminals in Pittsburgh and New York City. Engineering projects carried out under Mr. Clarke's direction included the construction of Penn Station in New York, the access tunnels under the Hudson and East Rivers and the terminal yards; Union Station in Pittsburgh and a railroad bridge over the Monongahela River at Pittsburgh.

After completion of the New York Pennsylvania terminals, he resigned his position with the Pennsylvania Railroad and became a member of the firm of Fraser-Brace & Company in 1911. Mr. Clarke remained associated with this company until his retirement in 1945.

In Canada, Mr. Clarke was associated with Mr. Charles E. Fraser and Major James H. Brace in the construction of many hydro-electric and industrial projects, including metallurgical plants and smelters for the International Nickel Company of Canada at Copper Cliff and Port Colborne, Ont.; pulp and paper mills for the International Paper Company at Three Rivers and Temiskaming in Que.; the hydro-electric development for the Montreal Light Heat & Power Company at Cedar Rapids, Que., and other hydro-electric developments in Quebec, Ontario, Manitoba, Saskatchewan and Newfoundland; a dam and power-house at Fifteen Mile Falls, Vermont, for the New England Power Company; and LaQuiebra Railway Tunnel in Colombia, South America.

As vice-president in charge of engineering for Fraser-Brace Engineering Company, Limited, Mr. Clarke was well

G. C. Clarke, M.E.I.C.

known for his work on the design and construction of hydro-electric power plants, including a power-house for the

• Obituaries

International Nickel Company of Canada at Turbine, Ont.; hydro-electric power plants for the Gatineau Power Company at Chelsea and Farmers Rapids on the Gatineau River; and the hydro-electric power development on the Churchill River at Island Falls, Saskatchewan, for the Hudson Bay Mining & Smelting Company.

In addition to these Canadian projects, Mr. Clarke was actively engaged on many outstanding projects in the U.S.A., such as the construction of the Federal Shipyards at Kearney, N.J., in World War I and three large U.S. Government Ordnance Works during World War II at Weldon Springs, Mo., Keystone Ordnance Works at Meadville, Pa. and Holston Ordnance Works at Kingsport, Tenn.

Mr. Clarke was a life member of the American Society of Civil Engineers, a member of the Corporation of Professional Engineers of Quebec, and of the Engineers Club of New York.

He joined the Engineering Institute in 1914 as a Member and attained Life Membership in 1947.

Arthur L. Patterson, M.E.I.C., a vice-president of Shawinigan Engineering Company Ltd., died on July 28, 1955 at his home in Montreal following a lengthy illness.

Mr. Patterson was born in Montreal and received his early education at schools in Montreal and Lakefield, Ont. He graduated from McGill University in 1915 with a B.Sc. degree in mechanical engineering.

During World War I Mr. Patterson enlisted in the Canadian Field Artillery and in 1915 was commissioned in the 84th Battery, Lahore Division, Royal Field Artillery in France. He returned to Canada in 1919 as acting captain of his unit.

He joined the Shawinigan Engineering Company in 1919 at its inception, as a junior engineer. He became assistant office engineer and then office engineer in 1929. Mr. Patterson was named assistant chief engineer in 1947 and was chief engineer in 1951. He was appointed a vice-president of the firm in 1953. During his years of association with the company Mr. Patterson was responsible for the design of hydro-electric developments in Quebec and British Columbia.

He was a member of the Corporation of Professional Engineers of Quebec and of the Canadian Electrical Association.

Mr. Patterson joined the Engineering Institute as a Student in 1914, transferring to Associate Member in 1926 and to full Member in 1940.

Stewart Troop, M.E.I.C., mining engineer and pioneer of the Chibougamau and Noranda developments, died on August 21, 1955 in the Royal Victoria Hospital in Montreal following a lengthy illness.

He was born in Annapolis, N.S., on September 20, 1886. Mr. Troop studied engineering at Acadia University, leaving the college in 1907 to join the New Brunswick Southern Railway Company as draughtsman and instrumentman. The following year he was associated with the National Transcontinental

A. L. Patterson, M.E.I.C.

Railway and in 1912 he was resident engineer for the Canadian Northern Ontario Railway. From 1914 to 1918 Mr. Troop was in business for himself and at the same time held several temporary engineering positions. These included inspection for the Dominion Engineering & Inspection Company at Montreal; and inspection and production for the National Steel Car Company in Hamilton, Ont. In 1918 he joined the Royal Canadian Engineers, served as a lieutenant and was sent to the United States to supervise manufacture of special equipment for the American Electro Products Company (Munitions).

Mr. Troop was one of Canada's best known mining experts and had prospected and acted as mining engineer and mine manager in nearly all the major districts of Canada and at the time of his death had been managing director of MacDonald Mines Ltd. for more than 10 years. He was also connected with East MacDonald Mines in Gaspe, Que.

Mr. Troop was a member of the Corporation of Professional Engineers of Quebec, the Canadian Institute of Mining and Metallurgy, and of the Montreal Engineers Club.

He joined the Engineering Institute as an Associate Member of 1919, transferring to Member in 1940. Mr. Troop attained Life Membership in 1955.

Charles Henry Fox, M.E.I.C., retired engineer with the Canadian Pacific Railway, died in St. Vincent Hospital, Vancouver, B.C. on August 11, 1955.

Mr. Fox was born in Winnipeg on April 2, 1885. He received his B.Sc. degree in civil engineering from McGill University in 1909, returning the following year to obtain his M.Sc. degree.

He first became associated with Canadian Pacific Railways in 1902 as a clerk and remained with the company continuously, except for his university training, until his retirement in 1952. In 1910 he became resident engineer at Fort William, Ont., for two years and then until 1916 he was assistant division engineer of the Manitoba division and from 1916 to 1918, division engineer of the Portage division of the company. After a year with the Canadian Engineers with the rank of lieutenant, he returned to the C.P.R. as division engineer at Regina and Saskatoon. In 1923 he was named engineer of water service and of the Winnipeg terminals division and in 1939 became district engineer for Saskatchewan with headquarters at Moose Jaw. Mr. Fox was transferred to Winnipeg in 1944 and to Vancouver in 1948. He retired in 1952 but continued to be available as a consultant to the company.

Mr. Fox joined the Engineering Institute as a Student in 1907, transferred to Associate Member in 1913, and to Member in 1921. He attained life membership in 1948.

Frank S. Fowler, M.E.I.C., manager and secretary-treasurer of Nelson River Construction Company Ltd. at St. Boniface, Man., died on March 4, 1955.

Mr. Fowler was born at Brandon Man., on April 26, 1888, and received his general education at Winnipeg Collegiate. He graduated from McGill University in 1910 with a B.Sc. degree in mining engineering. After graduation he joined the Shawinigan Water and Power Company as engineer on construction and assistant to the superintendent on the addition to the canal and bulkhead and the power-house at Shawinigan Falls, Que.

He served during World War I with the Allied Armies, 179 Battalion, in Canada, England and France, attaining the rank of captain. He was awarded the Military Cross in 1919.

Mr. Fowler returned to Canada in 1919 and became a member of the firm of Fowler and Young, general contractors in Winnipeg, Man. In 1928 he was named director of Nelson River Construction Company Ltd., general contractors.

He became an Associate Member of the Engineering Institute in 1915 and transferred to Member in 1940. Mr. Fowler attained life membership in 1950.

Robert H. Quintal, M.E.I.C., vice-president and director of Racey, MacCallum and Associates Ltd., consulting engineers in Montreal, died suddenly on August 26, 1955 at his home in Montreal.

Born in Montreal on December 1918, Mr. Quintal received his secondary education at Mont St. Louis College, Montreal. He graduated from Ecole Polytechnique in 1943 with a B.A.Sc. degree in civil engineering and received his master's degree the following year for his work on prestressed concrete. He also attended Purdue University for three years where he obtained training in the field of soil mechanics. During these years he worked for the summer months as a soils engineer for the government of the Province of Quebec.

In 1952 Mr. Quintal joined Construction Borings Limited in Montreal as chief engineer. Prior to this he had served with the Quebec Department of Roads as chief soils engineer, with the Public Works Department of Montreal, and with the Montreal Transportation Commission as chief soils engineer and structural engineer in the subway design division. Later that same year Mr. Quintal was one of the founders of the firm of Racey, MacCallum and Associates Ltd. and was named vice-president and director.

He was a member of the Corporation of Professional Engineers of Quebec, the International Society of Soil Mechanics, and the American Society of Civil Engineers.

Mr. Quintal joined the Engineer-

R. H. Quintal, M.E.I.C.

Lt.-Col. J. S. Merrett, M.E.I.C.

Institute as a Student in 1938 and transferred to Member in 1945.

Lt.-Col. J. S. Merrett, M.E.I.C., assistant manager of Westeel Products Limited in Winnipeg, Man., died on July 12, 1955 at his home in Winnipeg.

He was born in Montreal on December 7, 1903 and received his general education in Winnipeg. He graduated from the University of Manitoba in 1926 with a B.Sc. degree in civil engineering.

Lt.-Col. Merrett joined Westeel Products Limited upon graduation as draughtsman, subsequently becoming estimator, chief draughtsman and engineer for the company.

Prior to World War II he was a captain in the Royal Winnipeg Rifles. Transferred to active service in 1940, he went overseas in 1941. In October, 1942, he returned to Canada and was appointed second in command of the 2nd Battalion, Winnipeg Rifles. Lt.-Col. Merrett attended a staff course in England on civil affairs in military government and from 1943 to 1946 he was staff officer in civil affairs, serving with the 8th Army in North Africa, France, Italy and Austria. He was appointed chief of public works in Vienna during the reconstruction of the city immediately following the end of the war.

He returned to Westeel Products in 1948 and was named assistant manager in 1953.

He was a member of the Association of Professional Engineers of Manitoba.

Lt.-Col. Merrett became a Member of the Engineering Institute in 1940.

Emile G. Clossey, M.E.I.C., consulting engineer, died in Montreal on July 31, 1955.

Mr. Clossey was born in Montreal on March 29, 1897 and received his general education at Mont St. Louis College. He studied at Ecole Polytechnique and graduated from McGill University in 1922 with a B.Sc. degree. During World War I he served as a lieutenant with the First Canadian Tank Battalion from 1914 to 1918.

After graduation he was employed as resident engineer and then division engineer for the Department of Roads of the Province of Quebec. In 1927 he became associated with the City of Montreal engaged upon technical service and building inspection. In 1943 he also became associated with Ecole Polytechnique as a lecturer on the engineering faculty. Mr. Clossey had also been engaged in private practice for a number of years prior to his death.

He was a member of the Corporation of Professional Enginers of Quebec. Mr. Clossey became a Member of the Engineering Institute in 1946.

John A. L. Smith, M.E.I.C., general manager of J. A. Buchanan and Associates in Edmonton, Alta., died at his home in Edmonton on July 31, 1955.

He was born in Nanaimo, B.C., on September 19, 1917 and received his general education at Tofield, Alta. Later Mr. Smith graduated from the University of Alberta in 1950 with a B.Sc. degree in civil engineering.

He was active in military circles over a number of years, having joined the C.O.T.C. at the University of Alberta in 1935. In February of 1943 he went overseas with the 5th Canadian Armoured Division with the rank of lieutenant. Later he served in Northwestern Europe and at the end of the war he went to Germany with the Canadian Army of Occupation Force, returning to Canada in 1946.

Prior to World War II Mr. Smith had worked as rodman and instrumentman with the engineering department of the City of Edmonton. After his graduation in 1950 he returned to the City of Edmonton working on design and drafting. From 1951 to 1952 he was supervising engineer of Associated Engineering Services and then accepted the position which he held at his death with J. A. Buchanan and Associates in Edmonton.

Mr. Smith was a Member of the Association of Professional Engineers of Alberta, and of the Community Planning Association of Canada.

He joined the Engineering Institute as a Student in 1948, transferring to Junior in 1952 and to Member in 1954.

Josef Tanski, M.E.I.C., design engineer with Dominion Hoist & Shovel Company Ltd. in Montreal, died on September 5, 1955.

Mr. Tanski was born in Aleksandrow, Poland, on February 12, 1905, and attended high school there. He graduated as a mechanical engineer from the Machine Design College at Grudziadz, Poland in 1924 and then studied Diesel motor design for a year at Gdansk (Danzing) University. Later he returned to university and obtained his master's degree in mechanical engineering in 1939 from the University of Warsaw.

While in high school Mr. Tanski served in his father's works as an apprentice and in 1924, upon the death of his father, reorganized the works into a research station for experimental work and development of internal combustion motors, working on contracts for the Polish government.

During the Second World War he served as pilot and engineer officer in the Polish element of the Royal Air Force in France and Great Britain.

Mr. Tanski came to Canada in 1952 and joined Dominion Hoist & Shovel Company Ltd. as a design engineer, the position he held at his death.

He became a Member of the Engineering Institute in 1953.

Personals

News of the Personal Activities of Members of the Institute

James A. Vance, M.E.I.C., past-president of the Engineering Institute, has been appointed a member of the Water Resources and Supply Committee of Southwestern Ontario. This committee, chaired by **A. M. Snider,** M.E.I.C., has been appointed by Premier Frost of Ontario to study the water supply problem in Southwestern Ontario.

Among the aims of the committee are: To set up a commission similar to the Hydro to pump the water and pipeline it to municipalities; and to set up at the same time an overall plan for the prevention of pollution.

Mr. Snider said that the committee was likely to hold public meetings in various municipalities where members can consult with local authorities to discover their particular problems. Mr. Snider is vice-president and general manager of Sunshine Waterloo Company Ltd. in Waterloo, Ont.

Mr. Vance, who conducts his own general contracting business in Woodstock, Ont., is also a director of several industrial enterprises and telephone companies, including Avalon Fabrics Ltd. of Stratford, Ont.

He was president of the Engineering Institute in 1950 and received the Sir John Kennedy medal of the Institute in 1953.

James A. Vance, M.E.I.C.

S. D. Ford, M.E.I.C.

J. H. Smith, M.E.I.C., vice-president and general manager of Canadian General Electric Company Ltd., has moved from Toronto to Montreal where he will head the company's appliance business for Canada and will have his headquarters at the major appliance plant in Montreal. He was appointed a vice-president of the company last year.

Mr. Smith graduated from the University of New Brunswick with a degree in electrical engineering and received his M.Sc. degree in 1942. He followed Canadian General Electric's test training program and held a number of sales engineering appointments in Toronto and Hamilton. In the Toronto district he was supply division manager from 1945 to 1948, and apparatus division manager from 1948 until 1951.

He is a member of the A.I.E.E. and of the Toronto Board of Trade, and in 1953 served as president of the Association of Professional Engineers of Ontario.

Air Commodore C. F. Johns, M.E.I.C. former executive assistant for construction, engineering and properties at Defence Headquarters, has been named assistant deputy minister of construction, engineering and properties of the Defence Department at Ottawa.

Air Commodore Johns, a native of Portsmouth, England, is publisher of the Sackville Tribune Post in Sackville N.B. He joined the R.C.A.F. in 194 and was discharged in November, 194 In October, 1950, he rejoined the A Force to assist in a major constructio program launched that year by the D fence Department. He became a St dent Member of the Engineering Ins tute in 1924, transferring to Associa Member in 1939, and to Member 1940.

S. D. Ford, M.E.I.C., has been nam chief engineer of Sandwell & Compa Ltd. in Vancouver, B.C. He was forme assistant chief engineer for the compa

Mr. Ford graduated from the Univ sity of British Columbia in 1939 a joined Boeing Aircraft Company Canada in Vancouver where he was charge of the design section until 19 when he went to the Powell River Co pany as assistant to the project engine Mr. Ford joined the Sandwell organi tion in 1949.

J. H. Smith, M.E.I.C.

R. M. Richardson, M.E.I.C.

R. M. Richardson, M.E.I.C., chief en neer of New Brunswick Telephone Co pany Ltd., has been granted a leave absence prior to his retirement.

Mr. Richardson joined the compa in 1941 as general plant manager, f lowing extensive experience with Bell Telephone Company of Can in Montreal and Ottawa in telepho engineering, construction and maint ance.

He served overseas with the Canad Army and the Royal Flying Corps d ing World War I.

Mr. Richardson is a past-president the Dominion Council of Professio Engineers of Canada, and a past-pr dent of the Association of Professio Engineers of New Brunswick.

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• Personals

He is also a past-chairman of the Saint John Branch of the Engineering Institute, and has served as councillor of the Institute.

Succeeding Mr. Richardson as chief engineer is **A. A. Turnbull,** M.E.I.C.

Mr. Turnbull joined the company in 1922 as assistant engineer upon his graduation from Nova Scotia Technical College with a degree in electrical engineering. He had served overseas during World War I with the Canadian Army.

In 1933 he was appointed general plant engineer and later became plant extension engineer. Since 1954 he has been acting chief engineer for the company.

Appointed to assistant chief engineer for the company was **K. V. Cox,** M.E.I.C. Mr. Cox joined the company in 1942 following his graduation from the University of New Brunswick. In 1943 he was appointed transmission supervisor and the following year was named transmission engineer.

Both Mr. Turnbull and Mr. Cox are members of the Association of Professional Engineers of New Brunswick.

Hubert R. Sills, M.E.I.C., supervisor of design engineering at Canadian General Electric's Peterborough, Ont., plant, has been named a Fellow of the American Institute of Electrical Engineers.

Mr. Sills graduated in 1921 from Queen's University with a B.Sc. degree in electrical engineering. He joined Canadian General Electric's test course and in 1922 was assigned to design engineering with the AC group. He has served in a supervisory capacity since 1945.

Mr. Sills has designed or has been responsible for the design of generators for the majority of hydraulic generating stations in Canada, as well as in foreign countries.

He joined the A.I.E.E. as a student in 1920 and for some years has been a member of the A.I.E.E. committee on rotating machinery, and a member of the synchronous machine sub-committee.

Mr. Sills has been active in the Engineering Institute which he joined as a Student in 1921, becoming an Associate Member in 1936 and a Member in 1940. He was counsellor of the Institute from 1940 to 1945 and from 1945 he has been chairman of the Membership Committee.

Stanley Shupe, M.E.I.C., city engineer of Kitchener, Ont., has retired after 31 years of service with the city. He will continue, however, as consultant to the city engineering department. He was honored at farewell dinner by civic leaders in Kitchener upon his retirement.

A native of Fort Erie, Ont., Mr. Shupe graduated from the University of Toronto with a degree in civil engineering in 1941. While a student he did survey work in the west and also worked with the Kitchener engineering department. His first position after graduating was town engineer for Dunnville and county engineer for Haldimand county in Ontario. After a short period as city engineer at Oshawa, he became city engineer at Kitchener in May, 1921.

During his years of service with the city Mr. Shupe played a leading role in the construction of the present sewage treatment plants in Kitchener and supervised local improvements, maintenance and other work for the city totalling over twenty million dollars.

He is a past-president of the Canadian Institute on Sewage and Sanitation. He has also served as chairman of the Hamilton Branch of the Engineering Institute which he joined in 1920.

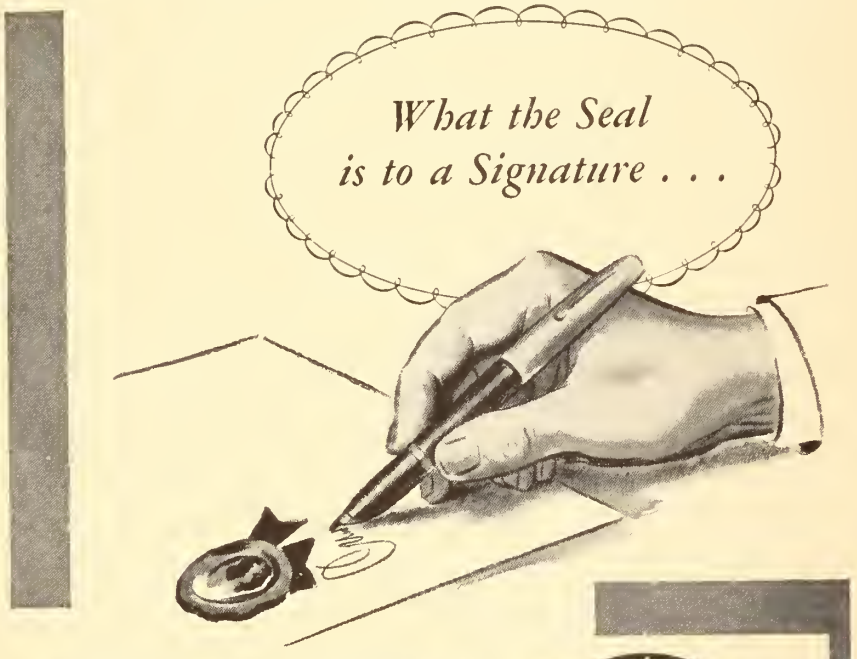
Lt.-Col. J. S. Beeman, M.E.I.C., deputy director of engineer development at Army Headquarters in Ottawa has been named assistant quartermaster general at Western Command Headquarters in Edmonton, Alta.

A graduate of the University of British Columbia, Lt.-Col. Beeman served with the Canadian Officers Training Corps and the R.C.E. permanent force prior to the Second World War. During the war he served in Canada, the United Kingdom, Italy and Northwest Europe.

Lt.-Col. Beeman has been senior highway engineer with the Northwest Highway System at Whitehorse, Y.T. and has also been command engineer with the Western Command at Edmonton, Alta.

A. H. Johnston, M.E.I.C., research engineer with Aluminum Laboratories Ltd. at Arvida, Que., has been named chairman of the Saguenay Branch of the Engineering Institute.

Born in Grafton, Ont., he received his general education at Coburg Collegiate Institute. Mr. Johnston graduated from Queen's University with



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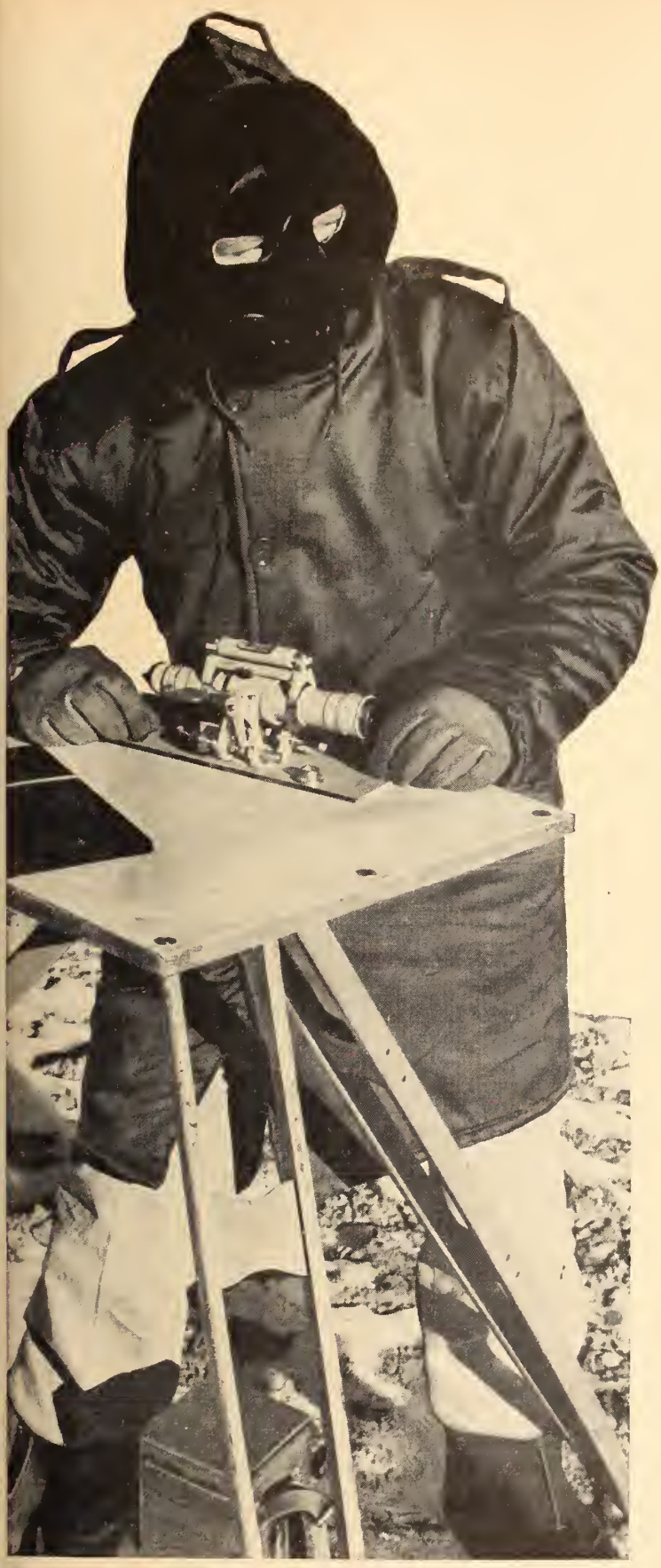

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• Personals

B.Sc. degree in chemical engineering in 1934 and spent some time at the University of Michigan engaged in post-graduate studies in chemical engineering.

His early professional experience included a year as research chemist with Abitibi Power and Paper Company and then two years as lecturer in chemical engineering design at the University of Alberta. In 1938 he joined Canadian Celanese Company Ltd. as sectional engineer in charge of construction and maintenance for the cellulose acetate division at Drummondville, Que.

Mr. Johnston became associated with the Aluminum Company of Canada in 1942 as supervisor in the ore plant and reduction division in Montreal, Que. He then became superintendent of the magnesium pilot production unit and in 1950 joined Aluminum Laboratories as research engineer in Arvida, Que.

He is a member of the Corporation of Professional Engineers of Quebec and a member of the American Institute of Chemical Engineers.

Mr. Johnston joined the Engineering Institute as a Member in 1946.

John K. Young, M.E.I.C., has been transferred by Armco Drainage & Metal Products of Canada Ltd. from Sackville, N.B. to Montreal. He will be sales manager for the eastern district.

Mr. Young graduated in civil engineering from the University of New Brunswick in 1945.

A. H. Johnston, M.E.I.C.

E. R. Smallhorn, M.E.I.C., has opened offices in Montreal as a consulting construction management engineer. He was formerly general manager of Aerocrete Construction Company Ltd. in Montreal.

Mr. Smallhorn graduated from McGill University in 1923 with a B.Sc. degree in civil engineering. Upon graduation he worked for H. G. Hunter, consulting engineer in Montreal on water works and sewage work. He then spent some time in Toronto as assistant to Willis Chapman, consulting engineer. Returning to Montreal Mr. Smallhorn accepted a position with the firm of R. S. and W. S. Lea for whom he acted as assistant engineer in connection with extensions to the water works systems at Windsor and Brantford, Ont.

In 1931 he became associated with Aerocrete Construction Company Ltd. in Montreal as manager, subsequently becoming general manager.

Mr. Smallhorn has been active in the Montreal Branch of the Engineering Institute, having served as its secretary-treasurer and as chairman in 1951. He has also served as chairman of the Papers Committee.

E. R. Smallhorn, M.E.I.C.

John M. Hanson, M.E.I.C., has been appointed town engineer for Fort Frances, Ont. He was previously em-

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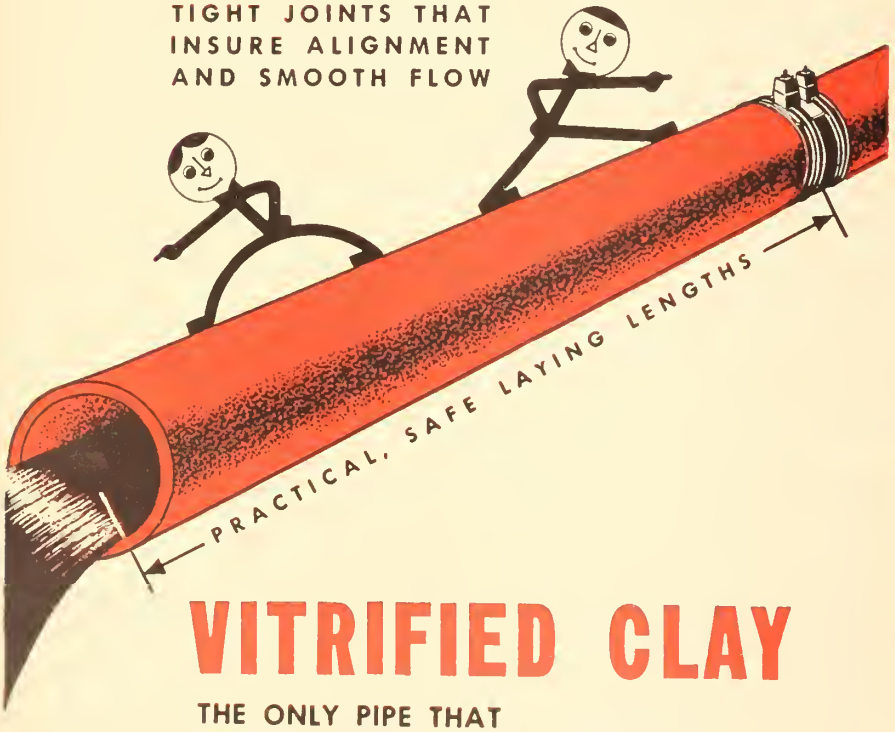

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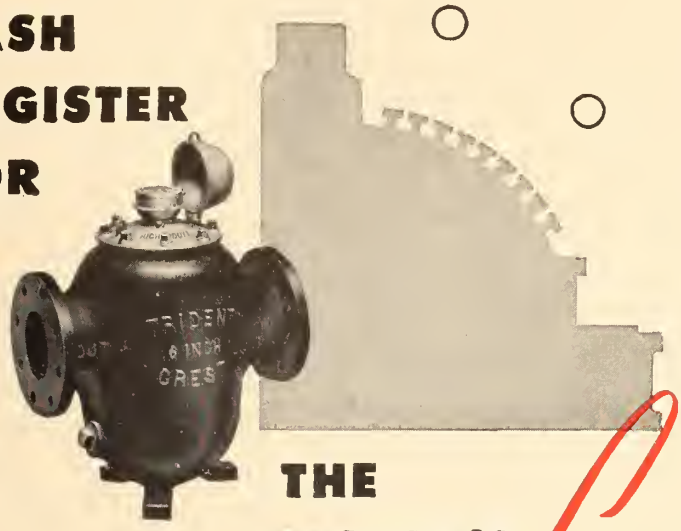

Over 21-*billion* tons of water are collected, processed, and distributed every year. That's over ten times the combined output of the next four leading industries . . . coal, farm products, oil, and steel.

All these five largest commodities have one thing in common:
They come from the ground, and cost good money to collect, process and deliver before they are of much use to man.
Like these other commodities, water must be paid for . . . by each user, according to quantity consumed.

Making these payments fair and accurate has been the job of Trident Meters for over 50 years. During this period, Tridents have become famous for their sustained accuracy, reliability, and long service.
More Tridents have been installed in Canada than any other meter.

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NEPTUNE METERS LIMITED
Toronto 14, Ontario

Branch Offices:
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neptune

• Personals

ployed as town engineer at Dauphin, Man.

A civil engineering graduate of the Royal Technical College, Copenhagen, Mr. Hanson had twelve years experience in Europe before coming to Canada. He spent five years with a general contractor and five years with the United Oil Company and the last two years on the city engineering department of Copenhagen.

When he first came to Canada Mr. Hanson joined the staff of W. M. Barnes, general contractor in Edmonton as designer and draughtsman. During 1949 he worked for Sparling and Davis, general contractors, Edmonton, after which he was with the City of Edmonton engineering department. In 1951 he joined Defence Construction Limited at Edmonton and in 1954 became town engineer for Dauphin, Man.

Mr. Hanson is a member of the Institute of Danish Civil Engineers.

George C. Davis, M.E.I.C., consulting engineer of Winnipeg, Man., was recently elected president of the local chapter of the American Society of Heating and Air-Conditioning Engineers.

Before opening his private practice in 1953 Mr. Davis was president of Winnipeg Central Heating Company Ltd. A civil engineering graduate of the University of Manitoba, he began his career with the Northern Public Service Corporation and Winnipeg Heating Company Ltd., the jointly managed residential heating companies that serve Winnipeg. Mr. Davis worked up through the service department and customer relations department becoming vice-president in 1937. In 1947 he was made vice-president and general manager of the companies, which merged in 1950. He became president of the new company upon its formation.

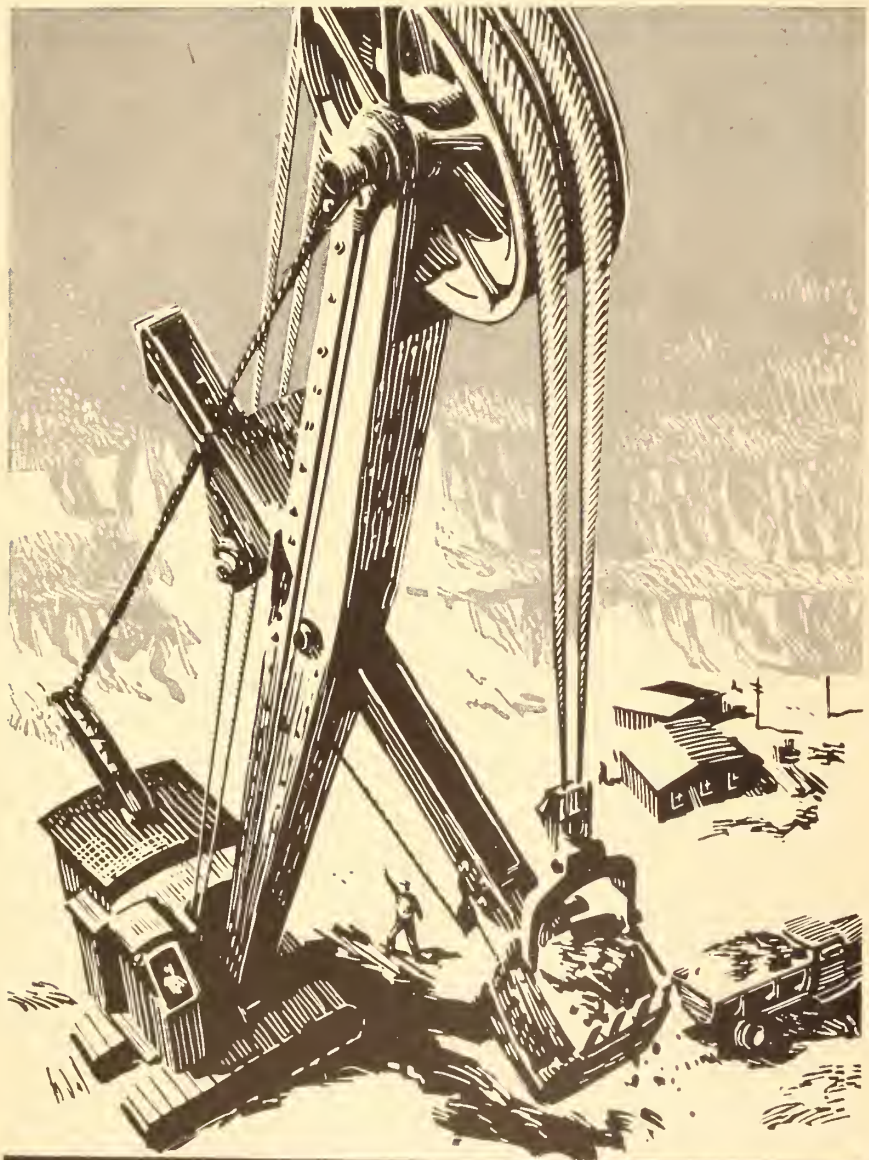
G. C. Davis, M.E.I.C.

Mr. Davis is a member of the Association of Professional Engineers of Manitoba.

J. S. Shales, M.E.I.C., has moved to the United States and is now vice-president of Cummins Diesel Michigan Inc., Detroit, Mich. He had been general manager of C. A. Meadows and Associates Limited in Toronto and had been responsible for co-ordinating the activities of the firm in the United States and Canada.

Mr. Shales is a 1943 graduate in engineering physics from the University of Toronto. He was associated with Federal Aircraft Limited and with DeHavilland Aircraft of Canada Limited in Toronto. He was also manager of the engine, pump and electrical departments of Canadian Fairbanks-Morse Company Ltd. in Toronto before joining C. A. Meadows and Associates Limited.

J. S. Shales, M.E.I.C.



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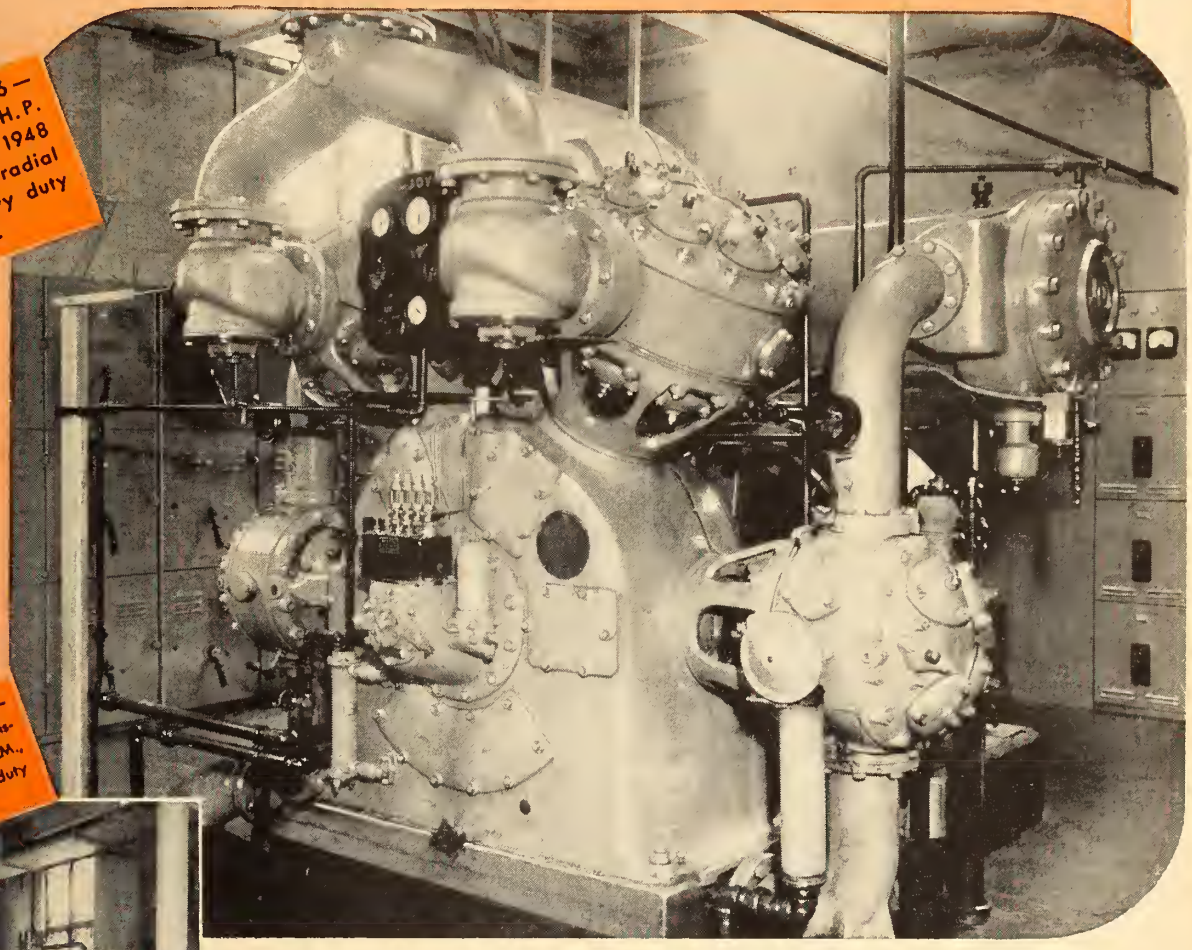
WN-114-C 16—10 x 7 300 H.P. displacement, 1948 C.F.M., semi-radial design heavy duty compressor.



WN-112-C 14½—8¾ x 7 125 H.P. displacement, 800 C.F.M., V. Vertical heavy duty compressor

These modern compressors were chosen for the completely modernized power house of a large Canadian electrical manufacturer after serious consideration of the JOY advanced design features. These include patented dual cushion valves, replaceable honed cylinder liners and crosshead guides, tinned box-type crossheads requiring no adjustment, antifriction main bearings, full forced feed lubrication, together with many other features of modern engineering practice.

These features together with a background of unrivalled performance make JOY Compressors the logical choice for an economical and efficient source of compressed air supply.

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A CANADIAN COMPANY MANUFACTURING AND SELLING COAST TO COAST.

• Personals

Michael H. D. Broadbent, M.E.I.C., h been appointed assistant plant engine at Cornwall, Ont. for Courtaulds (Ca ada) Ltd.

He was previously with Phillips Ele trical Works Company Ltd. in Broc ville, Ont., as equipment design e gineer, having joined that company mechanical engineer in 1953.

Mr. Broadbent had been secretar treasurer of the Brockville Branch the Engineering Institute until his mo to Cornwall.

M. F. Wilding, M.E.I.C., is present assistant resident electrical engineer the Kitimat project for the Aluminu Company of Canada Limited.

Mr. Wilding graduated from the Un versity of British Columbia in 1944 wi an electrical engineering degree. Aft graduation he became associated wi Northern Electric Company as a sa engineer. He was with that compa in Montreal, Vancouver and Calgary a power apparatus specialist. Mr. Wi ing joined the Aluminum Company 1951 at Montreal, becoming electri squad boss in 1953.

F. M. Cazalet, M.E.I.C.

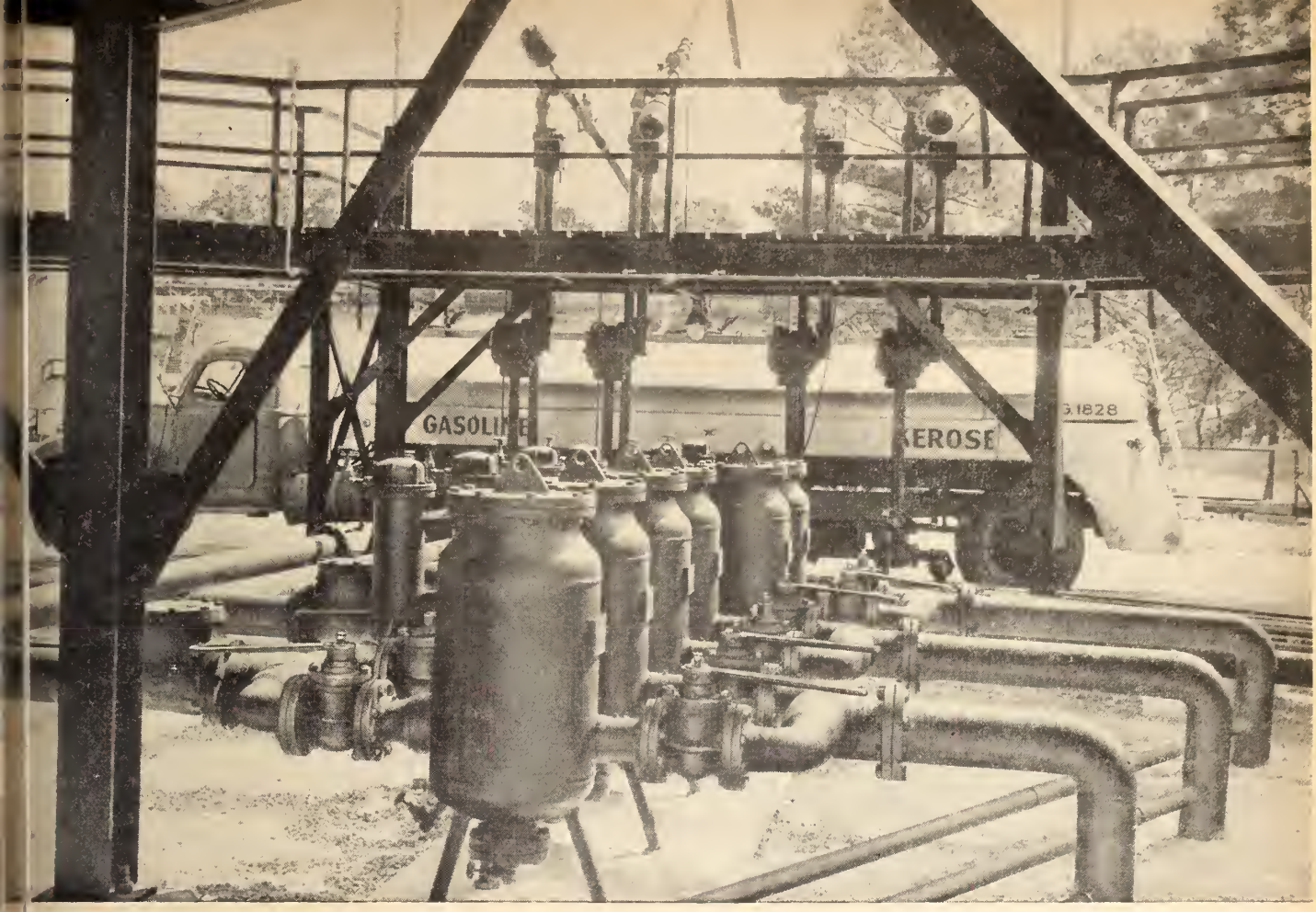
F. M. Cazalet, M.E.I.C., supervisor mechanical engineering for B.C. En neering Company Ltd., is the pres chairman of the Vancouver Branch the Engineering Institute.

A native of England, Mr. Cazalet ceived his preliminary education in th country at Ampleforth College a H.M.S. Worcester. He came to Cana and graduated from the University British Columbia in 1937 with a B.A. degree in mechanical engineering.

Directly after his graduation from u versity Mr. Cazalet became associat with B.C. Electric. He has worked research and sales and in the plann division. Mr. Cazalet became supervi of mechanical engineering in 1950.

He is a past chairman of the Va couver branch of the American Soci for Metals and of the National As ciation of Corrosion Engineers. He now chairman of the Vancouver bran of the B.C. Engineering Society.

Mr. Cazalet joined the Engineer Institute as a Member in 1948.



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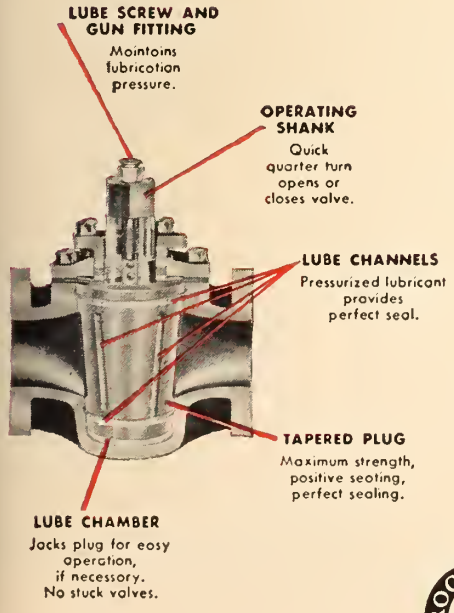
With **Rockwell**-Nordstrom **Valves**



Rockwell-Nordstrom valves are the most efficient and economical valves you can use on loading racks . . . or any petroleum marketing installation. Quarter-turn operation assures fast, positive flow control, and Rockwell-Nordstrom's pressurized lubricant sealing gives you leakproof service that eliminates costly, dangerous wastage.

Only Rockwell-Nordstrom offers you a *complete* range of valve sizes and operating accessories, plus lubricants that have been time-tested for your loading facilities. These valves and lubricants are built around 40 years of leadership in meeting the petroleum and gas industries' requirements.

Whatever your valve needs, there is a Rockwell-Nordstrom valve and lubricant that will do the job more efficiently, more dependably and at lower cost than any other valve you've ever used. Write for complete information today and learn how Rockwell-Nordstrom can put new profits in your petroleum marketing operations. *Canadian valve licensee:* Peacock Brothers Limited, Box 1040, Montreal, Que. Also, Sydney, Toronto, Sudbury, Winnipeg, Edmonton, Calgary and Vancouver.

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ROCKWELL-NORDSTROM VALVES

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PEACOCK BROTHERS LIMITED

• Personals

J. R. Morrison, M.E.I.C., has retired from the Dominion Coal Company in Sydney, N.S., after 53 years with the company. Mr. Morrison was field engineer for many years prior to his retirement. He also spent some years with the mining engineering department of the company.

Mr. Morrison became a Student member of the Engineering Institute in 1905 and attained life membership in 1949.

Gordon A. Antenbring, M.E.I.C., has been transferred from Orillia to Vancouver, B.C., by E. Long Limited. His new position will be that of western sales manager. He has been with the company since 1948 when he joined as a sales engineer in Orillia, Ont.

Mr. Antenbring received a degree in civil engineering in 1934 from the University of Manitoba, and a degree in mining engineering from Queen's University in 1937. After some time spent with the Aluminum Company of Canada Ltd. in Arvida he became an industrial engineer with the Canadian Johns-Manville Company, Asbestos Que., in 1947.

John S. L. King, M.E.I.C., until recently president of King Coon Limited in Toronto, has severed his connection with that firm and has opened a private consulting practice in Toronto. He will continue to undertake commissions in the field of municipal engineering, industrial development and land developments.

John S. L. King, M.E.I.C.

Mr. King graduated in 1947 from the University of Toronto with a degree in engineering.

M. W. Jennings, M.E.I.C., has retired from the Alberta Wheat Pool in Calgary, Alta. He joined the company in 1927.

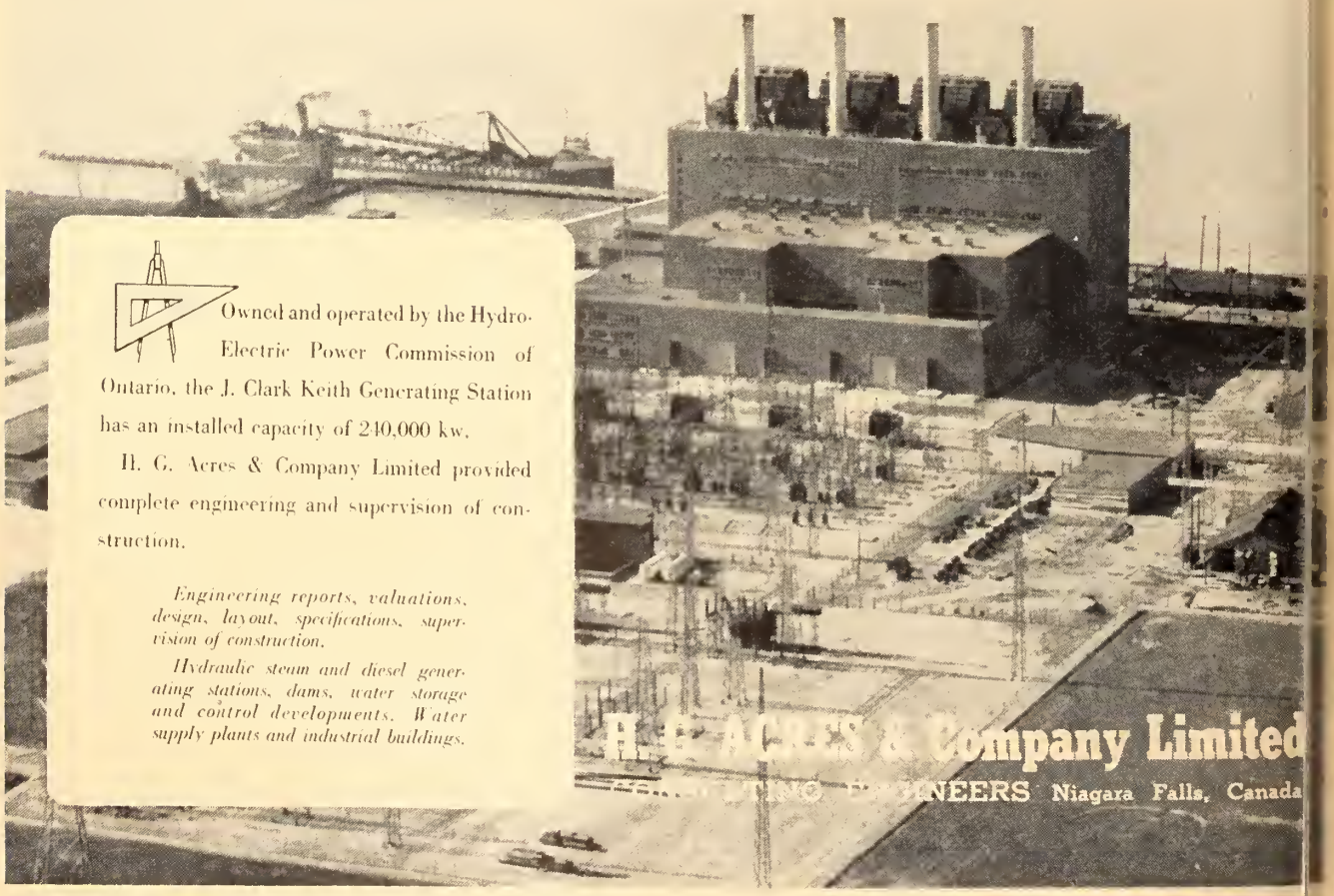
Born in Saint John, N.B., he graduated from the University of New Brunswick in 1911 with a B.Sc. degree. He was first employed by the Can dian Pacific Railways and in 1912 h became draughtsman on constructio for the National Transcontinental Ra way at Saint John, transferring Cochrane, Ont., in 1913 in the san capacity.

Mr. Jennings became draughtsman maintenance for the Canadian Gover ment Railways there in 1915 and w appointed chief clerk to the distri engineer and then assistant engineer 1916. He was acting division engine at Cochrane for some time and in 19 became assistant engineer for the Can dian National Railways at Cochran transferring to assistant engineer in Po Arthur the following year. After joini the Alberta Wheat Pool in 1927 he su sequently became superintendent construction for the company.

He is a past chairman of the Calga Branch of the Engineering Institu which he joined in 1922.

John A. Brooks, M.E.I.C., has been a pointed production superintendent f Canadian Resins and Chemicals Lt Montreal. Succeeding him as purcha ing agent is **John R. Hazle,** M.E.I. formerly plant production supervisor Shawinigan Falls, Que.

Mr. Brooks, a graduate of Queer University in chemical engineering 1942, joined Canadian Resins the fo lowing year. Prior to his appointme as purchasing agent in 1950 he w attached to the production departme of the company's Shawinigan Falls pla in various capacities.



• Personals

His successor, Mr. Hazle, has been with the company since 1948. A graduate of McGill University in chemical engineering in 1945, he has held several supervisory positions, including those of plant maintenance engineer and plant production supervisor. As purchasing agent he will continue to be located at Shawinigan Falls.

W. S. Hosking, M.E.I.C.

W. S. Hosking, M.E.I.C., steam plant superintendent of the Bathurst Power & Paper Company, has been elected chairman of the Northern New Brunswick Branch of the Engineering Institute.

Mr. Hosking was born in Bellows Falls, Vermont and received his education in the Province of Ontario; graduating from Georgetown High School and then from Queen's University in 1931 with a degree in mechanical engineering.

He was employed by the Bathurst Power & Paper Company for a short time in 1930 and joined the company again upon completion of his studies. Mr. Hosking has been with the company continuously since that time.

He is a member of the Institute of Power Engineers, a member of the Technical Section Canadian Pulp and Paper Association, being a former chairman of the Atlantic branch. Mr. Hosking is also a registered professional engineer of the Province of New Brunswick.

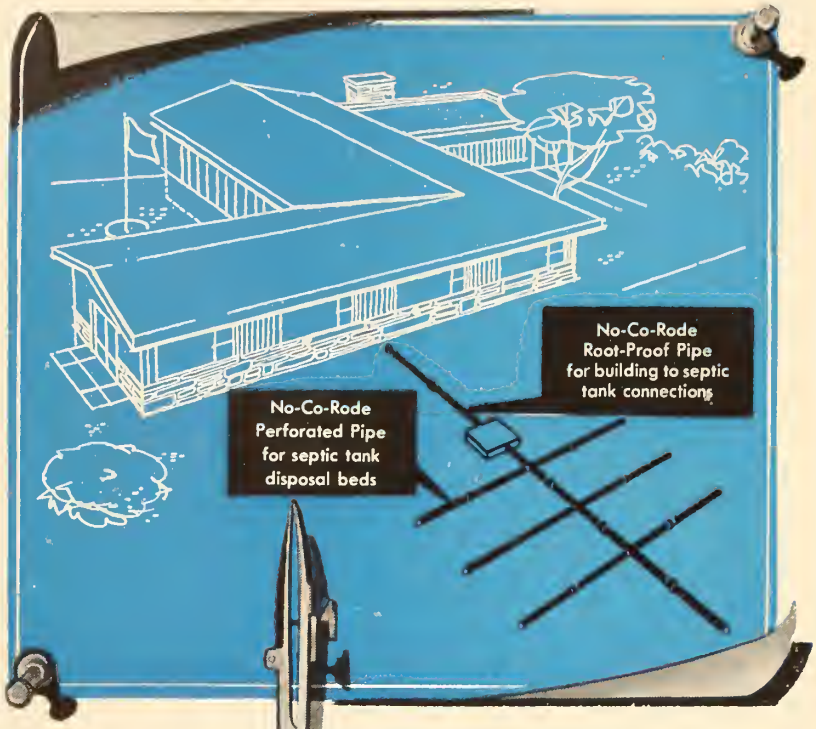
He became a Member of the Engineering Institute in 1953.

John S. Lochhead, M.E.I.C., is in charge of the new western office of Racey, MacCallum and Associates Ltd. in Vancouver, B.C. He was previously in Montreal with the company as an associate and vice-president. Before joining Racey, MacCallum, Mr. Lochhead was an administrative planning consultant in Montreal.

Mr. Lochhead has been planning engineer with Canadair Limited in Montreal and during World War II he was with Canadian Vickers Limited and with Defence Industries Limited in Montreal.

A civil engineering graduate of McGill University, he also spent some time with Dominion Bridge Company Ltd. in Montreal.

Designed for permanent, low-cost installation



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√ EASY TO INSTALL
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Long, lightweight lengths mean easier handling, fewer joints and a reduction in the time and cost of handling and installation. Specify No-Co-Rode Root-Proof Pipe for building to sewer or septic tank connections, storm drains and other underground non-pressure uses. The tapered, self-sealing joints quickly tap into place to provide permanent, watertight and root-proof connections—no extra materials or special tools needed. Extra Strong No-Co-Rode will not break, crack or shale in handling or in the ground—not affected by acids, alkalis, soil movements or surface shocks.

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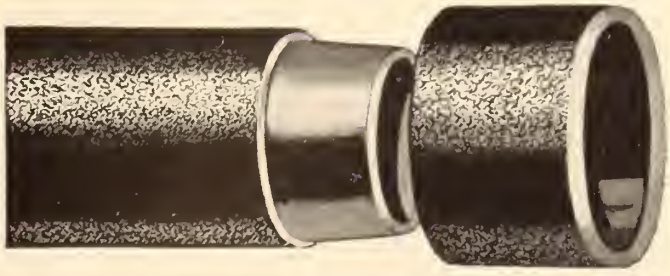

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The John Hart Development produces 168,000 h.p. of electricity from the water delivered by these three pipelines—each 12 feet in diameter and over 3,500 feet long. Accomplishments like the John Hart project are a credit to the foresight of the B.C. Power Commission and the people of British Columbia.

Designed by our engineers, these wood stave pipelines have proved the most economical and effective method known for handling water in large volumes under pressure.

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Canadian Wood Pipe and Tanks Limited

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• Personals

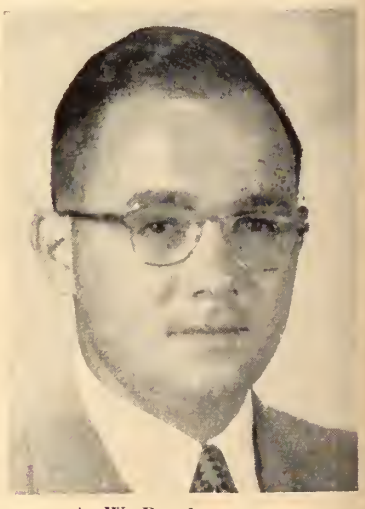
A. W. Purdy, M.E.I.C., district sale manager of Maritime Cement Company Limited at Moncton, N.B., has beer elected chairman of the Moncto Branch of the Engineering Institute.

A native of Toronto, Ont., Mr. Purdy received his secondary education i that city. After three years with th Canadian Army overseas during Worl War II, he graduated from Queen' University in 1949 with a degree in civi engineering.

Mr. Purdy became associated wit Canada Cement Company Ltd. imme diately after his graduation. His posi tion was that of technical engineer. H was named to his present position i 1951.

He is a registered engineer of th Province of New Brunswick.

Mr. Purdy joined the Engineering In stitute as a Junior in 1949, transferrin to Member in 1953.



A. W. Purdy, M.E.I.C.

E. J. Cole, M.E.I.C., is now associate with the Power Corporation of Canad in Montreal. He was previously in O tawa with the National Research Cou cil as senior engineer.

Mr. Cole graduated from the Unive sity of Saskatchewan in 1944 with degree in civil engineering and in 194 he received a degree in physics from th same university.

He has also been assistant researc officer and assistant chief engineer wit the N.R.C. in Ottawa.

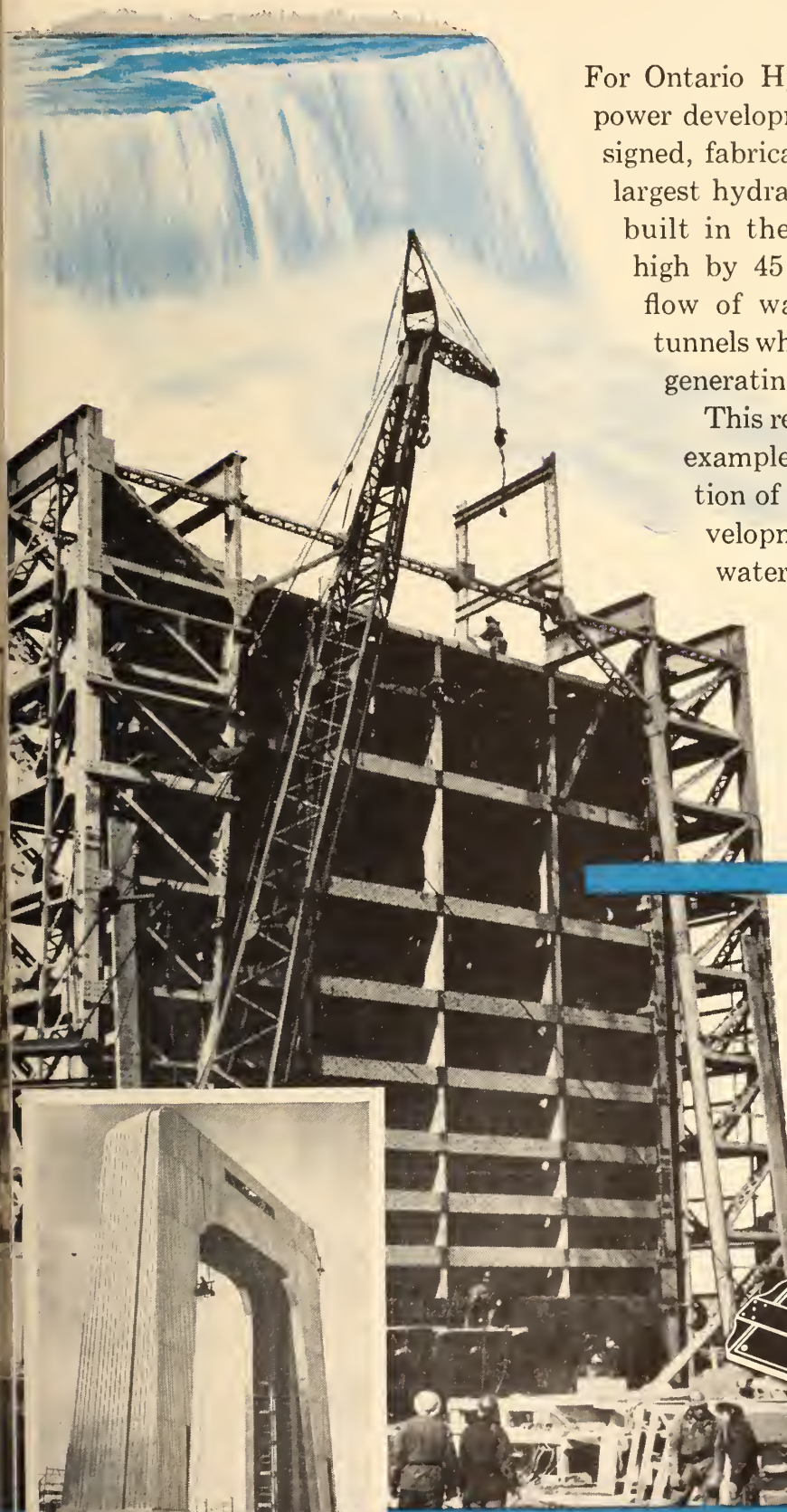
R. H. Bacon, M.E.I.C., is now Ontari manager of Combustion and Powe Equipment Ltd. in Toronto. He wa previously service manager with Fost Wheeler Limited in St. Catharines, On

Mr. Bacon is a mechanical engineerin graduate of the University of Saska chewan, class of 1947.

C. W. Johnston, M.E.I.C., has joine McColl Frontenac Oil Company Lt and is at the Montreal East refinery i the maintenance and construction de partment.

An electrical engineering graduate o Nova Scotia Technical College in 194 Mr. Johnston has been assistant super intendent of the steam plant of Nov Scotia Light and Power Company Lt at Halifax, N.S.

ontrolling 1,828,000 H.P.*at Niagara



For Ontario Hydro's new Sir Adam Beck power development, Dominion Bridge designed, fabricated and erected two of the largest hydraulic regulating gates so far built in the world. Measuring 58 ft. high by 45 ft. wide, they control the flow of water to the twin 5½ mile tunnels which feed the 1,828,000 H.P.* generating station.

This remarkable project is another example of the significant contribution of Dominion Bridge to the development of Canada's immense water power resources.

Dominion Bridge has designed and built the majority of the regulating gates, cranes and structural steelwork used in hydraulic power developments from coast to coast.

Height of arch .....75 ft.
Height of gate .....58 ft.
Width of gate.....45 ft.
Weight of each gate 225 tons

*Ultimate capacity

MECHANICAL DIVISION *
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*Other Divisions STRUCTURAL • BOILER • PLATEWORK • WAREHOUSE

Plants at: MONTREAL • OTTAWA • TORONTO • WINNIPEG • CALGARY • VANCOUVER
Assoc. Company plants at: AMHERST • QUEBEC • SAULT STE. MARIE • EDMONTON

• Personals

R. B. McRae, M.E.I.C., has been named general production manager with Belding-Corticelli Limited in Montreal. He has been plant engineer for Julius Kayser and Company Ltd. at Sherbrooke, Que.

Mr. McRae graduated from the University of Alberta in 1936 with a B.Sc. degree in electrical engineering. He received his M.A.Sc. degree in 1937 from the University of Toronto, also in electrical engineering.

He served with the Canadian Army during World War II as a lieutenant, returning to Julius Kayser and Company Ltd. in 1946.

Alfred H. Ashworth, M.E.I.C., is now consulting engineer and associate of North Western Associated Engineering Consultants in North Vancouver, B.C. Mr. Ashworth was previously municipal engineer for the district of North Vancouver, B.C.

Walter Beckett, M.E.I.C., is now with Gordon Russell Limited in Vancouver, B.C. Mr. Beckett was previously engineer with Northwestern Utilities Limited in Edmonton, Alta.

J. G. Stone, M.E.I.C., has been named plant superintendent of Thomas J. Lipton Limited in Montreal. He was formerly plant superintendent in Winnipeg, Man., of Simmons Limited.

Mr. Stone graduated in 1941 with a degree in civil engineering from Queen's University. He was construction engineer with E. G. M. Cape & Company in Montreal and in 1948 he became plant engineer for Simmons Limited in Montreal.

Robert J. Jones, M.E.I.C., is with Noranda Mines Limited in Toronto, Ont. He was previously in Ottawa with the Department of Mines and Technical Surveys.

Mr. Jones is a mechanical engineering graduate of McGill University, class of 1941.

In 1950 he was an engineer with the Department of Mines and Resources in Ottawa.

Roy W. Garrett, M.E.I.C., has retired as city engineer for the city of London, Ont. Mr. Garrett has been with the city's engineering department for over 35 years, and will now continue as an engineering consultant for the city. Succeeding him to the position of city engineer is **E. T. Skelton,** M.E.I.C., former deputy city engineer.

Mr. Skelton graduated from the University of New Brunswick in 1942 with a degree in civil engineering. Before becoming associated with the City of London in 1953 he was assistant city engineer for Westmount, Que. Immediately after his graduation from university he was with the Demarara Bauxite Company in Mackenzie, British Guiana.

W. H. George, M.E.I.C., has been appointed sales engineer to represent Canadian Meter Company Ltd. in Manitoba and Saskatchewan, with headquarters in Regina, Sask. Mr. George has

W. H. George, M.E.I.C.

just completed a six months traini course in the various plants of the Am ican Meter Company.

He graduated from the University Saskatchewan in 1951 with a degree civil engineering.

Mr. George has been associated wi the Department of Resources and D velopment as resident engineer in Jasp Alta., and with Hipperson Constructi Company Ltd. in Regina, Sask.

G. C. Drake, M.E.I.C., has been tra ferred from Calgary to Winnipeg Canada Creosoting Company Ltd.,

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THE WHARTON CRANE & HOIST CO. LTD.

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MANITOBA, SASKATCHEWAN AND ALBERTA: Mumford, Medland Ltd., 576 Wall Street, WINNIPEG, Man. Telephones: 37-187; 37-188; 37-189; 37-180. Telegram: "Mandem."

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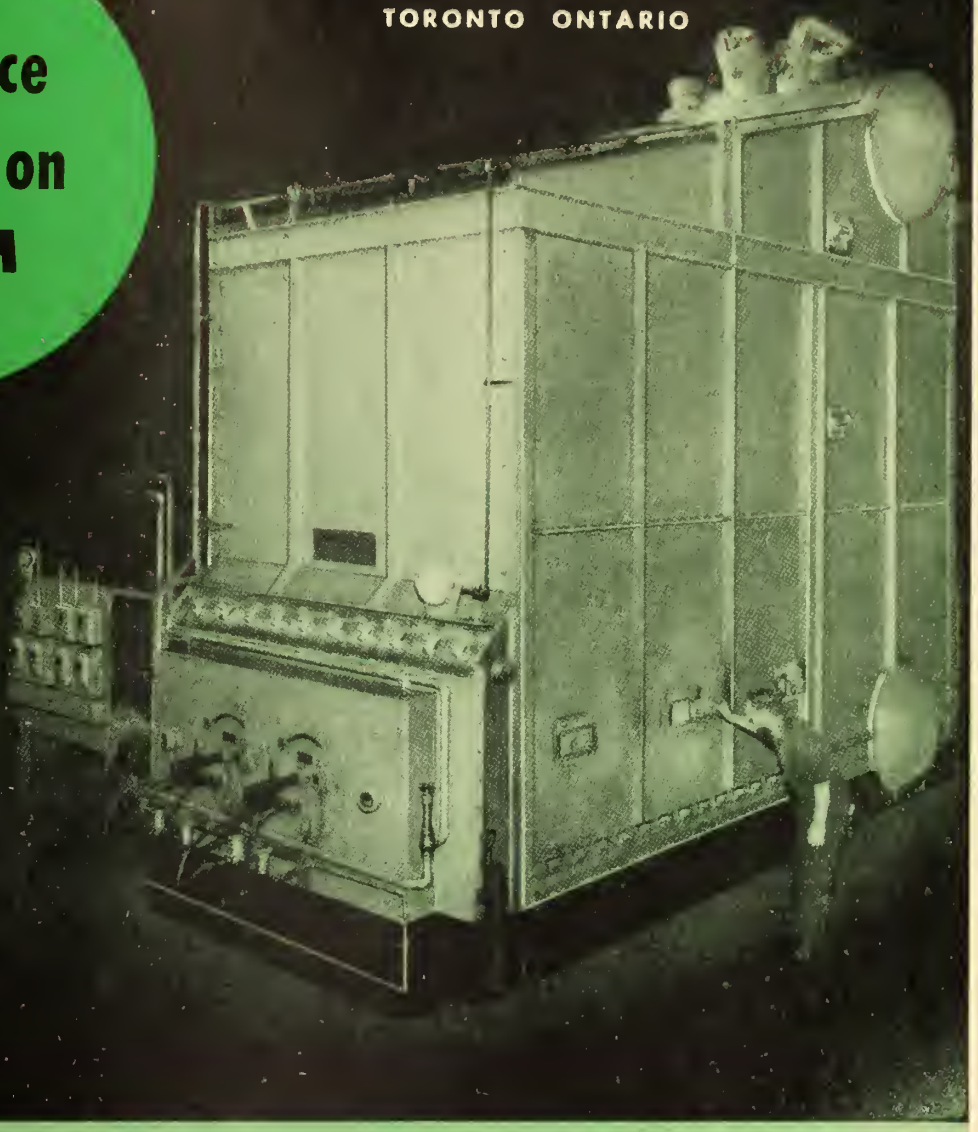
Parisian Laundry

TORONTO ONTARIO

Its service depends on STEAM

from one BABCOCK BOILER



This recently installed Babcock Type G "INTEGRAL-FURNACE" Boiler supplies all the steam requirements for operating the well known, Parisian Laundry, Toronto, one of the largest in Canada. The boiler has a designed steam capacity of 25,000 lbs/hr, operating at 135 psi. It is fired by two Babcock "Y" Jet Oil Burners.

Call in a Babcock technical consultant to discuss your boiler problems or write for bulletin on the Babcock type G "INTEGRAL-FURNACE" Boilers.

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• Personals

division of Dominion Tar & Chemical Company Ltd. Mr. Drake is a sales engineer and has been with the company since 1951 when he was associated with the company at Calgary as sales engineer.

He graduated in 1947 from the University of Alberta with a degree in chemical engineering.

A. J. Lewis, M.E.I.C., has joined the staff of Bendix Eclipse of Canada Limited in Toronto, Ont.

Mr. Lewis, a 1943 graduate in mechanical engineering of the University of Toronto, was formerly sales engineer with Canadian Allis-Chalmers Limited in Toronto, Ont.

George Crevier, M.E.I.C., has been transferred to Jamaica, B.W.I., and is in the construction department of Sprostons (Jamaica) Limited at Williamsfield.

Mr. Crevier was previously production engineer with the Aluminum Company of Canada at Kingston, Ont.

Michael Zinn, M.E.I.C., has joined the staff of Stadler Hurter & Company at Montreal.

Mr. Zinn was previously in Toronto as assistant engineer on oil refinery construction for W. V. Zinn and Associates Limited.

J. G. Wotherspoon, M.E.I.C., is now principal development engineer with the Department of Mineral Resources at Regina, Sask.

Mr. Wotherspoon was formerly manager of Oil Producers Limited in Lloydminster, Alta.

R. W. Curtis, M.E.I.C., who was design engineer at the National Film Board in Ottawa, is now demonstrator and graduate student in the department of electrical engineering at the University of Toronto.

Mr. Curtis is an electrical engineering graduate of the University of Manitoba, class of 1945, and was a lecturer in electrical engineering at that university for a time before joining the National Film Board.

V. G. Ulrich, M.E.I.C., is now associated with Emil Anderson Construction Company Ltd. at Lillooet, B.C. He was previously with Universal Seismic Surveys Ltd. in Calgary, Alta.

Mr. Ulrich graduated from the University of Manitoba in 1949 with a degree in civil engineering. After graduation he was with the P.F.R.A. in Regina, Sask., before joining Universal Seismic Surveys Ltd. in 1953.

J. C. Savage, M.E.I.C., assistant superintendent Bayer Ore Plants at the Arvida works of the Aluminum Company of Canada Ltd., has been transferred to Europe for one year. He will be at the international school of business administration, founded by the Aluminum Company at Geneva, Switzerland.

Mr. Savage graduated from McGill University in 1948 with a B.Eng. degree and has been with the Aluminum Company for the past seven years.

Sean Martyn, M.E.I.C., has joined Fraser-Brace Engineering Company Ltd. in Montreal. Mr. Martyn was previously with the special contracts division of the Bell Telephone Company of Canada, also in Montreal.

He is a civil engineering graduate of University College Galway, Ireland.

John R. v. Renteln, M.E.I.C., field and methods engineer with H. K. Ferguson Company Ltd. in Kingston, Ont., has formed a company known as Overseas Instruments of Canada, located in Kingston, Ont. The firm will import engineering instruments from Europe.

Ralph T. Morgan, M.E.I.C., has joined the department of trade and industry of the provincial government in Halifax, N.S.

Mr. Morgan, a 1944 graduate in mechanical engineering from Queen's University, has been with the United States Air Force at Goose Bay, Labrador, and also with Zwieker & Company Ltd. in Lunenburg, N.S.

Correction

In the August *Journal* (p. 1114) the name of the company of which **Leon Wigdor,** M.E.I.C., is technical manager was inadvertently misspelled. Mr. Wigdor is associated with Asbestonos Corporation Limited in St. Lambert, Que.

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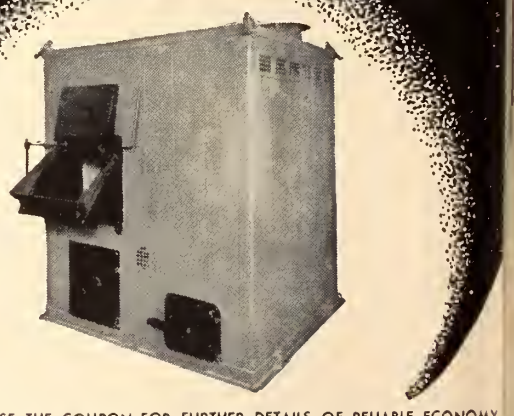

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• Personals

Walter T. Clarke, JR.E.I.C., has been appointed district manager in Montreal for Raymond Concrete Pile Company Ltd. Mr. Clarke has had charge of the boring contract operations of the Raymond organization in Toronto until his new appointment.

After serving with the R.C.A.F. during World War II as a flying officer Mr. Clarke graduated from McGill University in 1949 with a degree in civil engineering.

He had been associated with Gunite and Waterproofing Ltd. in Montreal and with Watson Jack & Company Ltd. in Montreal before joining Raymond Concrete Pile Company Ltd.

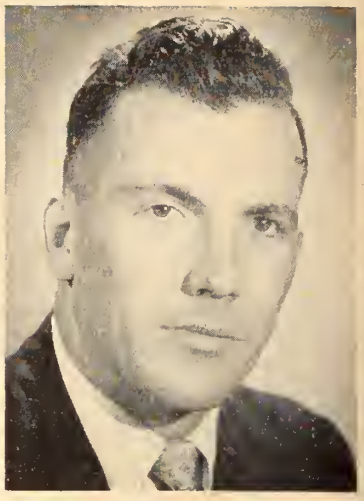
Mr. Clarke is a member of the Corporation of Professional Engineers of Quebec and in 1954 was president of the committee of young engineers of the Corporation.

W. D. Ousman, JR.E.I.C., is presently district engineer of the western division of the Carnation Company in California.

Mr. Ousman, who graduated from the University of Manitoba in 1946 with an electrical engineering degree, was formerly a field engineer with the Schlumber Well Surveying Corporation at Bakersfield, California.

J. A. Fuller, JR.E.I.C., has been transferred by John Inglis Company Ltd. to Toronto from Vancouver. He will be manager of the industrial division. He has been manager of the Vancouver district office of the company since 1951.

Mr. Fuller graduated from the University of Toronto in 1948 with a mechanical engineering degree and has been associated with John Inglis Company Ltd. since that time.



Walter T. Clarke, JR. E.I.C.

D. G. Donaldson, JR.E.I.C., has joined the Ontario Hydro-Electric Commission at Ottawa, Ont.

Mr. Donaldson graduated from the University of Saskatchewan in 1948 with a degree in electrical engineering. He joined Canadian General Electric Company Ltd. in Peterborough, Ont. in 1949 and remained with that company until his recent move to Ottawa.

H. D. Percy, JR.E.I.C., has joined Forano Limited in Montreal. He was previously in Brockville, Ont., with Phillips Electrical Works Ltd.

Mr. Percy graduated from McGill University in 1951 with a degree in mechanical engineering.

Richard E. Wells, JR.E.I.C., is now employed with Associated Engineering Services Ltd. of Vancouver, B.C.

Mr. Wells graduated from the University of British Columbia in 1951 with a degree in civil engineering. He joined the Canadian National Railways at Terrace, B.C. at that time. He was transferred to the bridge department of the C.N.R. at Winnipeg recently before accepting his present position.

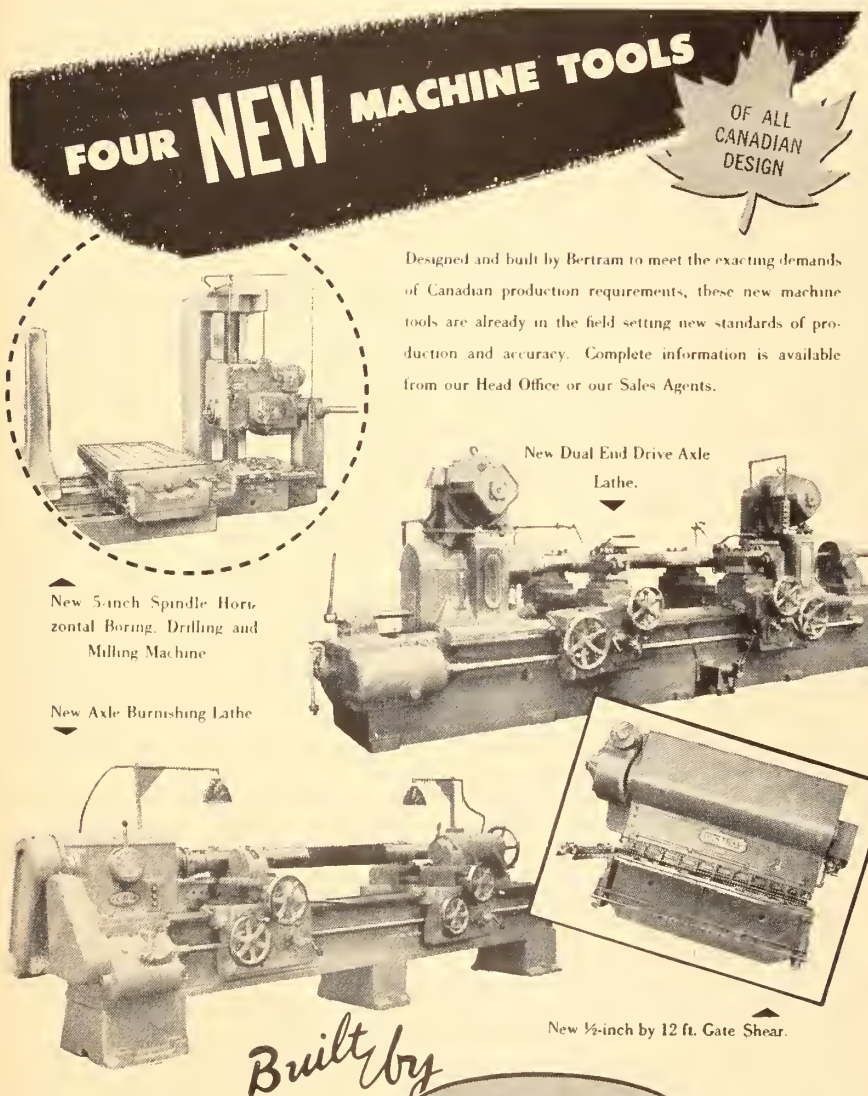
J. L. Durrell, JR.E.I.C., is now a design engineer with Foundation of Canada Engineering Corporation Ltd. in Toronto, Ont.

A mechanical engineering graduate of Queen's University in 1951, Mr. Durrell was previously employed with John H Ross, consulting engineer of Toronto.

A. G. McIntyre, JR.E.I.C., has been transferred to Port Arthur, Ont. by the Canadian National Railways and is division engineer of the Port Arthur division.

He has been associated with the company since 1949, following his graduation in 1948 from the University of Manitoba with a degree in civil engineering.

Mr. McIntyre was transitman in Port Arthur when he first became associated with the C.N.R. Subsequently he became division engineer and then resident engineer at Sherridon, Man. He was most recently in Victoria, B.C. with the company.



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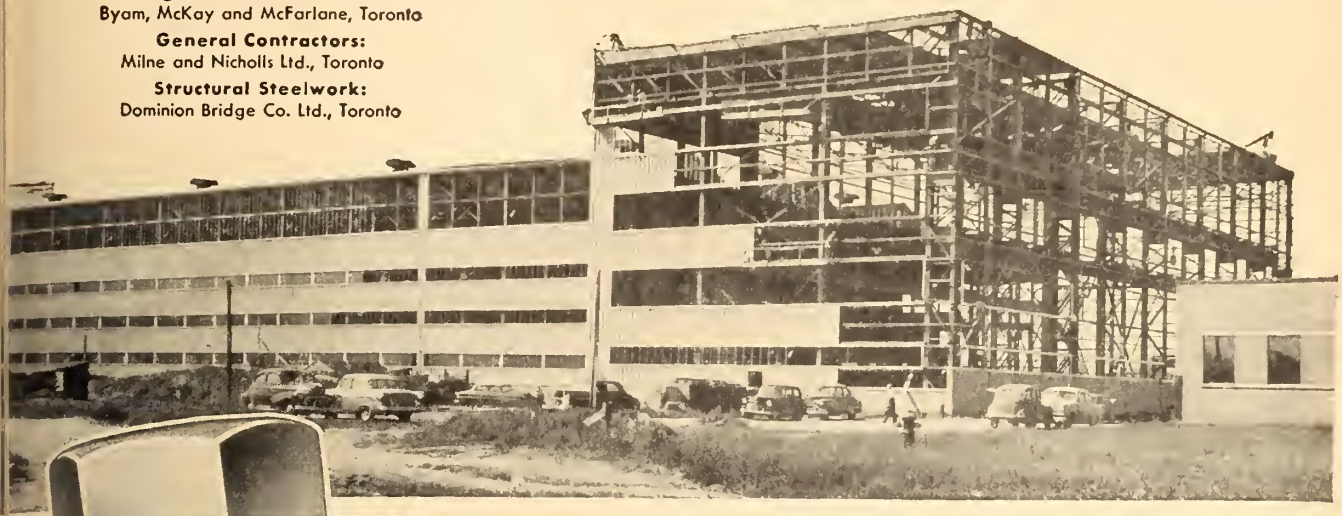

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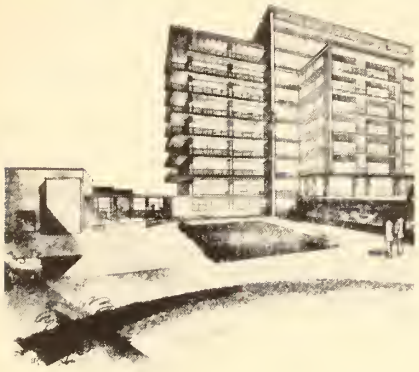
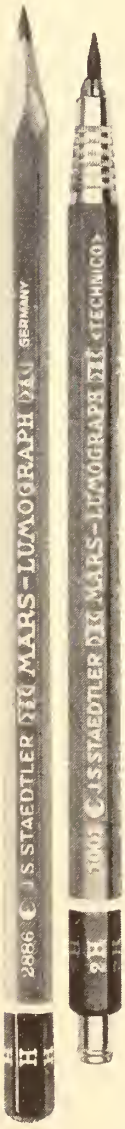


this renderer's technique?



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• Personals

R. G. Moorman, JR.E.I.C., previously assistant general manager of Riggs Motor Sales Ltd. in Belleville, Ont., has taken over the business of Culligan Soft Water Service, also in Belleville.

Mr. Moorman graduated from Queen's University in 1948 with a degree in mechanical engineering and became associated as junior engineer with the Ford Motor Company of Canada Ltd. in Windsor, Ont. He joined Riggs Motor Sales Ltd. in Belleville, Ont. in 1951 and became assistant general manager in 1953.

Warren A. Trotter, JR.E.I.C., has been named assistant commissioner of works by the Township of East York in Ontario.

He was previously deputy city engineer at Kingston, Ont.

Mr. Trotter graduated from Queen's University in 1948 with a degree in civil engineering. During his last year at university he received the Engineering Institute of Canada's prize awarded students of Canadian engineering schools annually.

M. E. Bailey, JR.E.I.C., has been appointed manager of belting and hose sales of the industrial products division of B.F. Goodrich Canada Limited at Kitchener, Ont. In addition to his previous responsibility as manager of flat belting and hose, Mr. Bailey will also be manager of V-Belt sales.

Mr. Bailey graduated from the University of Toronto in mechanical engineering in 1949 and immediately joined the staff of B.F. Goodrich Canada Limited. He has progressed through the positions of field and sales engineer and sales engineer in the industrial products division before his present appointment.

K. G. Lightwood, JR.E.I.C., is now project engineer with Marshall, Macklin and Monohan, consulting engineers in Toronto. He was previously sales engineer with Steel Building & Supply Ltd. in Toronto.

Mr. Lightwood graduated in 1949 from the University of Toronto with a degree in civil engineering. He has also been with Armco Drainage & Metal Products of Canada Ltd. in Guelph, Ont. as sales engineer.

Jean Claude Hurtubise, JR.E.I.C., is now on the engineering staff of the Quebec Telephone Corporation in Rimouski, Que. He was formerly on the engineering staff of the R.C.A. Victor Company in Montreal.

Mr. Hurtubise graduated from Laval University in 1949, specializing in electronics. He has also been scientific officer with the Defence Research Board at Shirley Bay, Ont.

J. MacDonald Hall, JR.E.I.C., has joined the staff of R. M. Way & Company Ltd., consulting engineers in Toronto, Ont.

Mr. Hall graduated from the University of Toronto in 1949 with a degree in civil engineering and joined the staff of the Toronto Harbour Commission as assistant engineer. In 1952 he became associated with Canadian Johns Manville Company Ltd. in Asbestos, Que. as a mechanical engineer and the following year was named design engineer for t company.

James Vincent Palmer, JR.E.I.C., ste plant supervisor for the Dominion Iro and Steel Corporation, has been name assistant superintendent of yards an docks in Sydney, N.S.

Mr. Palmer served with the Canadia Army during World War II and the graduated in 1950 from Nova Scot

M. E. Bailey, Jr. E.I.C.

Technical College with a degree in m chanical engineering.

Prior to joining Dominion Iron a Steel Corporation Mr. Palmer was ma ager of the Sydney plant of L. E. Sha Limited.

Stanley Hayden, JR.E.I.C., has bee named manager of the Winnipeg bran of Crowther MacKay and Associat Ltd. He was previously design engine for the company.

Mr. Hayden graduated from the Ur versity of Saskatchewan in 1950 in m chanical engineering.

E. J. Lee, JR.E.I.C., has been transferr to Jamaica by the Aluminum Compan He will be with the construction depar ment of Sprostons (Jamaica) Limit at Williamsfield.

A civil engineering graduate of t University of British Columbia, class 1950, Mr. Lee has been with the co pany in Vancouver and lastly, in Mon real.

John Sylvester, JR.E.I.C., has joined t hydraulic department of the St. La rence River Joint Board of Enginee Canadian Section, Montreal. Mr. Sy vester will be located in Cornwall, On

A 1950 civil engineering graduate Queen's University, he was previous junior design engineer with Spruce Fa Power and Paper Company Ltd. Kapuskasing, Ont.

C. R. deLannoy, JR.E.I.C., is now wo ing for the production division of t Kitimat Works of the Aluminum Co pany of Canada at Kitimat, B.C.

Mr. deLannoy who received his d gree of M.Sc. from the Catholic Univ sity of Louvain in 1950, was a train with the Aluminum Company at I Maligne, Que., before his transfer British Columbia.

Jacobus De Ruiter, JR.E.I.C., has acce ed a position as hydraulic engineer wi H. G. Acres & Company Ltd. in Niaga Falls, Ont.

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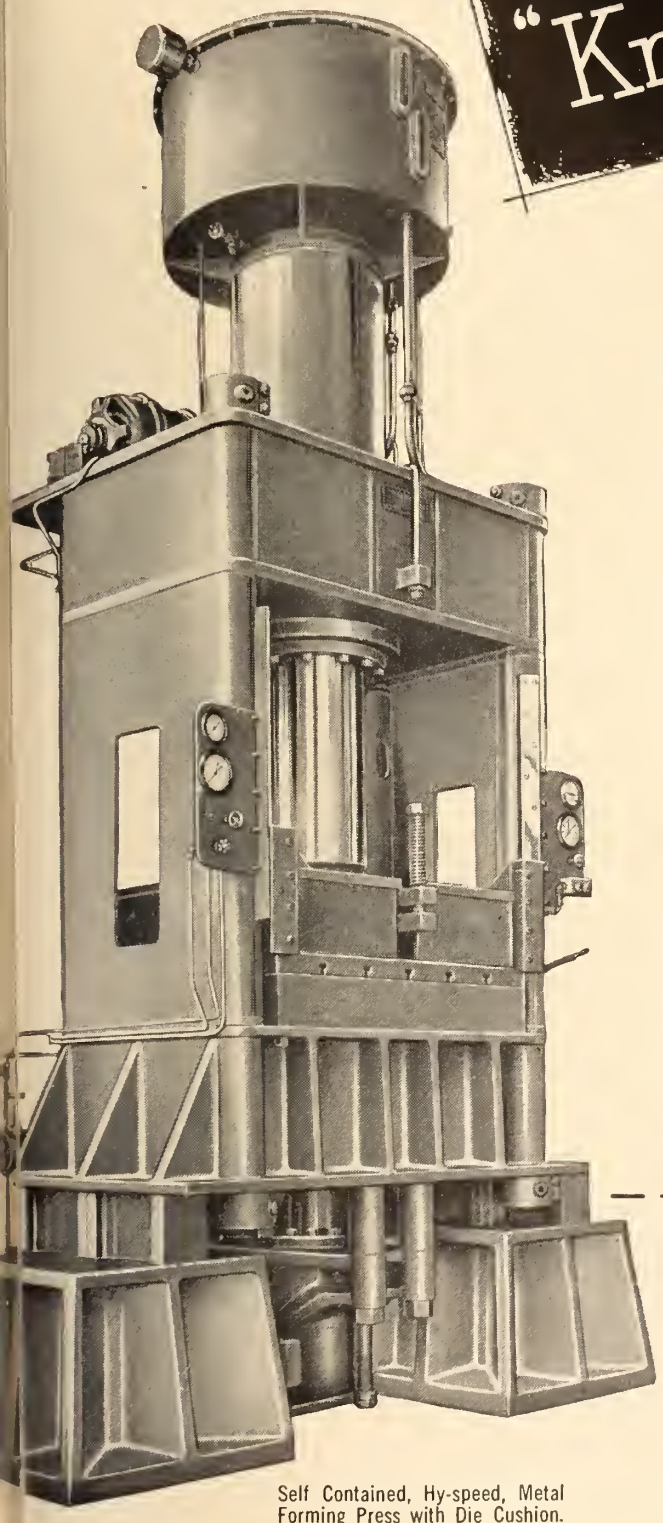

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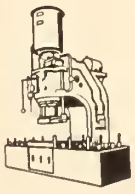

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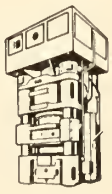

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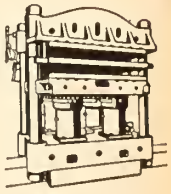

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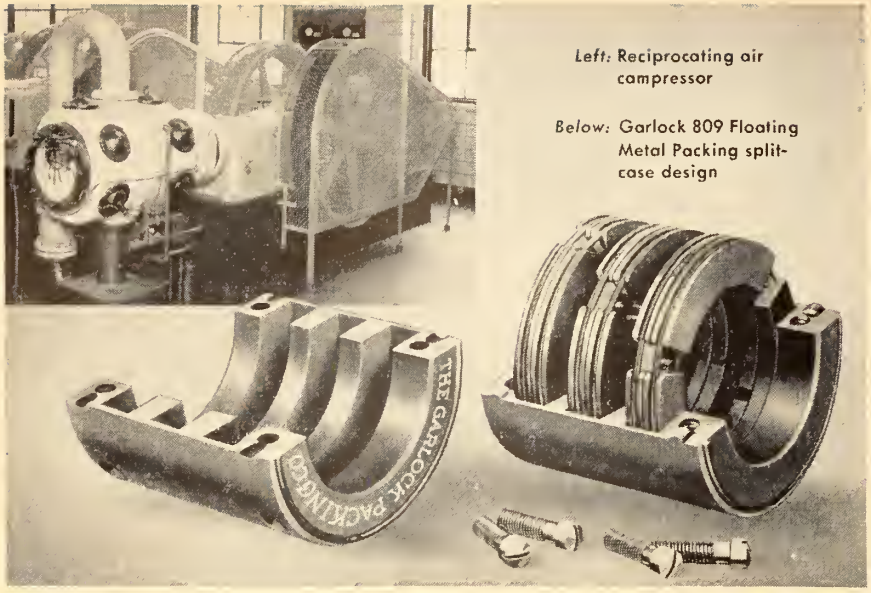

Left: Reciprocating air compressor

Below: Garlock 809 Floating Metal Packing split-case design

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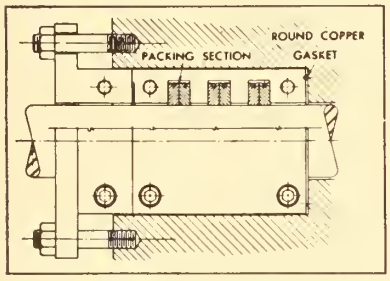

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• *Personals*

J. De Ruiter, Jr. E.I.C.

Mr. De Ruiter, a 1952 graduate of th Technical University of Delft in civ engineering, was previously with th P.F.R.A. (Dominion Department Agriculture). He was employed as hydraulic engineer on the Saskatchewa River Reclamation project, having bee associated with P.F.R.A. since April 19 when he came to Canada.

During the summer months of his un versity course Mr. De Ruiter was em ployed by Witteveen and Bos, consul ing engineers in Deventer, Holland; an by Electricité de France in Paris. H also spent some time in the Enginee Corps of the Royal Netherlands Arm

Mr. De Ruiter is a member of th Royal Dutch Engineering Institute.

Donald C. Tibbetts, Jr.E.I.C., has be transferred by the National Resear Council to Halifax where he will b working at the Maritime Regional St tion of the Building Research divisio He was previously in Ottawa as juni research officer.

Mr. Tibbetts graduated in 1952 fro Nova Scotia Technical College in civ engineering.

Robert C. Starr, S.E.I.C., has joined B. Sanderson & Company, consulti bridge engineers in Victoria, B.C., as civil engineer.

Formerly with Western Bridge Vancouver, Mr. Starr graduated fro McGill University last year with a d gree in civil engineering.

F. R. Serase, S.E.I.C., a graduate th year from the University of Manitob in civil engineering, is now employed the division engineer's office of t Canadian National Railways at Bel ville, Ont.

Stephen E. Steeves, S.E.I.C., is with t Anglo Newfoundland Developme Company at Grand Falls, Nfld.

He graduated this year from No Scotia Technical College with a chem cal engineering degree.

L. O. Fenniak, S.E.I.C., is a junior en neer in training with the Hydro Elect Power Commission of Ontario Niagara Falls, Ont.

Mr. Fenniak graduated this year fro the University of Alberta in electri engineering.

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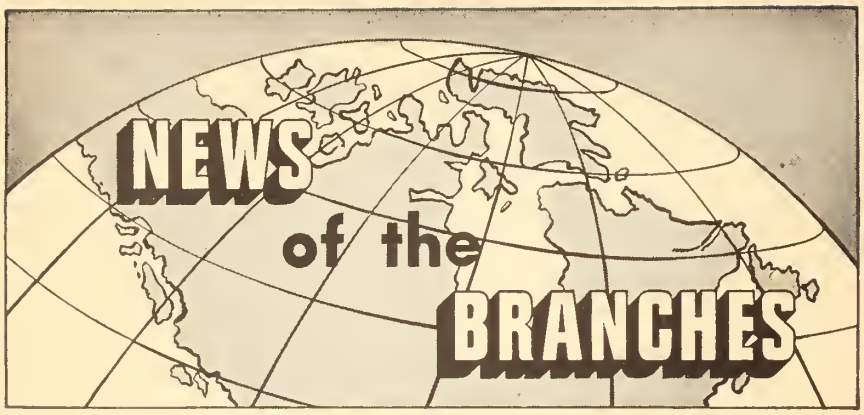

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and

abstracts of papers presented at their meetings

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Professional Development

One of the first activities to begin the winter season of the Hamilton Branch will be the Professional Development Program.

Wm. A. H. Filer, director of the Professional Development Program, has outlined the year's activities as follows:

Professional Development Programs are in operation throughout the country under the auspices of the Engineering Institute of Canada and with the voluntary leadership of E.I.C. members. The purpose of these programs is to stimulate the engineer's interest and to broaden his perspective of topics outside his own particular field. This is done through lectures, discussion periods, group presentations, and case studies. Each member is encouraged to participate actively for his own benefit and that of the group.

These programs started in Hamilton four years ago. As a result of past success and faith in the future, it is being expanded this year from three groups to four.

Group I will cover a wide range of subjects to interest the young engineer. The entrance qualifications will be those of Students or Juniors of the E.I.C. or the equivalent.

Group II will concentrate on five broad topics in some detail. Juniors of the E.I.C., graduates of Group I or those with equivalent qualifications will be accepted.

Group III will study business management intensively throughout the year. Members of the E.I.C., graduates of Group II or those with equivalent industrial experience will be eligible.

Group IV will discuss administrative practices by the case study method with active group participation. Membership in this group will be for graduates of Group III or those with equivalent management qualifications.

A certificate will be presented to each member having at least 66 per cent attendance during the year. This will be a testimony of active participation in the program.

This year's program will commence with Registration Night, September 21, 1955, in the Royal Canadian Artillery Mess, and will continue each Wednesday thereafter during the winter months.

At this meeting, Col. Grant will discuss the Engineering Council for Professional Development. Steps taken toward confederation and operation of the Association of Professional Engineers of Ontario will be explained by Col. Medland.

Eleventh Annual

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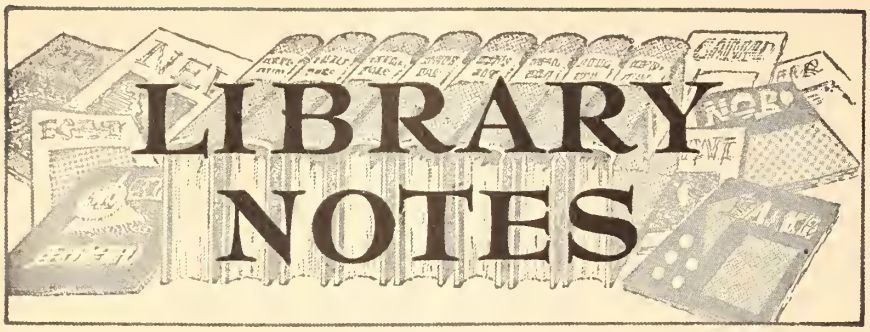

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Electric Power Capability and Load

The Bureau of Statistics in Ottawa has just released the first of what is planned to be a series of annual reports on the capability and load of the electric power industry in Canada. The figures, which were collected with the help of the Canadian Electrical Association, represented by two committees among whose nineteen members we note fourteen of our own, cover three periods; 1950-54 in the past, the current year (actual through March and estimated from March to December) and estimates for 1956-58.

Data were collected from 82 producers of electricity, 98 per cent of all those in the business, including some industries, e.g., pulp and paper, which produce and sell electricity incidentally to their major operations.

"Capability" is defined as "The maximum net kilowatt output (less) station service . . . with all equipment available at the time of the (annual) firm power peak load, determined as the average kilowatt output for one hour with no allowance for outage of generating units." This definition includes that of "firm power peak load".

To one not directly in the industry, the features of this report which make the most impact are the diagrams which show the great increase in the production, and hence use, of electricity since 1950 and the estimated increases to 1958. Figures are not given in kilowatt hours, but production and consumption measured in these units must roughly parallel capability and load. Capability increased from about 9.15 million kilowatts in 1950, to about 13.14 million in 1954 and is estimated to reach about 16.45 million in 1958. The corresponding loads are respectively, 8.49, 11.31 and 14.65 million kilowatts. These figures take into account power from and imported into Canada and show that there is and will be some reserve available for Canada as a whole, though there may be shortages in some provinces.

Another interesting fact brought to light in this report is that we are more and more depending on heat for the generation of our electricity. In 1950 our thermal generating capability was 0.642 million kilowatts; in March, 1955, it was 2.30 million. Thermal stations represented 7.0 per cent of our generating capability in 1950, 11.0 per cent in 1954 and will represent 14.0 in 1958. Will any of this be nuclear power?

The four diagrams and 19 pages of tables give the best picture of the phases of the electrical generating industry covered that we have seen. To get all the details buy the pamphlet yourself: **Annual electric power survey of capability and load as of March 1955.** Ottawa, Dominion bureau of statistics, 1955. 34pp., tables, 50c. S. C.

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Bibliography and Reference Service

Short subject bibliographies are compiled on request. When placing these requests, please give as much detail and background information as possible.

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Books, periodicals, pamphlets and films may be borrowed for two weeks at a time. All books included in the Library Notes Section of *The Engineering Journal* are available for loan. **A fine of 25c per day is charged for each day borrowed items are retained beyond the two-week period.**

A library deposit of $5.00 at par in Montreal is required, for which two items may be borrowed at a time. Temporary deposits (30 days or less) $10.00. Books are sent anywhere in Canada, and carrying charges are payable by the member concerned.

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• Library Notes

BOOK NOTES*

Prepared by the Library The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Atomic energy guidebook. Washington, Atomic energy guideletter, 1955 95pp., $7.50 (U.S.).

This comprehensive guidebook, covering civilian use in the atomic energy field, is a source of non-technical information on atomic energy and by-products that can be put to practical use.

The work covers the American scene and is divided into three sections. The first of these contains articles such as: How to enter the atomic energy business; Use of radioactive isotopes in industry and business, etc. Section Two goes on to more practical aspects: Multimillion dollar market in atomic instruments, Laboratory research contracts in science with the Atomic Energy Commission, and Status of atomic energy insurance. The remaining portion of the guidebook is a directory listing manufacturers of atomic instruments, a directory of the Atomic Energy Commission, statutory committees set up by congress, etc.

***Basic lubrication practice.** A. F. Brewer. New York, Reinhold, 1955 286pp., illus., $6.75 (U.S.).

Practical methods for lubricating machine parts, mechanisms, steam turbines, internal combustion engines, electric motors, and other types of machinery are discussed as an aid to engineers and others concerned with the selection and use of effective lubricants. Automatic lubrication, operating conditions affecting lubrication, physical tests, storage, handling, and reconditioning are also treated, and non-petroleum lubricants are considered briefly.

***Bibliographic survey of corrosion 1950-1951.** National association of corrosion engineers. Houston, The Association, 1955. 435pp., $12.50 (U.S.).

This compilation of 4454 abstracts is the fourth in a series covering 1945-1951. As in previous volumes, the abstracts are arranged by specific subdivisions under the eight main groups of the NACE filing system: general, testing, corrosion phenomena, corrosive environments, preventive measures, materials of construction, equipment, and indus-

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• Library Notes

tries. An author index and a detailed subject index complete the volume.

Brazing manual. American welding society. New York, Reinhold, 1955. 193pp., illus., $4.75 (U.S.).

Prepared by the Committee on Brazing and Soldering of the AWS, this manual covers the principles, equipment and procedures involved in eight methods of brazing—torch, twin-carbon arc, furnace, induction, resistance, dip, block and flow. All metals used in industrial brazing are described, and an appendix lists properties of metals and alloys suitable for brazing. There are also sections on testing, quality control, safety, etc.

The committee points out that the book is as complete and up-to-date as possible, but that many particular problems can only be solved through trial and error.

This manual will prove valuable to all those concerned with non-ferrous metals, or with ferrous to non-ferrous joining.

Business, legal, and ethical phases of engineering, 2nd ed. D. T. Canfield and J. H. Bowman. Toronto, McGraw-Hill, 1954. 365pp., $7.95 (U.S.).

A textbook intended for undergraduate students, this book contains all the material which might be covered in a course in engineering economics. It has been made as general as possible, but can be easily applied to any particular branch of engineering.

The four sections are headed business economy, cost determination, business law and engineering procedures. The last section includes chapters on bids and specifications, patents, copyrights and trade-marks, insurance, the practice of engineering and engineering as a profession.

Review problems and references for further reading are given at the ends of most chapters.

CABMA register of British products and Canadian distributors, 1955-56. London, Kelly's directories and Iliffe, 1955. 760pp., $7.50.

The third edition of this work is arranged in six sections. These are: a buyers' guide, providing an alphabetical list of some 4,000 British products available in Canada, together with their suppliers; a French glossary listing the equivalents of those headings; a directory of over 4,500 British firms giving details of their distribution arrangements in Canada; Canadian distributors listed alphabetically; proprietary names and trade names.

***The commissioning of electrical plant and associated problems,** 3rd ed. R. C. H. Richardson. Toronto, British Book Service, 1955. 440pp., diagrs., $8.50.

This thoroughly revised edition presents information that has been found useful in putting new plants into operation. The various sections of the book cover alternators, a-c motors, transformers, d-c generators and motors, rotary converters, mercury-arc rectifiers, and circuit breakers. A bibliography is included.

Communications du congres international de l'aluminium tenu à Paris du 14 au 19 juin 1954. Paris, Revue de l'Aluminium, 1955. 2 vols., illus.

In June, 1954, an international congress was held in Paris to commemorate the centenary of aluminum, and the eighty-one papers presented at the sessions are reprinted here. The majority are in French, one or two being in English.

The authors came from many different countries, and a wide variety of topics was covered. The papers are divided into seven classes; composition of aluminum and its alloys; manufacture; analysis; research; oxydation and corrosion; working; and uses.

Although there is unfortunately no index to the papers, the volumes should prove most useful, giving as they do an up-to-date survey of aluminum.

Concrete manual, 6th ed. Denver, United States. Bureau of reclamation. 1955. 491pp., illus., $2.50 (U.S.).

This, the first revision of the work since 1949, has new information on factors influencing strength of concrete. Type I cement is now recommended and precautions are given for the use of calcium chloride where sulfate attack is expected. Protection of new concrete during freezing weather is described, and a simpler test for mixer performance

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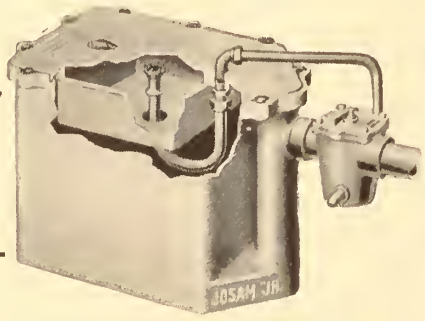

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outlined. In addition, more material is included on the repair of cracks in siphons and on the repair of concrete pipe.

This new edition of the manual will be welcomed by workers in the field of concrete, covering as it does all aspects of concrete mixing, testing, manufacture, placing and repair.

***Dimensions and tolerances for mass production.** Earle Buckingham. New York, Industrial Press, 1954. 164pp., diagrs., $8.00 (U.S.).

The author discusses the problem of dimensioning with tolerances in relation to production design, tool design, gage design, production, and inspection, and suggests methods and practices that would eliminate uncertainties in present practice. He also shows how limiting dimensions on detail drawings control conditions of bulk or size, form, position, assembly, operation, or functioning, and how methods for specifying tolerances may be different for each of these conditions. Worked out examples illustrate the discussion.

Douze; notre dix futur. Jean Essig. Paris, Dunod, Montreal, Fomac, 1955. 167pp., tables.

In this work, the subtitle of which is Essai sur la numération duodécimale et un system métrique concordant, the author outlines the case for the adoption of a duodecimal system of numeration. The writer's intent is to show that in the realm of figures, as in other domains, there is still progress to be made, and that the introduction of a system with a base 12 would simplify mathematics. His approach is a historical one and he includes a bibliography of works on numerical systems.

Electronique industrielle. G. Goudet. Paris, Eyrolles, 1955. 635pp., diagrs., 5,500 fr.

This book presents a synthesis of the principles necessary to the comprehension of modern electronics, illustrated by many examples of industrial applications.

Some of the main headings under which the material is grouped are: circuits, electron tubes, amplification, production and detection of electric signals, electron optics and applications, etc. Each of the seven main parts is further subdivided; for example, in the group of chapters dealing with electron optics are discussed the following: General laws of electron optics, the cathode ray tube, the electron microscope, electron diffraction apparatus and mass spectroscopes. High frequency heating, photoelectric cells and their applications, ultrasonics, etc., are among the subjects treated in the section on industrial applications.

The book has a bibliography and a well-elaborated table of contents.

Foundation engineering. Rolt Hammond. London, Odhams, Toronto, Nelson, Foster & Scott, 1955. 192pp., illus., $4.75.

Emphasizing practical problems and their solution, this compact volume deals with foundations for machinery, houses, buildings, bridges, and maritime structures. Throughout the book many examples of actual projects are cited, and a separate chapter is devoted to examples of especially complex operations. Selected aspects of soil mechanics and site engineering are also treated.

Light calculations and measurements; an introduction to the system of quantities and units in light-technology and to photometry. H. A. E. Keitz. Eindhoven, Philips', 1955. 113pp., illus.

Intended for both the student and the lighting engineer, this book is a practical guide to photometry, and deals with the application of the general principles found in most texts.

The first part of the book deals with light calculations; the theory of light refraction and dispersion, luminous intensity, methods of representing light distribution, etc. Part two is entitled Measurement of light, and covers photometry, photometers, etc.

The author has tried to present his information without having recourse to complicated mathematics, and has kept the practical aspects of the subject in mind. He presents most of the formulae and techniques needed in solving lighting problems.

Man in a cold environment. A. C. Burton and O. G. Edholm. London, Arnold, Toronto, Macmillan, 1955. 273pp., diagrs., $5.00.

This book was commissioned by the Defence Research Board of Canada, and one of the authors is on the staff of the University of Western Ontario, while the other was formerly there.

In the first section of the book the authors discuss the physical and physiological problems encountered in maintaining a thermal steady state. Secondly, the way animals have solved the problem is considered; the results of failure to maintain the heat balance are described, while a final chapter points the way to future research.

There is an author index to the many references contained in the text, although the authors state the bibliography is far from complete, December, 1951, being taken as a deadline in most cases.

Modern fluorescent lighting. 2nd ed. A. D. S. Atkinson. Toronto, British Book Service, 1955. 159pp., illus., $2.60

A concise treatment of principles and practices written for electrical and illuminating engineers, and architects. It covers the nature of light and fluorescence; principles and characteristics of lamps; illumination design; cold-cathode tubes; fittings; and applications in factories, offices, homes, etc. Both British and American practice is considered.

***Modern surveying for civil engineers.** 2nd ed. H. F. Birchal. Toronto, British Book Service, 1955. 528pp., illus., $8.50.

Intended for the surveyor in the field, this book briefly covers in a practical manner items such as mathematics, chaining, levelling, angular measurements, tacheometry, stadia traverse, surveys for hydraulic works, tunnels, harbors, and aerial surveying; as well as information on the organization of field parties. Errors and misprints in the 1935 edition have been corrected.

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Les moteurs diesel à grande vitesse. P. M. Heldt. Paris, Dunod, Montreal, Fomac, 1955. 463pp., illus., $13.05.

Translated from the seventh edition in English, the book takes into account the changes made in high-speed diesels in the last fifteen years. The author considers diesels connected with automobiles, aircraft, ships, railroads and industrial applications.

Largely rewritten, some of the topics covered are thermodynamics, injection pumps, two-stroke engines, and recent French engines and materials.

Navigational clearance requirements for highway and railroad bridges. Washington, United States, Department of commerce, 1955. 158pp., illus., map, $1.50 (U.S.).

Although applying to bridges over navigable rivers in the United States, we think many of our members will find this report interesting, and applicable to Canadian problems.

The report shows that in many cases slight modifications to craft using rivers would obviate the necessity for movable spans, which are costly and cause much delay to traffic.

Included in the many appendices is information on navigational clearances on various rivers, the cost of movable spans, cost of highway bridges, etc.

***Plant and process ventilation.** W. C. L. Hemeon. New York, Industrial Press, 1955. 437pp., diagrs., $9.00 (U.S.).

The emphasis in this book is on methods for analyzing factory ventilation problems and the dynamics of the air pollution process to determine quantities of ventilating air needed and the best methods for channeling air into the space in question. Subjects covered include behavior of contaminants in air; ventilation for bulk materials handling systems and hot processes; design of duct systems, exhaust systems, and related equipment. Tabular or graphical summaries are provided to meet the needs of the plant engineer.

Ports of the world, 9th ed. Sir Archibald Hurd, ed. London, Shipping World, 1955. 1581pp., 80/-.

The material in this ninth edition contains information sent to the editors by almost two thousand correspondents situated in every corner of the world.

The book is divided into two sections, the United Kingdom and the rest of the world. In the second section, the countries are grouped by continent. For each port is given a variety of information including location, population, principal imports and exports, authorities, accommodation, charges, pilotage, availability of repair facilities, rates, consuls, etc. There are line drawings of some ports, general information on national holidays, tables of distances between principal ports, a list of bunkering ports, and an alphabetical index to ports. It is surprising how much information has been compressed into this book.

Progress in cargo handling. London, Iliffe, 1955. 342pp., illus., 50/-.

The twenty-three papers comprising this book were presented at the second technical conference of the International Cargo Handling Co-ordination Association. The main objective of this four years old association is to co-ordinate discussion and provide information on moving cargo in and out of ships and ports.

Fifteen of the papers deal with various aspects of "The Ideal Port," the speakers giving concrete examples drawn from the ports best known to them. The other papers cover special aspects of cargo handling, including the unloading of bananas, problems connected with the fishing industry, training of dock workers, etc.

The value of the book is increased by the inclusion of a detailed index which is unusual in a work of this type.

Rhéologie théorique. M. Reiner. Paris, Dunod, Montreal, Fomac, 1955. 187pp., illus., $9.20.

Rheology owes its origin to the great use which is now made of synthetic products in such fields as paint, plastics, rubber, etc. It deals with the deformation and flow of matter.

This is one of the basic books on the subject, and is translated from the English. The author gives the mathe-

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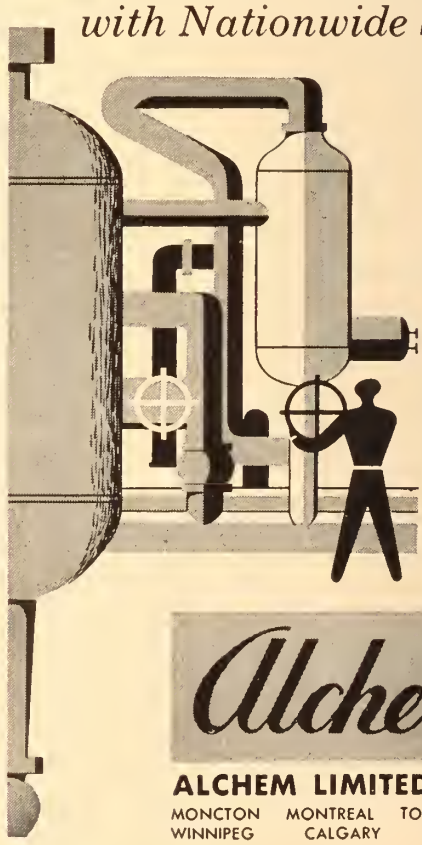

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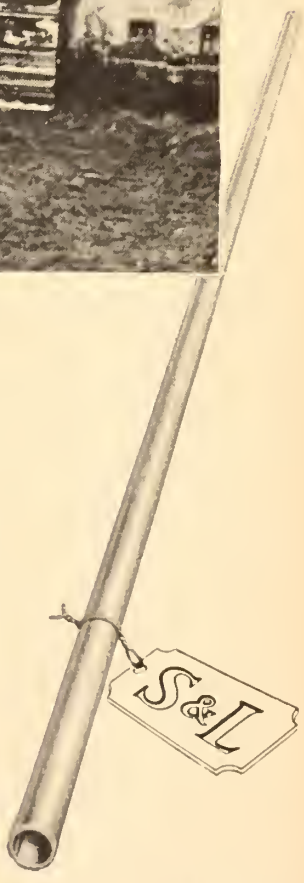

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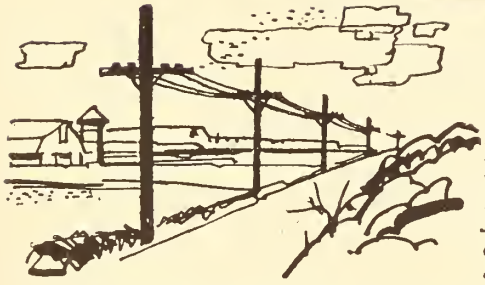

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matical basis of the subject, which as we find in the preface takes in the theory of elasticity, resistance of materials, plasticity, hydraulics, viscosity etc. There is a very useful six-page bibliography of periodical articles.

Scientific and technical societies of the United States and Canada, 6th ed. U.S. National Academy of Sciences-National Research Council Library and J. R. Kohr, comps. Washington, N.R.C., 1955. 447pp., $7.5 (U.S.).

The appearance of a new edition of this valuable handbook will be very welcome news, especially to librarians.

Divided into two sections, the first lists scientific and technical societies in the United States, while the second lists those in Canada. For each society the following details are given: address, permanent officers, history, purpose, membership, meetings, publications, library research funds, medals, etc.

The index lists publications, research funds and subject interests of the societies, and is very comprehensive, although not complete, as we notice the Engineering Journal does not appear.

This handbook is a must on any reference shelf.

Shell moulding process. Interim report. Birmingham, Association of bronze and brass founders, 1954. 36pp., mimeog., 5/-.

This report follows a three months survey of the industry in Great Britain and covers machines, equipment, sands resins, accuracy, etc. There is also a short list of references to periodical articles.

*__Some fundamentals of combustion__ D. B. Spalding. Toronto, Butterworth 1955. 250pp., diagrs., $7.50 (U.S.) (Gas Turbine Series, volume 2).

Brief chapters are included on selected aspects of heat and mass transfer thermodynamics, and fluid flow; somewhat longer chapters on heat and mass transfer with chemical reaction and chemical features of combustion. The latter deal with such specific topics as combustion of gas jets, combustion of pre-mixed gases, and combustion without pre-mixing. Some of the guiding principles for gas turbine design are discussed in the concluding chapter.

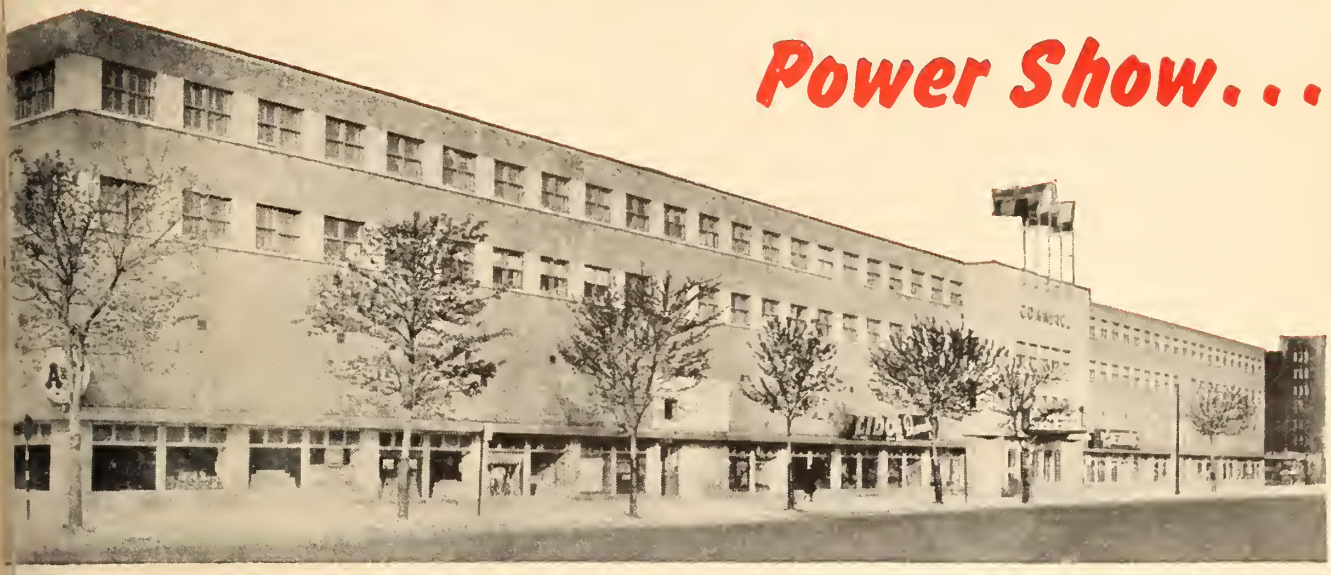
Speak to the earth. Max Miller. Toronto, Saunders, 1955. 310pp., $4.85.

In this popular account of the story of petroleum, the author traces both its geological and industrial history. Before writing his story, he journeyed all over the United States collecting information, and we have here a layman's impressions of the oil industry. The illustrations by J. W. McDermott add to the enjoyment of this interesting book.

*__Strength of materials. Part I: elementary theory and problems.__ 3rd ed. S. Timoshenko. Toronto, Van Nostrand, 1955. 442pp., diagrs., $6.50.

The third edition of this standard work has been expanded by the addition of two new chapters, one on the bending of beams in a plane which is not a plane of symmetry, the other on

PEACOCK at Canada's Power Show...



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• Library Notes

the bending of curved bars. A number of minor changes have been made throughout the book, and new problems have been added.

TV manufacturers' receiver trouble cures (volume 7). Milton Snitzer, ed. New York, Rider, 1955. 112pp., diagrs., pa., $1.80 (U.S.).

TV repair questions and answers (video circuits). Sidney Platt. New York, Rider, 1955. 121pp., illus., pa., $2.10 (U.S.).

Selling your TV-radio service. General Electric Co. Tube department. New York, Rider, 1955. 60pp., illus., pa., $1.00 (U.S.).

Picture book of TV troubles (vol. 4, Automatic gain control (ACG) circuits). John F. Rider Laboratories staff. New York, Rider, 1955. 84pp., illus., pa., $1.80 (U.S.).

Taxes and traffic: a study of highway financing. Toronto, Canadian tax foundation, 1955. 158pp., pa., $2.50. (Distributed by the Canadian good roads association to its members.)

This is the first Canadian study of the practical and theoretical aspects of highway financing to be published.

Techniques of plant maintenance and engineering, 1955. New York, Clapp and Poliak, Banner and Greif, 1955. 218pp., $7.50 (U.S.).

The proceedings of the technical sessions held concurrently with the Plant Maintenance and Engineering Show, this book contains in addition to the twenty-three prepared papers, the discussion they aroused, and summaries of the sixteen roundtable conferences which were also held.

Although most of the papers dealt with problems common to all plants, the chemical, food, paper, steel and textile industries were paid particular attention in the roundtables.

At the general session the requirements of maintenance and management were discussed, and other topics covered include training, planning maintenance, managing the maintenance force, materials handling, etc.

This volume is a valuable addition to a useful series.

Ten years of semi-conducting materials and transistors. N. L. Meyrick and G. Roman, comps. Cambridge, Pye Ltd., 1954. 37pp.

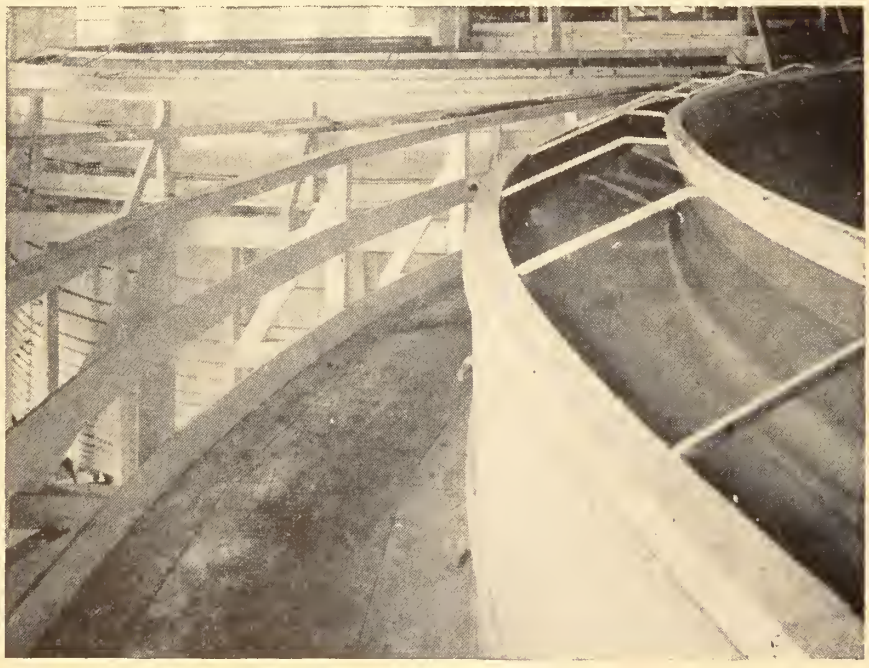
This bibliography covers the literature on semiconductors published in the past ten years or so. The entries are arranged by subject, and there is an author index. Unfortunately, there is no list of the sources from which the bibliography was compiled.

Thermionic valves 1904-1954: the first fifty years. London, Institution of electrical engineers, 1955. 69pp. illus., 9/-, 75c to E.I.C. members.

In commemoration of the fiftieth anniversary of Sir Ambrose Fleming's application for a patent for his diode, the Institution of Electrical Engineers held a special meeting when three lectures were given on the development of the thermionic valve. This book contains the three lectures, appreciations of Fleming and Lee de Forest, and illustrations of the exhibition of thermionic valves held at the time.

Wind effects on bridges and other flexible structures. Great Britain National physical laboratory. Ottawa U.K.I.O., 1955. 14pp., 40c.

This monograph is concerned with investigations, made chiefly in England into the oscillatory effects of wind on suspension bridges. Many of the findings are equally applicable to other flexible structures such as tall chimneys transmission lines and buildings.



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NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS WANTED

PRODUCTION ENGINEER, M.E.I.C., P.Eng. (Que.) McGill, diversified experience includes business administration, plant operation. Sales, purchasing, product control. Project engineering, labor negotiations. Manufacturing cost estimates and anaiyses. Plant layout, metbods studies. Production planning and scbeduling, material bandling. Age 45. Married. Desires cballenging and demanding position. Available on reasonable notice. Full resume on request. File No. 1186-W.

GRADUATE ENGINEER, B.Sc. (C.E.) cum laude, 10 years experience selling beavy machinery, gears, speed reducers, steel and bronze castings to heavy industry, including sbipyards, machinery builders, cement industry, steel fabricators and paper mills. Prior to this, wide experience in tbe production, inspection, maintenance engineering and time and methods study, phases of industry. The position desired would be in top level sales work, in sales management, or in management. It would offer ability and initiative, scope for advancement. File No. 2500-W.

GRADUATE ENGINEER 1945, age 33, bilingual, diversified industrial experience combined with sales engineering in various fields such as process control instruments, coals and petroleum fuels. Excellent knowledge of fuel marketing and extensive experience in many aspects of fuel utilization: beating, combustion, smoke abatement, steam plant engineering and related equipment. Seeks technical position of senior responsibility in sales, service, purchasing, management. Montreal area preferred. File No. 2554-W.

ELECTRICAL ENGINEER, P.Eng. Ont., with post-graduate training in business administration seeks responsible position leading to sales management. Eight years sales and manufacturing experience at supervisory level. Presently in sales administration, functions including supervision of sales, product promotion, technical projects, top level customer contact in Industrial market. File No. 2975-W.

CIVIL ENGINEER, Jr.E.I.C., McGill 1949, P.Eng., (Ont.), age 27. Experience as follows: design in reinforced concrete and structural steel, layout of building sites including roads, grading and drainage. Design of storm and sanitary sewers. Estimating and specification writing. Seeks job where knowledge will lead to position of increased responsibility. File No. 3134-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.) N.S.T.C. graduate 1950, 27 years old, single. Two years pulp and paper mill design and layout, one year diesel locomotive maintenance, 18 months railway car building and heavy repair. Desires responsible position where qualifications and experience can be utilized. Available on reasonable notice to present employer. File No. 3271-W.

MECHANICAL ENGINEER, M.E.I.C., P.Eng. (Ont.) graduated (Univ. Vienna) 1944 (Hons.) age 39, married, left home country 1947, in Canada since 1951. Ten years experience in manufacturing methods, production engineering of high precision components and heavy machinery; design and engineering of heavy machinery, precision parts, steam engines, boiler, heating and ventilating, piping, structures, material handling equipment. Good organizer. Excellent scientific worker. Desires responsible and challenging position. File No. 3990-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng., 1949, graduate. Married, 2 children. Experience as follows—1 year electronics, 2 years on inspection of electrical equipment, 2 years on construction, operation and maintenance of power houses, transmission lines, substations, 1½ years with consulting engineers on design of power and lighting systems for industrial and commercial buildings. Desire position with heavy industrial power or consulting company. File No. 4124-W.

SALES ENGINEER, P.Eng., Alberta 1950, age 31, desires employment as sales representative working out of Hamilton. Willing to sell any industrial or construction product. Five years experience in sales and engineering with industrial electrical manufacturing firm. Have both factory and district experience (2 years Montreal). 3 years with Navy as petty officer in radio and radar, married, family, resident of Hamilton. File No. 4213-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C., B.Eng. McGill '51. Single, 30. Completed graduate student training course with large electrical equipment manufacturer. Presently engaged as industrial engineer responsible for productivity of a power products line. Post graduate courses. Interested in position with greater responsibility, challenge and opportunity to demonstrate ability. File No. 4217-W.

INDUSTRIAL MANAGER, M.E.I.C. Mechanical engineer with twenty years experience all phases of engineering, production and management at both factory and general management level. Background covers sheet-metal manufacturing in both aircraft and commercial products. Successful record in organizing, leadership, and labor relations. Seeking career appointment, preferably in moderate sized company with opportunity for participation. File No. 4219-W.

ELECTRICAL ENGINEER, P.Eng., University of Alberta 1950, bilingual, experience in maintenance and plant engineering in heavy industry, statistical engineering and switchgear engineering. Seek responsible position in manufacturing. File No. 4427-W.

CIVIL ENGINEER, Jr.E.I.C., Sask. '49. Married. Age 27. Desirous of employment in Alberta. Experience chiefly in the field of heavy industrial equipment. Would like sales, plant engineering, application engineering. Presently located in Montreal. File No. 4517-W.

MECHANICAL AND INDUSTRIAL ENGINEER, McGill graduate, age 46, M.E.I.C., P.E.Q. and P.E.O., married, 21 years newsprint and fine paper experience, in repairs, maintenance and all phases of plant engineering. Desires change outside of Quebec. Available short notice. File No. 4540-W.

CIVIL ENGINEER, GRADUATE McGill University, wishes to find employment with a medium sized construction company or smaller consulting firm. Over five years experience in all phases of the building field: Engineering studies, sight and soil investigation, design, construction, maintenance, inspection, and costing. Have worked for some of the best construction firms and engineers. File No. 4588-W.

ELECTRICAL Jr.E.I.C., McGill '52, presently employed, experience includes utility and power project work, switchgear and control design, and contracts, industrial rectifier sales, and control work on D.C. drives. Interested in consulting or manufacturing in or around Montreal and would be available on one month's notice. File No. 4694-W.

INDUSTRIAL SALES ENGINEER, 30, graduate chemical engineer Jr.E.I.C., McGill 1951, P.Eng. (Que.), bilingual, married with family. Production and sales experience in building materials field and mechanical engineering field. Desires sales position with progressive firm having opportunities for advancement. File No. 4704-W.

CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.), A.M.I.C.E. (Britain), age 35, married, desires responsible position with well established engineering firm or municipal authority, preferably in British Columbia or Ontario. Experience includes approximately 10 years with highways and bridges authorities in U.K., 3 years as executive engineer in the Public Works Dept., East Africa, and 2 years in government engineering and construction service in Canada. Good administrative ability with considerable experience in design specification writing, and supervision of construction of highway projects, reinforced concrete bridges, domestic and public building works, airfields, water supply, sewage disposal, and drainage schemes. File No. 4707-W.

ELECTRICAL ENGINEER, B.A.Sc. 1945, P.Eng., M.E.I.C., age 31, married with family, C.G.E. test course, presently employed. Excellent technical and practical background combined with administrative experience including 7 years complete charge of electrical engineering, design, construction, operation and maintenance of large papermill and hydro electric stations including water control, transmission, relaying, and distribution. Other experience includes substation, illumination design and sales. Desires position in Canada or elsewhere with heavy industrial, power or consulting company where experience will be an asset. File No. 4725-W.

CHEMICAL ENGINEER, B.Sc., Alberta, 1951, Athlone Fellow, Jr.E.I.C., now completing research for Ph.D., University of London, desires position in chemical industry, preferably in Western Canada. File No. 4749-W.

ELECTRICAL ENGINEER, age 32, married, graduate (England), seven years experience in high voltage laboratory of a cable company, specialized in high voltage impulse testing of cables and accessories, impulse measuring and recording apparatus, seeks

situation in Ontario. Membership of the Association of Professional Engineers applied for. File No. 4751-W.

MECHANICAL-ELECTRICAL ENGINEER, with B.Sc., in Electrical Engineering, M.E.I.C., P.Eng. and Associate Member A.I.E.E., with seven years experience desires supervisory or management level position with an industrial organization. Experience includes one year manufacturer's test course, one and one-half years Sales Engineer and four and one-half years as Co-ordinating Engineer on large scale projects co-ordinating design, drawings, shop contact, engineering tests and field applications. Have completed Executive Evaluation Tests and results are available to prospective employer. Travel not objectionable and will locate anywhere in Canada or the Eastern United States. File No. 4759-W.

CIVIL ENGINEER, Toronto, B.A.Sc., M.A.Sc., Jr.E.I.C., P.Eng., age 27, married. Graduating in October. Seeks employment in structural design or fabrication in or around Toronto. Varied experience, including two years draughting, two years work in welding field. Special interest in metallurgy and welding during post graduate studies. File No. 4761-W.

MECHANICAL ENGINEER, P.Eng. (Ont.), age 35, graduated 1949 from Hannover University, Germany, diplom-ingenieur. Married, one child. In Canada two years. Experience in machine design, inspection, sales engineer. In Germany six years experience in plant maintenance, vibration research, with continental rubber industries. Consulting Engineer for vibration problems. Desires employment preferably in Ontario or Quebec. Available immediately. File No. 4762-W.

ELECTRICAL ENGINEER, B.Sc. (Queens, Belfast), 1953, Grad.I.E.E. Age 28, single, seeks contacts offering position soon after arrival Montreal October 4th, 1955. Experience: 3 years fleet air arm; completed two years graduate apprenticeship with B.T.H. Coy., Rugby, including four months industrial electronics; 8½ months with world renowned electrical consultants as an Assistant Resident Engineer; vacation work in power station in Germany, paper mill in Sweden, and distribution in Reykjavik, Iceland. Details and credentials upon request. File No. 4764-W.

MECHANICAL-ELECTRICAL ENGINEER, B.Sc. (Mechanical), Sask. 1952, Jr.E.I.C. Age 25, married. Have 3 years experience with large electrical manufacturer including their training course. Capable public speaker and lecturer. Experienced in the problems involved in producing and marketing a quality product at customers price. Capable of contacting and negotiating effectively at management or executive level. Desires a plant managers position or sales position with scope for initiative. Preferred location in Western Canada. File No. 4765-W.

CIVIL ENGINEER, National University of Ireland, with eight years good general construction experience, including tunnels, roads and piling. Seeks position with good construction company. Free to travel. File No. 4770-W.

AGRICULTURAL ENGINEER, P.Eng., Jr.E.I.C., B.E. (Sask. 1951). Canadian citizen, 26, married, farm background, Canadian experience: 2½ years design drawing office. British experience under Athlone Fellowship: one year machine shop training, one year divided between process planning, time and motion study, and design drawing departments. Desires position in design or development field, preferably connected with the farm equipment industry. Available Nov. 1st. Location open. Resume sent on request. File No. 4772-W.

FIRMS OR INDIVIDUALS IN CANADA or the U.S. desiring consultations or representation in Mexico, or other parts of Latin America may contact a professional engineer (Member Corp. of Professional Engineers of Quebec) with broad and lengthy experience and travel, knowledge of Spanish, permanent resident status in Mexico, and numerous important contacts in Canada, the U.S., Mexico, Venezuela, and the West Indies. Correspondence invited. File No. 4773-W.

MECHANICAL ELECTRICAL ENGINEER. P.Eng., Jr.E.I.C., high standing graduate from Polytechnique, 1953, bilingual, single. Two years experience in administrative work with large municipality. Actually in charge of two engineers, one technician and two foremen. Two years evening studies in general electricity at McGill University. Seeks challenging position with advancement and incentive for consulting engineers or contractors located in Montreal area, not necessarily in electricity or mechanics. File No. 4774-W.

MECHANICAL ENGINEER, Jr.E.I.C., B.Sc., P.Eng. Six years varied experience in estimating, incentive systems, plant layout and product inspection. Supervisory and administrative experience as a departmental head responsible for high daily productive output of forged and machined products. Seeking responsible position with greater opportunity for advancement. File No. 4775-W.

METALLURGICAL ENGINEER, P.Eng., M.E.I.C., M.C.I.M.M. Canadian born. Married, age 37. Graduate McGill University. Course in management administration. Twelve years diversified experience in ferrous metallurgical development and supervision of chemical and metallurgical laboratories, inspection, specification and technical service divisions in steel finishing mill. Presently employed but seeks more responsible position. File No. 4782-W.

MECHANICAL ENGINEER, S.E.I.C., N.S.T.C., 1952, age 26, married, 2 children. Experienced in newsprint mill process and development. Excellent knowledge of process instrumentation. Desires permanent responsible position in development, production or instrumentation. Has done considerable supervising. Detailed resume on request. File No. 4783-W.

MECHANICAL ENGINEER, P.Eng. (Ont.), Jr.E.I.C., B.Eng., 1954, McGill University, age 24, married, experience in sales, manufacturing methods and maintenance. Desires work of definite mechanical nature, either sales or/and engineering. Hamilton area preferred with moderate travel acceptable. File No. 4785-W.

YOUNG MANUFACTURING EXECUTIVE electrical engineer, M.S., P.Eng., M.E.I.C., A.M.I.E.E., A.M.A.I.E.E., early thirties, experienced manufacture switchgear and control gear, successively development engineer, chief engineer, manager. Seeks executive position (not necessarily electrical) with scope and good future prospects. Location open. File No. 4786-W.

MINING ENGINEER, specialized also in soil mechanics, wide experience drilling, prospecting, development, production; in coal, salt, quarries, oil and formerly full professor Mining Engineering. Technical Assistance Administration (U.N.) expert. Fluent English and French, Spanish, Portuguese. Married, age 45 years. Desires position where any former experience may be best utilized. Available immediately. File No. 4791-W.

MECHANICAL AND INDUSTRIAL ENGINEER, P.Eng. (Que.), Jr.E.I.C., graduate B.Eng. McGill 1951. 27 year old, married, with two children. Four years experience in fields of plant engineering, plant layout, process engineering, production control in various junior administrative positions with a medium-sized company in the manufacture of light precision machine parts. Extensive extra-curricular study in the fields of business administration accounting and auditing. Desires responsible position as deputy to general manager or in industrial engineering and production control where initiative and top performance will lead to increases in responsibility and incentive. Willing to travel and will locate anywhere in Canada or northeastern United States. Canadian citizen available upon three months notice. Substantiating data available on request. File No. 4792-W.

ELECTRICAL ENGINEER, B.Sc., E.E., 1953, age 24, single, Jr.E.I.C., 2 years in England on Athlone Fellowship, experience with large manufacturer of power equipment, several months experience in switchgear and relay applications departments, desires employment with future leading to position of responsibility in Canada or abroad. Please reply to File No. 4794-W.

CHEMICAL ENGINEER, M.E.I.C., married, age 47, 16 years experience in oil industry, 3 years experience in Canada as chemist analyst for ferrous and non-ferrous alloys. Economic studies, business and sales experience. Speaking fluently French and Italian. Interested in a position where capabilities will be fully utilized. Location and size of company is not important. Available on 15 days notice to present employer. File No. 4797-W.

MECHANICAL ENGINEER, Jr.E.I.C., age 30, five years practical experience in power plant, chemical plant, and refinery design and construction. Desires position in P.Q., preferably Montreal area. File No. 4798-W.

ELECTRICAL ENGINEER, B.A., B.A.Sc., Laval University 1954. Presently on a two year training course in England with a world wide company, specializing in hydro-electric. Undergraduate experience in the power field, experienced traveller. Married, 24, bilingual. Seeking interesting position with consultant firm or power company. Location open. File No. 4799-W.

GRADUATE ENGINEER, M.E.I.C., U. of T. 1922, chemical, civil, mechanical. Available Oct. 15, now resident Toronto. Immediate employment is desired anywhere, where there is prospect of permanence and some future ahead. Experience: tool designer, mechanical and architectural draftsman, structural steel and reinforced concrete detailer, pressure vessel detailer (over 10 years). Hold high school teaching certificate have technical school and university teaching experience (1 years). Particular interest includes: chemical plant, oil refinery, steam plant, structural steel fabrication plant, associate or partner in consulting practice. Transportation expens advance is requested where interview is re quired prior to engagement. File No. 4800-W

MECHANICAL ENGINEER, S.E.I.C., N.S.T.C. 1955. Summer experience includes, design sales and price estimating with heating an ventilating contractor. Laterly engineerin trainee in plant operation and maintenance Seeks opportunity with engineering compan in any location. Presently located in Mont real. File No. 4801-W.

SITUATIONS VACANT

CHEMICAL

CHEMICAL ENGINEER OR CHEMIST, require for position as Technical Assistant to th Plant Manager of new caustic-chlorine plant i Alberta. Preferably a young man with on to three years experience in control and de velopment work in an industrial plant. Positio affords an excellent opportunity for a ma with initiative who is willing to assume re sponsibility. File No. 5310-V.

CHEMICAL ENGINEERING GRADUATE, re quired for oil refinery in Winnipeg, as technical assistant. One or two years experienc in technical and economic studies and proces design preferred. Write giving full particular of training and experience. File No. 5316-V

VACANCIES EXIST in a large specialty pul and paper mill in the Eastern Township Province of Quebec. We require one chemic engineer and one chemist. The successfu applicants will be employed in the Technic Department. Initially work will consist technical investigations throughout the m aimed at increased production and high quality. The positions offer interesting wo with good opportunities for advancemen Candidates must be recent graduates of recognized university. Previous experience the industry is not necessary. Essential qua ties are initiative, self confidence and abili to work with a minimum of supervision. App in writing giving full details of education, e perience and career. All applications will handled in strict confidence. File No. 5321-

CHEMICAL ENGINEER, required by large company located in Toronto to work into sale Applicant will start in Toronto area, but mu be willing to move elsewhere in Canada. Can dian graduate preferred. Salary commensu ate with ability, etc. File No. 5324-V.

CHEMICAL ENGINEER or mechanical engine with chemcial plant experience required f plant development and process improveme in a chemical plant in Toronto. Must hav 5-10 years experience in chemical plant ope ation or maintenance some design or e gineering experience desirable. Salary cor mensurate with ability, pension, health a hospitalization benefits provided. File N 5329-V.

CHEMICAL ENGINEER or chemist requir for training to manage a new department an established chemical manufacturing co cern in Montreal. Practical industrial e perience in chemical operations helpful, b not essential. Apply giving training, experien and salary expected. File No. 5331-V.

CHEMICAL ENGINEER required to fill t position of junior research engineer. Interest in young engineers recently graduated a who are interested in research work. T position is available immediately. Good sta ing salary. File No. 5334-V.

CHEMICAL ENGINEERS required by chemic works within 40 miles of Montreal. Success applicants will be trained for producti supervision. Two years experience preferre File No. 5352-V.

RESEARCH CHEMICAL ENGINEER requir in Montreal. A recent graduate, with go scholastic record for small, scale pilot-mod research and development on cooking and r covery processes in the manufacture of pu and paper. Apply by resume to File N 5362-V.

YOUNG CHEMICAL ENGINEER recent grad ate or one with 1 to 4 years experience r quired by long established chemical manufa turer located 18 miles from centre of Mon real. Duties include part office and pa plant. File No. 5371-V.

CHEMICAL ENGINEERS (3 years or less e perience) required for reseach and develo

TO THE YOUNG ENGINEER

A Chance to Perform

IN THE SERVICE OF CANADA

Today an army runs on powered wheels and muzzle velocity, cosine and stress, vanishing point and point of no return, logistics and stamina level, absolute zero and the cathode ray.

To be on top, an army must have the talents of men who can design, prove and service the machines and instruments that will keep it there.

Engineers — civil, chemical, electrical, mechanical — help keep an army functioning smoothly.

Therefore the Army can use young imaginative engineers, engineers who, in the interest of keeping the Canadian Army ahead, will be encouraged to pursue their special talents.

Request an interview with the Recruiting Officer nearest you. Ask him about careers for officers in the Engineering branches of the Army. He has the answers you need, or write:

Directorate of Manning,
Army Headquarters, Ottawa, Ont.

ment work in large chemical company situated in Niagara Falls, Ontario. File No. 5380-V.

PETROLEUM CHEMIST, wanted to work on research and manufacture of lubricating greases and oils. Must have experience in development and process plant, operational knowledge of manufacture of greases, motor oils, metal cutting oils and soluble oils. Education level, B.Sc. or B.A. minimum. Age 25-55. Salary commensurate with previous experience and ability to contribute to technical group work. Location of employment, Montreal. File No. 5399-V.

ENGINEER REQUIRED FOR PROJECT engineering work by petroleum contractors in the Toronto area. Applicants should have minimum 3 to 5 years experience in petroleum or chemical industry with knowledge of equipment selection and co-ordination of engineering purchasing and construction. Salary open. File No. 5407-V.

CHEMICAL ENGINEER required by large Montreal manufacturer, recent graduate to be trained for work involving a wide variety of plant processes including organic finishes. Preference will be given to a recent University graduate, but consideration will also be given applicants with chemical finishing experience in the mass production field. File No. 5425-V.

CIVIL

STRUCTURAL ENGINEERS AND DRAUGHTSMEN. General industrial steel and concrete design, draughting. Salary commensurate with experience. Location Montreal. File No. 5326-V.

SENIOR STRUCTURAL DESIGNER required by firm of consulting engineers in Toronto. Salary negotiable. File No. 5342-V.

CIVIL ENGINEER required by firm of consulting engineers to act as resident engineer for large highway job. Location Ontario. Living quarters provided for wife and family. Well experienced man required. Duration of present work approximately 3 years, with possibility of permanent employment. Salary negotiable. File No. 5342-V.

CIVIL OR STRUCTURAL ENGINEER with administrative ability required for timber development engineering by Canadian Institute of timber construction. This institute, representing the structural timber fabricating industry in Canada, has several projects under way requiring professional personnel with ability to develop and present design information for the use of designing engineers and architects. Experience in design, preferably with a consulting firm is desirable. Ability to administrate and to coordinate activities of others is essential. We visualize a man 30-40 who likes variety in his work and enjoys working with people. Location, Ottawa. Reply giving full details. File No. 5355-V.

STRUCTURAL ENGINEER for technical promotion work in connection with a major type of building construction. Applicant must be a Canadian citizen experienced in structural design and capable of meeting and assisting engineers, architects and public officials with structural problems. Office in Toronto, considerable travel in Ontario. Salary $6,000. Car allowance. Reply stating personal data, qualifications and references. File No. 5360-V.

SOILS ENGINEER, required by rapidly expanding consulting firm located in Western Canada. Must have a post graduate degree majoring in soils and a minimum of five years experience in related work. State full particulars as to age, experience and salary expected in first letter. File No. 5365-V.

WATERWORKS DESIGN ENGINEER. Applicant must be a graduate professional engineer of a recognized university and preferably a member of the Association of Professional Engineers of Ontario or the equivalent. Should have a minimum of 7 to 10 years experience in the design of engineering structures re, watermains, pumping station, elevated tanks, etc. Excellent opportunity for advancement. Generous sick leave, pension, vacation, and hospital and medical plan. Initial salary range $5,600 to $7,200. Starting salary commensurate with ability and experience. Municipality located in Southern Ontario. File No. 5369-V.

YOUNG ENGINEER or architect required for young construction firm, specializing more in sewer work and excavation but also doing building construction. Salary to start $400.00 per month. Must have at least two years experience and not over 35 years of age. Apply stating age, graduation, experience, and references to File No. 5373-V.

RECENT GRADUATE CIVIL ENGINEER required in the track section of the office of the chief engineer of a major railway company in Montreal. File No. 5377-V.

CIVIL ENGINEER preferably not over 35 years of age required by structural steel firm in Montreal, to act as salesman for roof deck and wall panel construction. Salary open. Please reply File No. 5393-V.

SOIL ENGINEERS, required by well known Engineering and Construction Company. Must be graduate Civil Engineers, preferably with post graduate studies in soil mechanics and foundation engineering. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

GRADUATE CIVIL ENGINEERS, required by well known engineering and construction company for special work in the field of soil mechanics and foundation engineering. Post graduate studies in soil mechanics and structures desirable but not essential. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

SENIOR STRUCTURAL ENGINEER required for mining and concentrating plant design and layout. Please state full details of qualifications, experience and age in first letter to File No. 5398-V.

LECTURER CIVIL ENGINEERING for immediate appointment: to give undergraduate instruction in design of steel and timber structures and allied subjects to carry out investigations and research. Salary range $3440 to $4100 with superannuation, hospital insurance and other benefits. Applicant should be university graduate with some years practical or teaching experience in structural design. Location Halifax, Nova Scotia. File No. 5410-V.

A PRESIDENT IS REQUIRED immediately by a Montreal firm, thoroughly experienced in the contracting industry, especially in the management and public relations industry. Successful candidate should be a man of ability and vision. Preferred age 35-45; must be a civil engineering graduate. Salary in five figures plus bonus. File No. 5417-V.

ELECTRICAL

IMMEDIATE OPENINGS, for electronic engineers. General company expansion has created several opportunities for men with proven ability and experience for the design and development of complex electronic apparatus. There are openings for electrical and mechanical engineers in the following fields: electronic computors, microwave relay systems, test equipment design and development. Systems engineering, transistors. If you are interested in improving your professional status and knowledge by joining a firm that offers the security and prestige of leadership send full details as to age, education and past experience by mail. All replies will be held in strict confidence and will be acknowledged. File No. 5299-V.

ELECTRICAL ENGINEER, 4 to 8 years experience in electronics, electrical or electromagnetic circuits. Capable of doing and directing development in these fields; interested in developing his own ideas with those of others in exchange for an opportunity to participate in a small progressive engineering company. File No. 5304-V.

APPLICATIONS ARE INVITED from engineers with at least five years experience to act as assistant to City Engineer. Must have experience in design, planning, grading and paving roads and streets. Good permanent position for right person. Pension plan and other fringe benefits. Official application forms may be obtained at the Executive Director Office, City Hall, Saint John, N.B. File No. 5305-V.

STRUCTURAL STEEL DESIGNER. Outstanding opportunity for Ontario Professional Engineer with minimum of five years experience in the design of structural steel buildings. Excellent starting salary, modern office and good working conditions. Please state age, experience, references and salary required. File No. 5306-V.

ASSISTANT SALES MANAGER for electrical industry. Graduate electrical engineer preferred with experience of sales organization, in the switchgear and transformer field. Please state experience, age and salary expected. Application to be accompanied by a recent photograph. File No. 5308-V.

ELECTRICAL ENGINEERS AND DRAUGHTSMEN. Industrial, electrical light and power distribution. Salary commensurate with experience. Location Montreal. File No. 5326-V.

ELECTRICAL ENGINEER up to $7,200.00 to supervise the installation and the design, preparation of plans, specifications and estimates of electrical systems for public buildings. For further information write to File No. 5330-V.

ELECTRICAL ENGINEER for the production department. This man to have a maximum

YOUR OPPORTUNITY TO INCREASE EXPERIENCE RESPONSIBILITY SALARY

Continuing progress and expansion of Dow-Canada's operations have created interesting permanent career opportunities for:

PROCESS ENGINEERS

Initially these two young Chemical Engineers will be assigned process evaluation and/or development problems and will do trouble shooting in the process plants*. This on-the-job training will lead to Production Supervision, Technical Sales or Service or Technical Administration, etc. (Located in Sarnia)

*Ethylene, Chlorine, Caustic, Styrene, Polystyrene, Latex, Glycol, Solvents or Ammonia.

SALES ENGINEERS

Two Engineers with a flair for selling and with some sales experience in a process industry will be given the opportunity to combine technical training with interesting customer contact. (Initially located in Toronto or Montreal)

One young Metallurgical, Mechanical or Chemical Engineer with the aggressiveness to develop a national market in the light metal industry. (Located in Toronto)

PROJECT ENGINEER

With 2 to 5 years mechanical design experience in a process industry. This position would provide the opportunities to handle major prospects in all aspects and to see the project actually built in the field. (Located in Sarnia)

ELECTRICAL ENGINEER

A recent graduate now in a narrow field but who wants broad experience in the design, installation and operation of heavy power distributing equipment.

SALES TRAINEE

After extensive training in Canada and U.S. these two trainees will be given permanent assignments as field representatives. (Initially located in Toronto)

To arrange an interview, write to our General Sales Service Manager in Toronto (Mr. T. Chambers, 600 University Ave.) or our Personnel Supervisor in Sarnia (Mr. L. Pressnail, P.O. Box 1012, Sarnia)

DOW CHEMICAL OF CANADA, LIMITED

PROJECT ENGINEER

Excellent opening for the right man, with a well established engineering firm in Montreal specializing in the hydro-electric field.

• • •

This is a senior position. Applicant should be a graduote with 15 - 20 yeors' experience in the design, preparation of plans and specificotions, reports and estimates for the civil engineering aspects of hydro-electric power developments. He will be required to toke charge of a design group as Project Engineer.

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The position is of a permanent nature and entoils the usual pension, group insurance, and other benefits. The salary will be commensurate with the capobilities, educational bockground and experience of the applicant. The applicant should be prepared to furnish references as to his quolifications ond experience. All applications will be acknowledged.

Please apply to The Engineering Journal file number 5431-V.

of two years experience in production detailing and checking on low voltage distribution equipment of all kinds. Location South Ontario. File No. 5346-V.

GRADUATE ELECTRICAL ENGINEERS. We require graduate electrical engineers for our Montreal Engineering department. We are looking for men with experience in power utility work or associated lines. Duties will consist of design of power stations, transmission systems, sub-stations, distribution and control systems and would include field supervision of installations. The salary offered will be based on ability and experience. The company has normal employee benefits. File No. 5354-V.

GRADUATE ELECTRICAL ENGINEER, required as assistant engineer rural department of power company in Alberta. Location in Edmonton. Duties involve design and estimation of single phase farm power lines with related engineering. Salary commensurate with qualifications. Excellent employee benefits provide pension, group life, sickness and accident coverage. File No. 5359-V.

TWO JUNIOR ELECTRICAL OR engineering physicists for work in our research and development departments. The work involves research and development work in various special antennae and related components. Location Ontario. File No. 5374-V.

ELECTRICAL ENGINEER university graduate required for electrical service of power and industrial equipment of a Canadian manufacturer. Applicant will be located in Montreal with possibility of limited amount of travel in Province of Quebec. Please state education, experience and starting salary expected. File No. 5384-V.

ELECTRICAL SALES ENGINEERING AND APPLICATION ENGINEERING positions in new and growing company making electrical, industrial control apparatus in S. W. Ontario. Prefer electrical, mechanical or engineering and business. File No. 5388-V.

ELECTRICAL MANUFACTURING ENGINEER, with experience in the design and manufacture of Air Break Switchgear required for Chief Engineers position with Western Manufacturer. Should be capable of leading a development program in a newly equipped laboratory on low voltage air break switchgear and circuit breakers up to 15 kv. Salary open. Replies from applicants with all or part of the required experience will be treated in strict confidence, and should contain full details of experience, age, and educational background. File No. 5395-V.

COMMUNICATIONS DEPARTMENT OF LARGE transportation company in Montreal has immediate openings for electrical engineering graduates specializing in or with experience in communications as assistant engineers in the transmission and equipment groups. Work involves application and special engineering of all types of carrier telephone telegraph program network transmission, television and broadband microwave systems. Offers wide range of experience in communications field. Headquarters Montreal, with field engineering throughout system. All replies will be held in strict confidence and will be acknowledged. File No. 5403-V.

ELECTRICAL ENGINEER WITH experience in design of electrical installations including communications for industrial and commercial buildings. Minimum five years experience since graduation. Firm of consulting engineers in Toronto. File No. 5411-V.

ELECTRONIC ENGINEER required with several years experience in design and construction of experimental equipment. Knowledge of magnetic amplifiers essential. Capable of independent work on servo-mechanisms for aircraft application. Manufacturer of aircraft engine fuel systems located in Toronto. Apply with full details as to age, date of graduation, experience and approximate salary required. File No. 5412-V.

LARGE ELECTRICAL MANUFACTURING Industry in Niagara Peninsula, has vacancies for graduate electrical engineers in switchgear sales department. Duties include the preparation of specifications and settlement of technical details for all classes of switchgear from 600 volts to 330 KV. Previous switchgear engineering experience with a manufacturer or utility desirable but not essential. File No. 5415-V.

INSTRUMENTATION ENGINEER

TO DESIGN measuring and control systems for chemical and metallurgical processes. Work includes preparation of flowsheets, wiring ond piping diagrams, layout and detail drawings, detailed instrument specifications and cost estimates. Location Western Canada Salary — open.

Apply to Manager,

Personnel Division,
Consolidated Mining
and Smelting Company
of Canada Limited,
Trail, B.C., Canada

MECHANICAL

MAINTENANCE SUPERINTENDENT, required in Montreal for large chain of supermarkets. Position requires a qualified mechanical engineer with strong administrative ability and a background including refrigeration and electrical installation. File No. 5390-V.

MECHANICAL ENGINEER, to take complete charge of engineering department in medium sized, aggressive electrical manufacturing plant in Montreal. The right man must be a good draughtsman with some practical experience and be prepared to re-organize the present engineering department. There is an excellent opportunity that position would lead to executive level and company participation. File No. 5311-V.

MECHANICAL ENGINEER, required by architectural firm in Winnipeg. Heating, ventilating, plumbing design and layout experience preferred. To work with Chief Engineer. File No. 5314-V.

MECHANICAL ENGINEER, with 3 to 5 years experience in the design and construction of materials handling equipment. Working knowledge of electricity and the strength of structures helpful. Position offers good salary and opportunity for advancement with full employee benefits. Location Niagara Peninsula. File No. 5322-V.

MECHANICAL DESIGNERS (engineers or draughtsmen) capable of doing the work of machine design including pulleys, gear, etc. Location Ottawa and Montreal. Salary commensurate with experience. File No. 5326-V.

MECHANICAL ENGINEERS AND DRAUGHTSMEN, for industrial installation of equipment, piping, etc. Salary commensurate with experience. Location Montreal. File No. 5326-V.

GRADUATE MECHANICAL ENGINEER required by a heavy industry with extensive mining and milling operations in the Eastern Townships (Quebec). Duties will include machine design, plant layout, work scheduling etc. Preference will be given to applicant with one year's experience or recent graduates. Good opportunity. Interesting and permanent position with attractive salary. Numerous employee benefits. Replies should include complete record of education, also salary expectation should be mentioned. File No. 5338-V.

WORK EQUIPMENT MANAGER required by large transportation company headquarters in Montreal. Applicants must be graduate mechanical engineers, not over 40 years old, with at least 10 years experience in the selection, operation and repair of contractors' work equipment or mechanical equipment used in woodlands operations. Apply to the undersigned by letter, giving complete information in regard to person, education and experience. Personal interviews will be arranged if applications justify. Salary depends on capability of successful applicant. File No. 5343-V.

ASSISTANT MECHANICAL SUPERINTENDENT required for Southern Quebec pulp and paper mill. Recent mechanical engineering graduate preferred. To assist mechanical superintendent in all phases eventually taking over complete responsibility for mechanical maintenance. Position offers excellent opportunity for advancement. Hospitalization and life insurances, pension plan, etc. available. Please include in application all details regarding education and experience. File No. 5349-V.

GRADUATE MECHANICAL ENGINEER required by large manufacturing plant located in Montreal. A minimum of five years experience in heavy mechanical equipment essential. Some shop experience desirable. Applicant will be required to study, analyze and report on new product lines and develop specifications for cost estimating. Give details of age, education, experience, salary requirements and other relevant information to File No. 5357-V.

THE PLANT ENGINEERING SERVICES of the National Research Council, requires at Ottawa a graduate mechanical engineer preferably with some experience in plant work to design, prepare plans and specifications for heating, ventilating and air conditioning systems. Familiarity with various manufacturers equipment and control systems is essential. Initial salary up to $4,500 per annum depending on qualifications. Apply by letter giving full details of education and experience to The Employment Office, National Research Council, Sussex Drive, Ottawa, Ontario. Please quote File PE-236, File No. 5358-V.

MECHANICAL ENGINEER required for work in refinery at Sarnia as area maintenance engineer. Must have 3 to 5 years experience

PHYSICAL METALLURGIST

To undertake both fundamental and applied research on nonferrous metals, primarily lead and zinc and their alloys. Salary dependent upon qualifications and experience. Location Southern British Columbia.

Apply to Manager,

Personnel Division,
Consolidated Mining
and Smelting Company
of Canada Limited,
Trail, B.C., Canada.

BRITISH THOMSON-HOUSTON

COMPANY, ENGLAND

require

MICROWAVE DEVELOPMENT ENGINEER

Applications are invited for the position of Development Engineer at the Company's main plant at Rugby, England. The position is permanent and pensionable, and concerns long-term development of the latest techniques in microwave systems of unusuol complexity. Ample opportunities are afforded for original work.

Qualificatians: University degree in electrical engineering or physics, and at least two years practical experience in microwave systems and/or components development.

Applications, stating age and giving details of qualifications and experience, should be made in the first instance to:—

THE BRITISH

THOMSON-HOUSTON EXPORT

CO., LTD. (HGM)

7, Adelaide Street West,

Toronto, Ontario

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in oil refinery or related industry. Dutles include general engineering and estimating. Permanent position, full employee benefits. Write giving full particulars of age, qualifications, experience, present salary. File No. 5364-V.

MECHANICAL ENGINEER required for product design by manufacturer of mining machincry in Southern Ontario. Registered or qualificd professional engineer. Reply in detail stating personal history, education and experience. File No. 5368-V.

MECHANICAL ENGINEER for sales office required by manufacturer of hydraulic fittings and hoses etc. located in Ontario. Salary open with excellent future prospects. Age group approximately 23 to 30 years. File No. 5370-V.

LARGE MONTREAL MANUFACTURER requires specialist in welding and brazing techniques for mass produced apparatus. Applicant should bc mechanical engincering graduate or equivalent with minimum of five years experience in welding processes. Salary open. Your confidencc will be respected. File No. 5376-V.

MECHANICAL ENGINEER required by pulp and paper company with all or some of the following qualifications. Experience in maintenance work, knowledge of the fundamentals of time and motion study. Ability to supervise a group of approximately ten persons. Some knowledge of production cost systems. Duties include work with consultants on the installation of a system of maintenance standards. Develop standard time values, supervise a crew of maintenance standard assessors. File No. 5382-V.

A WELL KNOWN MACHINERY manufacturer requires a mechanical sales engineer to contact large industries in the Province of Quebec. Established clientele assuring substantial income for qualified man. Some knowledge of French desirable. This is in addition to the existing staff who are aware of this vacancy. If you believe you are the man for this position, please send complete details of qualifications and past experience which will be held in strict confidence. File No. 5389-V.

GRADUATE MECHANICAL ENGINEER for large industrial concern near Montreal required for development work and general project engineering. Permanent staff position, and good prospects of promotion for young engineer with initiative and ability for original design work. Previous experience preferred but not necessary. We will pay travelling expenses for interview. Write stating personal information, experience in detail, salary required and date available. File No. 5390-V.

MECHANICAL DESIGN ENGINEER. We require an experienced professional mechanical engineer with 10 to 15 years experience in design mechanical equipment particularly cranes or materials handling machinery. Experience in design of radioactive material handling valuable. Will be required to design layout of fuel rod handling system and equipment. Please reply by letter stating experience, qualifications, etc. Location Ontario. File No. 5401-V.

PLATE AND VESSEL DESIGNER. We require an experienced professional mechanical engineer with 5 to 10 years design experience in vessels, heat exchangers or allied equipment. Will be required to work on pressure vessels and heat exchanger for the reactor, as well as plate and tube components for the reactor core. Please reply by letter stating experience, qualifications, etc. Location Ontario. File No. 5401-V.

RECENT MECHANICAL GRADUATES of Canadian Universities have exceptional opportunities to train for sales of combustion control and industrial instruments. Prominent American manufacturer has organized Canadian company with general offices and assembly plant in Toronto. Canadian born engineers required. Extensive factory and field service training will be provided. File No. 5404-V.

MECHANICAL ENGINEER required by sheet metal fabricating company in Montreal, to take charge of small engineering department. Duties will include supervision of drafting and estimating standard and custom products and development of new products. Applicant should have 4 or more years applicable experience and be preferably bilingual. Starting salary minimum $6,000.00 per year. Company name Eastern Steel Products but please submit full details as to past experience, age, etc., to File No. 5416-V.

TWO GRADUATE MECHANICAL ENGINEERS wanted by manufacturer of heavy industrial machinery in Western Montreal for application engineering and sales. 1950-1955 graduates considered. Training provided. Benefits include generous life insurance, sickness and accident and pension plans. Five day week. Applicants should outline training, experience, and salary expected. File No. 5423-V.

CANADA'S MOST MODERN transformer plant requires mechanical engineer with five years experience on pressure vessel design, medium to heavy structural steel or plate design, for work on large tanks and components. Work is interesting and varied; transformer experience not necessary. Full employee benefits, pleasant working conditions in attractive Southern Ontario community. File No. 5426-V.

DESIGN ENGINEERS required for commercial vehicle design. Good opportunity with a sound future for a graduate mechanical engineer, who has had practical experience in structural design. Location Ontario. File No. 5429-V.

MISCELLANEOUS

TWENTY-FIVE OPPORTUNITIES, for electrical and mechanical engineers to undergo training as patent examiners with the Federal Government at Ottawa. Good careers, numerous benefits. Starting salaries up to $4,620. For additional information write to Civil Service Commission of Canada, Ottawa. Ask for circular B297. File No. 5278-V.

ENGINEERING REPRESENTATIVE, required by new progressive organization handling a variety of specialized building materials. Company is well represented in Ontario the Western Provinces and British Columbia. The opening is for the Quebec territory. File No. 5301-V.

YOUNG ENGINEERS, required for training in the Industrial Engineering Department of a progressive Ontario firm. The men we are looking for have some engineering training and are willing to accept responsibility. There are excellent chances for advancement for men who can develop the ability to deal effectively with all levels of management. Starting salary $4,000 to $5,000, depending on experience and ability. Reply giving full particulars on experience, education and interests. File No. 5312-V.

SALES ENGINEER for Vitrified sewer pipe (Western Provinces). Write stating experience and references. Excellent opportunity. File No. 5313-V.

MACHINERY SALESMAN, required by leadin manufacturer of machine tools in Souther Ontario. Applicants should have some practic machine shop experience, plus a proven sale record. Reply in writing, stating age, salar expected and experience, etc. File No. 5317-V

GRADUATE ENGINEERS, for large structura steel plant in Ontario. Recent graduates fro Canadian Universities preferred. Excellent o portunities for two young men who are willin to train for positions in design, contractin and production. Salary is in line with 19 schedules as recommended by Assoc. of Pro Eng. File 5318-V.

SALES ENGINEER required, age 25-32, wi about 3 years experience, to handle fair large accounts for company selling industri finishes to manufacturers such as enamel lacquers used by paper industry, to work o of Ottawa. File No. 5319-V.

TWO YOUNG GRADUATE ENGINEERS r quired in the production study and metho department. Age 23 to 27 years. Applican should possess a desire to learn new met ods, the ability to work with a minimum supervision, and practical industrial expe ence. The first nine months of employme would consist of training in the Productio Study Section learning labour controls b fore being transferred to the productio methods section. The salary would be bas on the experience and qualifications of t applicant. File No. 5320-V.

SALES ENGINEER, chemical, mining, meta lurgical or mechanical graduate with son experience. Will be based in Toronto, O tario. References and reputation most i portant. This is a large foundry and t position has an excellent future with be possible salary and benefits. File No. 5323-

A CANADIAN UNIVERSITY wishes to recei applications from engineering graduate preferably civil, mechanical or electric under thirty-five years of age, to teach en neering problems and drawing. Applicatio should give applicants' age, university a experience. The salary offered is $2,200 a up for the session depending on qualific tions. Might lead to permanent appointme File No. 5325-V.

MECHANICAL, CIVIL OR ELECTRICAL E GINEER, for work in mechanical goods sal

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BRITISH THOMSON-HOUSTON

COMPANY, ENGLAND

require

ELECTRONICS ENGINEER for INTERMEDIATE FREQUENCY DEVELOPMENTS

Applications are invited from Electronic Development Engineers with experience in the intermediate Frequency field, for advonced development work associated with I.F. circuits and systems for new techniques in pulse and doppler radar.

The position, which is permanent and pensionable, is at the Company's main plant at Rugby, Englond.

Qualifications: University Degree and at least two years experience in I.F. or related circuit developments.

Applications, stating age ond giving details of qualifications, should be made in the first instance to:—

THE BRITISH

THOMSON-HOUSTON EXPORT

CO., LTD. (HGM)

7, Adelaide Street West,

Toronto, Ontario

REFINERY ENGINEERING AND SAFETY ADMINISTRATION OPPORTUNITIES

Modern catalytic oil refinery requires a Plant Engineer. Responsibilities involve structural design, supervision of contract work, and engineering programing. Salary commensurate with qualifications.

Safety Engineer also required to conduct equipment inspection and plant safety programs. Professional qualifications preferred but not necessary. Responsibilities and salary commensurate with qualifications.

Apply in writing to:

The Personnel Manager,
Consumers' Co-Operative Refineries, Limited
P.O. Box 399,
Regina, Saskatchewan

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division. Company located in Montreal. The job deals with the larger industrial conecrns and involves many individual problems that require originality and imagination, together with technieal know-how and selling ability. Applicant should be 25 to 35 years of age and anxious to show his ability. File No. 5327-V.

PROVINCE OF NOVA SCOTIA requires an architect for Department of Public Works. Applicant should be registered or qualified for registration with Nova Seotia Assoeiation of Architeets. Forms may be obtained by applying to the Civil Serviee Commission, P.O. Box 943, Halifax, N.S. File No. 5328-V.

SALES MANAGER FOR SCIENTIFIC instrument division of international company. Instruments inelude speetro-photometers, PH meters, goniometers, preeision electronic instruments and nucleonie instruments. A general knowledge of application of above equipment plus some experience in sales to industry or research establishments preferred but not essential. Remuneration on salary bonus and expense arrangement. Location Toronto. periodie travelling throughout Canada neeessary. File No. 5337-V.

ENGINEERS REQUIRED for expanding clay produets industry in British Columbia and Alberta. Opportunities available in plant engineering, process engineering, produetion engineering and sales engineering. Please reply stating personal information, experienee and qualifications ete. to File No. 5341-V.

PULP AND PAPER MILL exeeutive engineer wanted for full partnership established Pacific Coast Consulting Engineering Firm—No investment required—submit complete qualifications to File No. 5348-V.

CHIEF OPERATOR required for hydro-electric power plant. Must have experience, ability to direct and be responsible for operation and maintenance of power plants, dams and equipment. Location Northern Quebec. Full company benefit plan. In reply state age, education, experience, marital status, date available and salary expected to File No. 5353-V.

APPLICATIONS ARE INVITED for a position of assistant professor of engineering at Mount Allison Univerity. Particulars regarding the position may be obtained from the Dean of Selenee, Mount Allison University, Sackville, N.B. File No. 5356-V.

SENIOR ESTIMATING ENGINEER required in a large manufacturing plant located in Montreal. Applieant must have general experience in heavy mechanical equipment, a broad knowledge of product costs, be energetic and have administrative abillties. Give details of age, edueation, experience, salary requirements and other relevant information to File No. 5357-V.

RESEARCH HYDRAULIC ENGINEER requlred for researeh team studying the forces involved in pulpwood holding grounds, at both model and full scale. Requirements: master's degree in hydraulies engineering, good aeademic reeord and ability to work with woods personnel in the field. Apply by résumé to File No. 5361-V.

PULP AND PAPER ENGINEER required. Graduate engineer capable of planning and developing eomplete pulp and paper projeets. Must have not less than five years experienee in newsprint manufaeturing. Summarize experience. Loeation about 100 miles from Montreal. File No. 5363-V.

SALES ENGINEER REQUIRED by Canadian transformer manufacturer. Preferably professional engineer with test eourse training. To be responsible for sales in the Maritime Provinees, reporting to the Montreal offiee. Drawing aeeount and car mileage allowanee provided for business travelling. State age, experienee ete. File No. 5366-V.

CONSULTING MANAGEMENT ENGINEER requires engineer with thorough knowledge of plant maintenance and operation for eonsulting work in Canada and the U.S.A. Starting salary $150. per week or more plus expenses depending upon qualifieations. File No. 5367-V.

MINING OR CHEMICAL ENGINEER having design and detail experienee in ore handling or chemieal plant equipment is required by

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ASSISTANT CHIEF INSPECTION ENGINEER

Graduate mechanical engineer, age 30 to 40, minimum five years practical shop experience. Ability to get along well with others essential. Duties cover all phases of mechanical inspection, working directly under the chief inspection engineer.

Apply in writing, stating place of birth, to: Personnel Supervisor, Dominion Engineering Works Limited, 1st Avenue, Lachine.

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a large Kingston manufacturing eompany. Reply giving eomplete information on personal history, education and experienee. File No. 5372-V.

PROJECT AND CONSTRUCTION ENGINEER. Graduate in civil or meehanical engineering with three to five years experience in building strueture, material handling equipment, structural and machine design. Supervisory ability in draughting. Experienee in smelting operation or construction would be an asset. Fluent English is essential. File No. 5378-V.

EASTERN TOWNSHIPS OF QUEBEC firm requires graduate and/or practical engineer to take over responsibility for all plant mechaniea, electrieal, heating and eonstruction problems. This is basically a planning and coordinative job with appointment as mechanical superintendent as its aim. File No. 5379-V.

ENGINEERING OPPORTUNITIES in Victoria, B.C., for senior and intermediate civil engineers in hydraulic design, both offiee and field and senior electrical station designers. Excellent welfare provisions. File No. 5385-V.

APPLICATIONS ARE INVITED for engineers and arehitects with good academic records and preferably with a few years of experience for positions as researeh offieers in the division of building researeh, National Researeh Counеil, for work in the following fields: Housing: to undertake studies leading to the assessment of materials and the evaluation of the performanee of eomponents for application in housing. Construetion: the dissemination of teehnieal information to the eonstruction industry. Study in the performanee of new materials and teehniques used in eonstruetion. Building Code: to undertake studies relating to the preparation of building regulations, partieularly in the field of public health engineering, in relation to the National Building Code of Canada. Building Design: A eivil engineer for the investigation of the structural performance of building eomponents and eompleted struetures. The work in view ineludes the testing of full seale struetural elements in the laboratory and in the field. Soil Meehanics: A civil engineer to work in the laboratory and in the field on urgent projeets already under way in this seetion. Fire Researeh: A ehemical engineer or ehemist for laboratory research into the combustion properties of materials expecially those used in buildings, and into the applieation of chemieal agents for the suppression of fire. File No. 5386-V.

PLANT ENGINEER required for a plant loeated in Sherbrooke, P.Q. Should be eapable of taking full eharge of all maintenanee and construction work. Salary dependent upon qualifications. File No. 5387-V.

MECHANICAL SALES ENGINEERING and applieation engineering positions in new and growing company making eleetrieal, industrial eontrol apparatus in S.W. Ontario. Prefer eleetrieal, mechanical or engineering and business 1955 graduates. File No. 5388-V.

PHYSICAL METALLURGIST to undertake both fundamental and applied research on nonferrous metals primarily lead and zine and their alloys. Salary dependent upon qualifieations and experience. Loeation Southern British Columbia. File No. 5391-V.

INSTRUMENTATION ENGINEER to design measuring and eontrol systems for ehemieal and metallurgieal process. Work ineludes preparation of flowsheets, wiring and piping diagrams, layout and detail drawings, detailed instrument speeifications and eost estimates. Loeation Western Canada. Salary open. File No. 5391-V.

CIVIL, MECHANICAL or CHEMICAL engineers with about 5 years experienee on eonstruetion of industrial plants and proeess equipment required as field engineers by eompany planning to build new plant. Loeation Ontario. File No. 5392-V.

ENGINEERING GEOLOGIST, required by well known eompany specializing in the field of Soil Mechanics, foundation engineering and geotechnieal proeesses. Must have post grad-

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THE GOVERNMENT OF BRITISH COLUMBIA REQUIRES ENGINEERS AND TECHNICIANS FOR A MULTI-MILLION DOLLAR HIGHWAY PROGRAMME

ENGINEERS: Should have experience in highway lacotian, design or constructian. Professional registrotian desirable but not essential. Salaries range from $327-$464 per month depending on qualifications and experience.

BENEFITS include compensatian caverage, sick and vacation leave after ane year; pension plan; statutory holidays.

OPPORTUNITIES FOR EXPERIENCE AND ADVANCEMENT WITH A PROGRESSIVE PROGRAMME IN A FAST-GROWING PROVINCE.

Detailed information may be obtained from the Department af Highways, Parliament Buildings, Victoria, B.C.

PERMANENT POSITIONS AVAILABLE FOR

ENGINEERS

WITH

CITY OF CALGARY

Comp. 55-100 Engineer I (Traffic)

DUTIES: Under general direction of the Traffic Engineer; to conduct detailed traffic origin and destination surveys; to design traffic roadway layouts; to check traffic movement efficiency; to assist in supervision of department personnel, and to perform related work as required.

QUALIFICATIONS: University graduation in Civil Engineering supplemented by some related traffic engineering experience or an equivalent combination of training and experience.

Comp. 55-097 Engineer II (2) (Projects and Design)

DUTIES: Under direction to perform professional engineering tasks such as: Designing storm and sanitary sewers; buildings, waterworks installations; acting as the City's representative on various contracted construction projects and similar related work as required.

QUALIFICATIONS: University graduation in Civil Engineering, with at least two years related experience, preferably in municipal employment.

Comp. 55-098 Engineer II (Electrical)

DUTIES: Under general direction, to design details of the entire electrical overhead and underground distribution system; to provide information to industrial customers concerning available voltages, rates and conditions of supply; to perform related work as required.

QUALIFICATIONS: University graduation in Electrical Engineering supplemented by considerable related experience.

Comp. 55-099 Engineer II (Mechanical)

DUTIES: To advise on construction of o large-scale City Garage; to plan, organize and supervise the maintenance and repair of a large City-owned and subsidized fleet of cars and trucks.

QUALIFICATIONS University graduation in Mechanical Engineering, supplemented by considerable related experience.

Comp. 55-096 Engineer III (Waterworks)

DUTIES: Under direction, to supervise the design and construction of various waterworks projects and installations; to interpret plans and blueprints to subordinates and contractors; to make technical studies and reports and to perform related engineering tasks as required.

QUALIFICATIONS: University graduation in Civil Engineering with four to six years related experience, preferably in municipal employment.

Comp. 55-094 Engineer IV (Sewer)

DUTIES: Under the general direction of the City Engineer, to plan, organize and supervise through subordinate supervisory and technical staff, all sanitary and storm sewer design, construction and maintenance operations in the City.

QUALIFICATIONS: University graduation in Civil Engineering, supplemented by extensive related experience including previous supervisory and administrative responsibility preferably in municipal employment; or an equivalent combination of training and experience.

Comp. 55-095 Engineer IV (Maintenance Supervisor)

DUTIES: Under the general direction of the City Engineer, to plan, organize, direct, coordinate, review and supervise through subordinate supervisors, all Waterworks, Sewers and Streets and Roads maintenance and repair operations throughout the City. Work involves responsibility for: preparing project and annual estimates and controlling expenditures; dealing with divisional personnel problems; collaborating with superiors, Department and Division heads on major problems and in determining the priority and limits of proposed operations; studying, investigating and evaluating new development, equipment, tools, methods and procedures and making recommendations concerning their acceptance or rejection; to maintain a close check on all maintenance operations to ensure the efficient and effective use of all personnel, equipment and materials, and to perform related work as required.

QUALIFICATIONS: University graduation in Civil Engineering, supplemented by extensive related experience including supervisory and administrative responsibility preferably in municipal employment; or an equivalent combination of training and experience.

SALARY

Engineer I . . . . . $319 - 335 - 352 - 370 - 388 per month
Engineer II . . . . . $370 - 388 - 408 - 428 - 449 per month
Engineer III . . . . . $428 - 449 - 472 - 496 - 520 per month
Engineer IV. . . . . $496 - 520 - 546 - 574 - 602 per month

Depending upon qualifications and experience.

GOOD PENSION PLAN AND MEDICAL BENEFITS

Application forms are to be obtained from and returned to the Personnel Director, City Hall, Calgary, Alberta, not later than 5:00 p.m. Saturday, November 15, 1955.

---

uate studies in Pleistocene and be interested in the application of geologic aspects to civil engineering works. Send résumé of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

MECHANICAL, MINING OR CIVIL ENGINEER, required for sales work in the Province of Quebec. Requirements: earthmoving and/or heavy equipment experience, bilingual preferred, free to travel. Age up to 40. Good appearance and background. Excellent remuneration, insurance and pension benefits guaranteed by advertisers who are Quebec distributors for world renowned make of heavy equipment in the earthmoving field. File No. 5397-V.

ATTRACTIVE OPPORTUNITIES for senior architects and engineers with the Federal Government in Ottawa. Salaries up to $7,900. Requirements include: an assistant chief penitentiaries engineer with training in engineering or architecture; a telecommunications engineer, a communications engineer, an architect (building) an electrical engineer (power), a structural engineer and a construction engineer (runways). Opportunities for advancement. Generous fringe benefits. File No. 5400-V.

DESIGN ENGINEER young graduate with several years product engineering experience and writing ability, for editorial work on new magazine. Good working conditions and remuneration in keeping with ability. With first letter give education and experience also starting salary requirements. File No. 5406-V

YOUNG ENGINEER required for work in heating and ventilating company located in Ontario. Will be trained in the engineering, research and sales departments of the company with a view to eventual branch office work. File No. 5408-V.

ON BEHALF OF BRITISH INSULATED CALLENDER'S CABLES LIMITED we have been asked to select outstanding engineering graduates in Canada to be guests of B.I.C.C. in

(*Continued on page 1494*)

Someone is looking
(we don't know him from Adam)

for the solution to a problem
(we haven't a clue)

involving a new product
(we don't know what)

requiring quality machined castings
(that's something we do know about)

If you have a problem that involves a sand casting, die casting, forging or automatic screw machine part . . . we probably have the answer. For fifty years we've been supplying our customers with the right component part for the purpose . . . when they want it . . . at a fair price! Now, with Wallaceburg-Singer Limited in production on cored brass forgings we've more than ever to offer.

Call us for Machined Sand Castings in brass and bronze, Cored Brass Forgings, Die Castings in zinc and aluminum, and Automatic Screw Machine Products in brass, steel and aluminum.

WALLACEBURG AND AFFILIATED COMPANIES

BRASS LIMITED

WALLACEBURG, ONTARIO

Wallaceburg-Singer Limited
Dominion Die Casting Limited

BRANCHES: TORONTO • LONDON • WINNIPEG • CALGARY • VANCOUVER

BUSINESS & INDUSTRIAL BRIEFS

A Digest of Information

received by

The Editor

Appointments and Transfers

B. F. Goodrich Appointment.—John A MacNeil has been appointed sales engineer in the industrial products division of B. F. Goodrich Canada Limited, it was announced recently by M. E. Bailey, manager of belting and hose sales.

●

Zurn Engineering.—The officers and directors of Canadian Zurn Engineering, Ltd., Montreal, announce the appointment of John E. Shreve as managing director in charge of the sale and distribution of Zurn engineered plumbing and marine drainage control products, pipe line strainers and mechanical power transmission equipment.

●

Appointed Ontario Sales Manager.—P. F. Davidson has been appointed Ontario sales manager of Rosco Metal & Roofing Products Ltd. The announcement was made by H. G. Pipher, president of the company.

●

Consulting Engineers Expand.—M. K. (Keith) Douglass, P.Eng., heads a new Vancouver Branch of A. B. Sanderson & Company Limited, Victoria consulting engineers. The Vancouver branch will specialize in industrial structural engineering, in which Mr. Douglass has had experience as chief engineer of the B.C. Concrete Company Limited. A. B. Sanderson, P.Eng., head of the firm, will continue his specialized practice in bridge design and construction at the Victoria office.

●

Defence Production.—The Right Hon. C. D. Howe, Minister of Defence Production, announced that R. M. Robertson was to resign, effective September 30th, as director of the shipbuilding branch of the department. Mr. Robertson, who was on loan from the Dominion Bridge Company for 14 months, returned to his position with that company. His successor in the Department is J. C. Putledge, formerly deputy director of the branch.

●

Shell Oil Vice-President.—The appointment of G. Davidson as vice-president, manufacturing, of Shell Oil Company of Canada, Limited, is announced by W. M. V. Ash, president. For the past five years Mr. Davidson has been manager of the company's Montreal East Refinery. He succeeds Dr. D. M. Morrison who was recently elected president of Trans Mountain Oil Pipe Line Company.

●

John Inglis and English Electric.—John Inglis Co. Limited and English Electric Company of Canada Limited announce the appointment of J. A. Farr to the position of manager, indust relations of the English Electric-J Inglis organization. J. P. Hunt has b appointed personnel manager at English Electric Company of Can Limited, St. Catharines.

●

Letson and Burpee Executives.—N executive appointments are announ by Letson & Burpee Limited, of V couver. Gordon M. Letson, gen manager of the company, and a dire since 1924, has been named presid He succeeds Major-General H. F. Letson, C.B., C.B.E., M.C., E.D., B Ph.D., LL.D., who has headed the f for more than 15 years. General Let continues active association with company as a director and an advis officer. L. C. Jolivet, president Christopher Lawrence Ltd., has joi Letson & Burpee as a director, and comes sales manager.

New Equipment and Developments

Automatic Ultrasonic Cleaning Plant.—An example of the application of ultrasonics to industrial cleaning is provided by the new completely-mechanized plant which has been jointly developed by Mullard Limited, and Kerry's (Great Britain) Limited, both of London. A fully-automatic unit incorporating the latest Mullard high-frequency ultrasonic generator, it is suitable for removing loose contamination such as swarf, lapping compounds, oil and grease from such engineered parts as ball races and hydraulic valve components. Since the equipment is capable of cleaning articles rapidly and thoroughly and delivering them in a dry condition, it can be incorporated in an assembly line. An important feature is a system for continuously filtering and purifying the cleaning fluid. Ferrous particles are removed by a magnetic filter, while gauze, ceramic and paper filters remove particles down to as little as 1 micron (0.00004 inch) in diameter. Oil and grease are removed by a continuous distillation process.

Rivetless Steel Frame Construction.—First large steel-frame structure to be erected in Canada without the use of rivets is the new Hiram Walker artillery now under construction at Walkerville, Ontario. High-tensile steel bolts are being used in place of rivets. Although the bolts cost above times as much as rivets, the ultimate cost of erecting the steel frame is considerably lower, according to B. Bailie, consulting engineer for Hiram Walker and Sons Ltd. It is claimed that a two-man bolting team can put twice the number of fastenings per shift as a four-man riveting team; skilled riveters are not required, and the two-man team can quickly be trained.

●

Magnesium Yard Ramp.—What is believed to be the largest piece of magnesium equipment ever fabricated in Canada—a 30-foot-long portable yard ramp with a capacity of 10,000 lbs.—has been completed in Toronto

50 below or 100 above...

"SIPOREX"* stands the test!

Precast "SIPOREX" cellular concrete construction units have been tested and proven in use for over twenty years under the most rigorous conditions. They have been found to be particularly suitable where severe, widely varying climatic conditions are encountered. "SIPOREX" is an ideal, economical construction material for use in extreme heat or cold. Being a structural material with high insulating properties, additional insulation is not normally required.

Technical data is available to permit analyses of specific problems involving temperature and humidity conditions. Our engineering department will be happy to receive your inquiries.

PRECAST "SIPOREX" CONSTRUCTION UNITS ARE MANUFACTURED AT DELSON, QUEBEC.

Shingles and roll roofing may be nailed directly to "Siporex" roofs using special nails.

*EGISTERED TRADE MARK

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OMPANY, LIMITED

640 CATHCART ST., MONTREAL, QUE.

TORONTO OFFICE
26 Hollinger Rd.

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13 Place d'Aiguillion

Bus. and Ind. Briefs

Magcoa Limited. It is also the first Magcoa magnesium yard ramp produced in the Dominion. It will be used by Botterell Warehouses, Ltd., for unloading and loading tractor trailers at its Oakville, Ontario, warehouse. One of the first assignments for the ramp, which has a capacity of 10,000 pounds, will be in unloading automotive engines specially packed in sets of four for an Oakville automotive manufacturer.

●

Inspection and Testing Facilities. — The Warnock Hersey Company Ltd., who have recently become associated with Canadian Inspection and Testing Ltd., have issued an illustrated brochure outlining the services of Warnock Hersey to Canadian industry. Copies are available from The Warnock Hersey Company Ltd., 128 Elmslie Street, Montreal, Que.

●

Plumbing Alloy.—Josam Canada Limited is now offering many of its plumbing drainage products made of a new metal developed in Josam research laboratories, and is now replacing all items formerly furnished in white metal with "Nikaloy". An alloy with a high nickel content, it has the same appearance as chrome plate, when polished; tensile strength and resistance to surface wear and corrosion are high.

Tube Testing Machine. — Hydropress, Inc., New York, announce that the company has received an order from Mannesmann Tube Corporation, Ltd, Sault Ste. Marie, Ont., for a tube testing machine having maximum test pressure of 13,000 p.s.i.; this is part of the equipment to be used in their newly built tube plant in Canada.

●

New Blade for Cutting Concrete.—A new diamond blade for sawing joints in green or cured concrete has been developed by Canadian Carborundum Company, Limited, Niagara Falls, Ont. The new DM190 blade has proved its ability to cut at rates up to 10 feet per minute at a depth of 2 inches, depending on the type of aggregate used in the mix. Faster cuts can be made on limestone aggregate than tougher trap rock, quartzite, and river bottom gravel mix. Rate of cut also depends on the machine horsepower and whether it is self-propelled or manually pushed.

●

Corrugated Metal Pipe.—Production of corrugated metal pipe at the Armco Drainage & Metal Products plant at Charney, Quebec, was to begin about October 1. The announcement was made by E. L. Campbell, vice-president and general manager of the company, who said that Armco Drainage now has seven plants in operation in Canada, including a newly-constructed plant at Bishop's Falls, Newfoundland. Under construction since June, the Charney plant will manufacture corrugated metal pipe and pipe arch for drainage use. Asbestos bonded paved invert pipe will also be produced for installation where corrosive conditions are especially severe.

●

Siporex Expansion. — Siporex Limited announces that work is to start on additional plant capacity designed to triple present output. The Siporex plant, located at Delson, Que., a few miles from Montreal, commenced production early this year of precast, lightweight concrete roof slabs, floor slabs, load-bearing wall slabs and non-load bearing partition wall slabs. The increased production facilities of the Siporex plant will mean the employment of another 100 operating personnel which will more than double present plant staff.

●

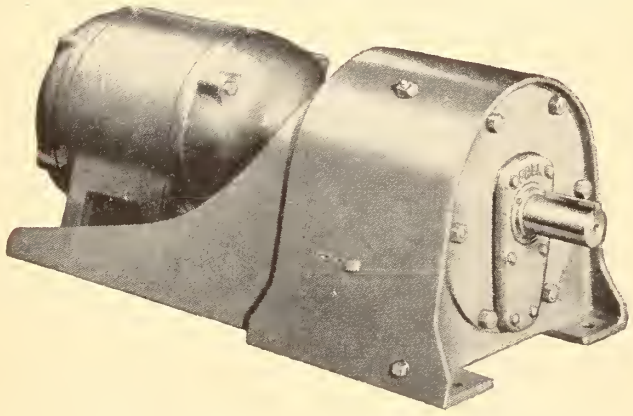
U.S.A.F. Contract for Canada.—B. W. King, managing director of Sperry Gyroscope Company of Canada, Ltd., announces that the company has been successful in securing a contract originating with the United States Airforce for fire control equipment amounting to $1,300,000. The contract, which will be completed within one year, is the first order for this type of equipment to be received by a Canadian manufacturer.

●

Maintenance for Paint. — The establishment of a maintenance sales section within its sales organization is announc-

FALK MOTOREDUCERS

Built to withstand the rigours of tough industrial service



Falk Motoreducers are used to drive mixers, agitators, conveyors, pumps, dust collectors, screens, classifiers, shot blast machinery, vats, fans, washers, foundry equipment, line shafts, machine tools, various types of mills, and other equipment.

CHECK THESE ADVANTAGES

1. All-steel housings — unbreakable, stronger, more rigid than cast iron.
2. Standard units in arrangements applicable to both ordinary and unusual requirements.
3. High overhung load capacity — large shafts, husky bearings, improved mountings.
4. Sealed housings — a tested leakproof, dustproof and splashproof unit.
5. Wide speed range — standard output speeds down to 1 r.p.m. available with stock gearing.
6. Adaptability to motors — the motor bracket is arranged to mount any standard motor frome.
7. Gearing — proven, heat-treated alloy steel, helical gearing — crown shaved throughout.
8. Lubrication — self-contained, flooded lubrication — continuous, safe, reliable in all operating positions and under all conditions.

THE WILLIAM KENNEDY & SONS LIMITED

A DIVISION OF MILLSPAUGH LIMITED, SHEFFIELD, ENGLAND

OWEN SOUND, ONTARIO

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. . . he can save dollars on WATER costs!

C.P.G.—means cost per gallon and water costs are an all important item to city — farm or industry.

The man from Layne knows most about water costs and how to cut them—for the man from Layne knows most about every phase of water development.

Exploration . . . modernization . . . equipment . . . well drilling all affect C.P.G. — and when you "ask the man from Layne" you get authoritative, factual information on any question that relates to water.

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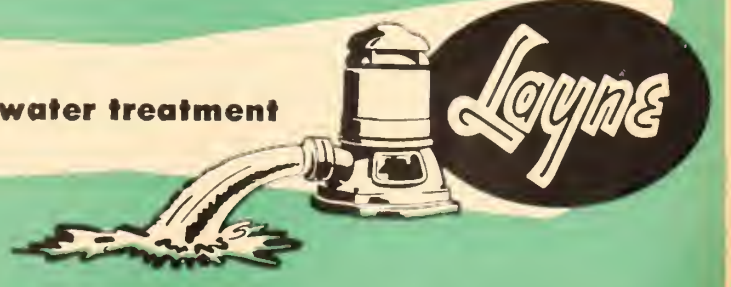
out the World.

water wells • vertical turbine pumps • water treatment



Bus. and Ind. Briefs

ed by the paints division of Canadian Industries (1954) Limited. This section will serve such consumers as railways and street railways, structural steel and iron fabricators, bridge companies, federal and provincial government departments, oil companies, construction firms, public utilities, pulp and paper firms, textile industries, steamship companies, boat builders, shipyards and building maintenance accounts. The section will have behind it the full support of the company's extensive technical service and paints research and development facilities. D. H. Brown has been appointed supervisor of maintenance sales for the Quebec district, with headquarters in Montreal, and C. A. Wickens of Toronto has been appointed supervisor of maintenance sales in Ontario.

●

Toronto Iron Works.—As a result of the financial interest which Toronto Iron Works, Limited, recently acquired in the British firm of Dominion, Scott, Barron, Limited, Benton Dixon, executive vice-president of Toronto Iron Works, Limited, and chairman of the board and president of Dominion, Scott, Barron, stated that Toronto Iron Works would expand its manufacturing f ties and sales organization. He sai united management team of the companies would now be in a st position to sell Canadian and U States markets. Toronto Iron W having long experience and modern equipment in the fabrication of steel platework and alloys and I inion, Scott, Barron engineering sp ization in the design of plants, pilot to production in the chemical, and allied industries.

●

Package Unit Boiler. — Differing other package units supplied to Canadian market, the newly-devel Dominion Bridge package boiler ca equipped with any well-established of firing arrangements to suit indiv conditions. Thus, the user has the vantage of selecting equipment w though supplied as a complete un in reality "tailored" to his parti needs. Moreover, the purchaser is the opportunity of using firing e ment of a type which offers the service facilities in his particular l ity. An example of this type—equi with a rotary cup burner and el combustion controls—will be displ at the Power Show, Montreal, Nov.

●

New Airco Portable.—It is annou by Air Reduction Canada Limited two new Airco portable, engine-d combination AC arc welders and iary power plants are available, k as models GEA-200 and GEA 2 These units are designed for rough service under adverse weather cond and where versatility and an easily able machine are required. M GEA-200 and GEA-200-L are suite light welding applications where A AC-DC electrodes from 1/16" to diameter are required. Rated we current is 200 amperes, 100 cycle, s phase with a 100% duty cycle and circuit voltage is 80 volts. In ad to welding power, both models pr 1KW, 110 volt DC auxiliary p Model GEA-200-L also can be us supply 4.5 KW, 110 or 220, 60 single phase AC power identical to supplied from normal power s lines. Four receptacles are provide each machine so that both power and lights may be connected.

●

Canadian Oil Merger. — Canadia Companies, Ltd. recent offer to pur Anglo-Canadian Oil Co. Ltd. approved August 31st at a special ing of the shareholders of Anglo-C dian held at Calgary, Alberta. Wit indicated value of more than $23,00 Canadian Oil Companies offered seventh share of its own stock and in cash for each share of Anglo-C dian.

●

A New Overhead Line Pole.—A overhead line pole for use on dis tion and transmission lines where ports do not have to withstand l mechanical loading, has been deve by Painter Brothers Ltd., of Her England, in collaboration with B Insulated Callender's Construction Ltd. It will be known as the P.N. In its design full consideration has given to the need for economy, ligh and simplicity of construction.

FOR TEMPERATURE CONTROL

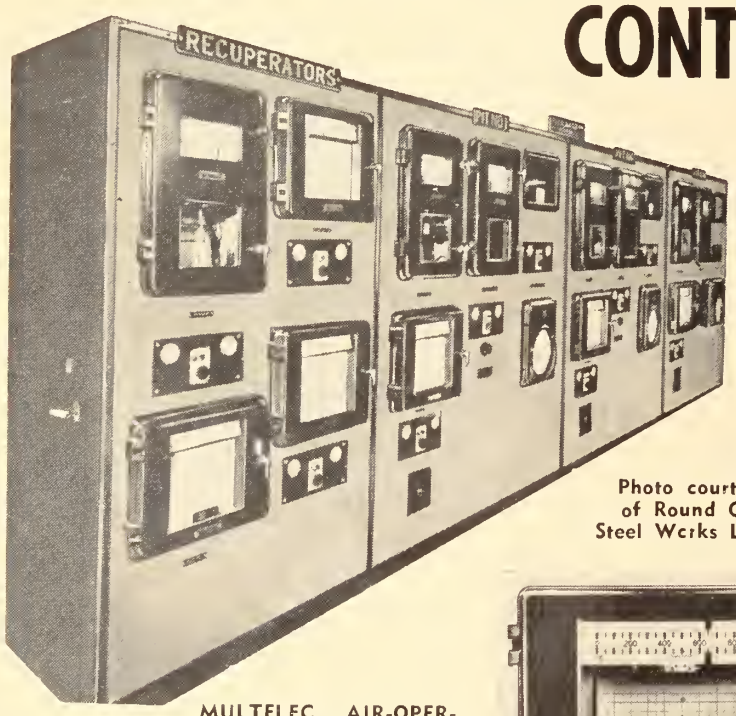
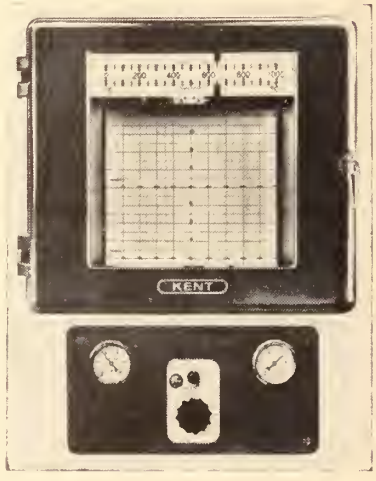


Photo courtesy of Round Oak Steel Works Ltd.



MULTELEC AIR-OPERATED TEMPERATURE CONTROLLER. Stondord Multelec indicoting ond recording instrument fitted with Mork 20 control

Automatic control of temperature in the many types of furnaces, oven stills, autoclaves, kilns and heating apparatus used in industry is the logical development of indicating and recarding equipment. Just as logical is the selection of K. N. instruments.

The Kent Multelec with Mark 20 Control provides a complete range of instruments to control heat processing, from the simple "on-off" control to complicated plant layouts where difficult control conditions may require a variable speed floating and proportional controller with wide throttling range, or three term air operated control.

KENT-NORLANTIC

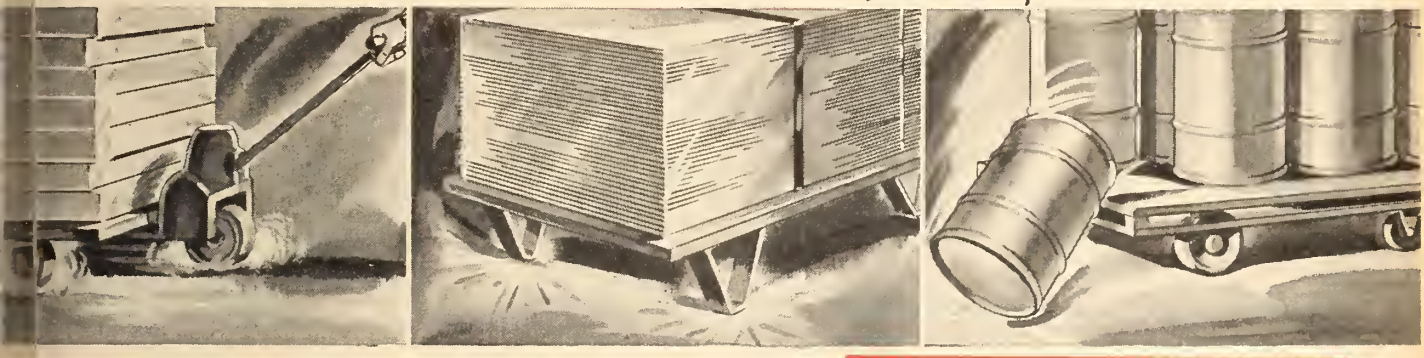
Horner Ave. Toronto 16 CLifford 9-1177

Vancouver—Seoland Products Ltd., 2746 W. Broodwoy
Winnipeg—Mumford, Medland Ltd., 576 Woll Street

KN-55-4

will your floors be SHATTERPROOF?

No concrete floor surface provides an absolutely true plane. Even minor irregularities intensify impact, causing a continual hammering action.



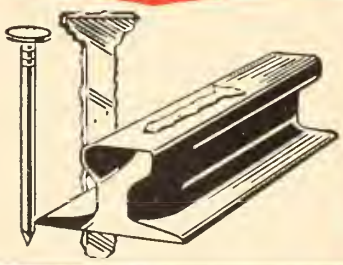
Hard aggregates do not necessarily make long-life floors. Many aggregates—even traprock, granite and emery—are unfortunately brittle. Impact from truck wheels, pallets and skids, and falling objects can shatter these brittle materials, produce ravelling, and start a chain of costly floor maintenance.

Masterplate metallic aggregate is tough yet ductile. The scientifically graded iron particles cushion impact, prevent ravelling and provide the highest abrasion resistance*.

Many million square feet of Masterplate floors are in use today and giving excellent service. Masterplate floors are virtually non-absorbent, oil proof and resistant to many corrosives found in industry.

Full information on Masterplate and "see-for-yourself" demonstration kit on request.

*In U. S. National Bureau of Standards Tests the Masterplate type floor had 6 times greater resistance to wear than the best plain concrete flaar.



Basic principle of MASTERPLATE

You know what happens to a nail on the railraad track—it daesn't fracture ar crumble; it merely flattens, retaining the same general shape. This is the basic principle af Masterplate. Because af its ductility, Masterplate, unlike brittle material, "gives" under impact, producing a floor with great wear resistance.

MASTER BUILDERS CO. LTD

Subsidiary of American-Marietta Company

Products sold in Canada are manufactured in Canada

RAM DRIVE — TORONTO 9, ONTARIO

Bus. and Ind. Briefs

features have been achieved by fabricating the pole from standard commercial sizes of small-bore steel tubing and adopting a bracing system which permits a break-down of the complete pole into component pieces. This, in turn, results in easy transportation and enables the assembly and erection of the poles to be carried out with the minimum of skilled workmen and supervision.

The pole is made in two sizes, 30 feet and 35 feet over all length, designed for a depth below ground level of 5 feet and 5 feet 6 inches respectively. The transverse face tapers from ground line to peak to form an "A" frame with a reverse taper below ground to provide an efficient foundation. Longitudinally the tubes are parallel. The pole has been designed for an ultimate head load not exceeding 1,250 lb. at the pole top, and has been subjected to full scale comprehensive tests so that poles are of a guaranteed known strength. Particularly suitable for tropical conditions, these poles will support a wide range of conductors on spans varying between 250 feet and 350 feet depending on conductor size and material. This design cannot be used for angle or terminal positions but a similar, more substantial, design may be substituted in such cases.

British Industries Fair. — Big changes are planned for the 1956 British Industries Fair, which will be the second organized wholly by private enterprise. For the first time since the B.I.F. was started in 1915, there will be two big fairs featuring different classes of goods. The first fair will be at Earls Court, London, from February 22 to March 2. The second will be at Olympia, London, and at Castle Bromwich, Birmingham, from April 23 to May 4. Since the war the B.I.F. has usually been held at the beginning of May, but experience has shown that this date has become too late for buying and selling certain kinds of consumer goods for which there is a seasonal demand. British Industries Fair Ltd. are, therefore, introducing the earlier fair in February for the convenience of buyers interested in these categories of merchandise. The inauguration of the "two fairs" also represents part of the long-term plans for the expansion of the B.I.F.

●

Mass Spectrometer Leak Detector.—A new mass spectrometer leak detector that is smaller, easier to maintain and four times more sensitive than its predecessor, has been announced as available from Canadian General Electric Company's apparatus department. Designated Type M-1, the new model is the successor to the G-E Type M which is widely used as a production testing and inspection instrument by manufacturers of products involving vacuum and pressure systems. The M-1 is designed to detect a leak rate of 5 x 10^{-10} standard cubic centimeters of air per second entering an evacuated system under atmospheric pressure. It can be used selectively to locate a specific leak in the presence of other leaks, without loss of sensitivity. Twenty sensitivity ranges are provided by means of attenuating factors of 1, 3, 10, 50 and 150, and by four levels of emission current, making it possible to locate leaks of different sizes.

●

B. F. Goodrich Expansion.—An internal expansion program of three and a half million dollars at the B. F. Goodrich plant in Kitchener will be completed in less than a year, it was announced by Ira G. Needles, president. The large capital expenditure for new equipment and machinery in the tire and industrial products divisions was initiated two years ago. Planning for the present expansion was started in 1952, but most of the new manufacturing equipment has been installed in the past few months. The president said that additional equipment is on order and will be installed by next summer. Production capacity of the plant will be increased by at least 30% when all equipment is installed.

●

New Oxy-Acetylene Cutting Attachment. — The Oxweld CW-45 cutting attachment, designed for use with the

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SPECIALISTS IN:

"Gunite" restoration of buildings and concrete structures.

Soil Investigations, Geophysical Surveys and Dewatering by Wellpoints.

Sale, supply and erection of Butler pre-engineered steel buildings.

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Your search for a material..

. . . combining mechanical and dielectric strength, lightness, easy machineability and dimensional stability, with resistance to heat, chemicals, fatigue, weathering and abrasion . . .

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PERMALI

ample shows impregnated veneers efore ond after densification. trength can be developed as equired for specific appli- ations, by vorying rrangement of veneers uring monufacture.

Write for full details now — stating nature of application.

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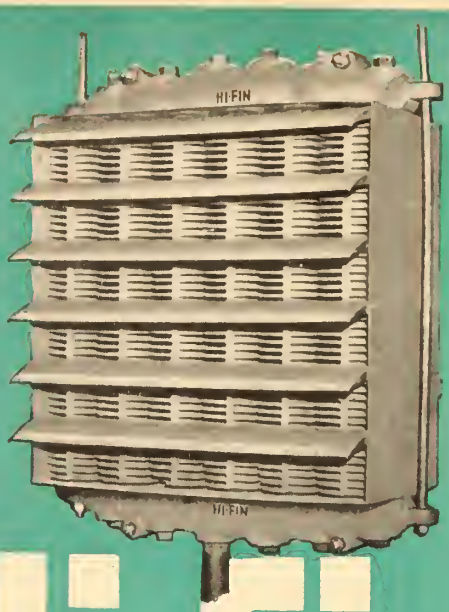
(Telephone: BElmont 3-2179)

nufacturers of: Laminates for Electrical Insulating and General Engineering Uses Rail Track Insulation, Guy Insulators, S.R.B.P. Tubes, H.V. Bushings and Terminals.



Hi-Fin

UNIT HEATERS OF LASTING QUALITY

"Hi-Fin" UNIT HEATERS

and radiators operate on steam or water pressures up to 250 p.s.i. Do not fail due to corrosion inside or outside. Easy to clean. High air volumes with lower outlet temperatures result in best performance.

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new Oxweld W-45 Blowpipe, has been introduced by Linde Air Products Company, Division of Union Carbide Canada Limited. Capable of cutting steel 8 in. thick, the CW-45 cutting attachment operates on acetylene pressure of only 5 lb. per sq. in., a distinct advantage when cutting must be done at the extremes of lengthy acetylene supply lines. The new attachment is intended for intermittent cutting in contract welding shops, manufacturing plants, shipyards, railroads, steel fabricating and maintenance shops.

●

Commercial Explosives Plant. — Construction of its $7,000,000 commercial explosives plant in West Ferris Township, about five miles southeast of North Bay, was due to begin early October, according to Du Pont Company of Canada Limited. General contract for the 30-building project has been awarded to the Fraser-Brace Engineering Company (Ontario) Limited. The plant is expected to go into production within 15 months.

At the same time, the company announced the appointment of W. D. Irwin as manager of its new explosives department; C. T. Hambley, a native of North Bay, as sales manager; and Frank A. Reid as manager of the plant located in West Ferris.

New Long Span Roof Deck.—A new type of steel roof deck, specifically designed to meet the demands of today's architectural trends toward long, unsupported spans of roof and ceiling, is now available from Robertson-Irwin Limited, Hamilton, Ontario. Called "long span Q-Deck", it can be supplied in lengths up to 32 feet.

The company reports that the new steel deck cuts building costs because its extra length permits a reduction in the amount of steel required for the framing of a building. The elimination of intermediate supporting beams also adds several inches of available headroom.

●

Flameproof Instruments.—Bepco Canada Limited, Montreal, announce the addition of a flameproof model of their controller or pedestal pattern meters. The meter was designed for use in hazardous locations and has passed the Buxton test for use in: Group I, methane; II, petroleum and acetone vapour; III, coal gas and coke oven gas. Details from Bepco Canada Ltd, P.O. Box 190, Montreal 6, P.Q.

●

"Philadelphia" Pumps in Canada.—The Canadian Meter Company, a subsidiary of the American Meter Company, has been appointed to handle sales and service in Canada for the Philadelphia Pump and Machinery Company.

Federal Public Works Contracts. — Works Minister Winters has announced that contracts involving expenditures totalling $12,605,979.50 were awarded by the Federal Department of Public Works during the month of August, 1955. The amount for new works is $3,928,532.51; for the repair and maintenance of existing structures $2,945,598.19; and for dredging contracts, $3,731,848.80.

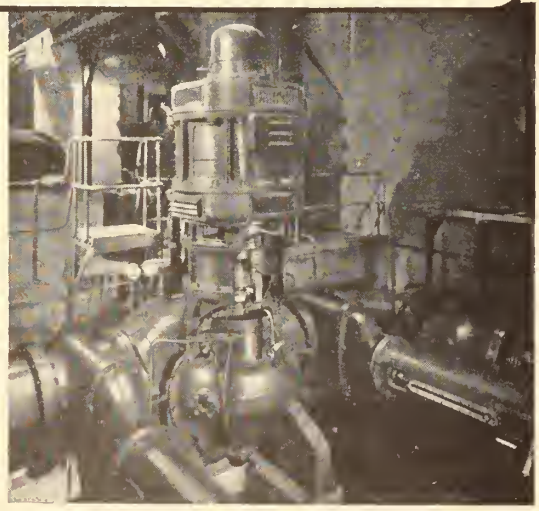
●

New Selling Arrangements. — George Ellison Ltd. and Tufnol Ltd. announce that in future the sales and engineering service for Ellison electric switchgear and for Tufnol in Canada will be handled by the Electric Construction Co. Canada Ltd., Toronto 12. President and managing director of Electric Construction Co. Canada Ltd. is H. Copping, M.I.E.E.

●

Catalytic Reformer Contract. — The Fluor Corporation of Canada, Ltd., has been awarded a contract to construct a catalytic reformer for Imperial Oil, Ltd. at Sarnia, Ontario. The catalytic reformer is the main unit in a plan calling for expenditure of more than $5,000,000 in improved equipment, as announced by Imperial. Construction will start early in 1956 and completion is scheduled in the fall of 1956. The new unit will have a daily capacity of 13,500 barrels of high octane gasoline and will be built from process designs supplied by Imperial engineers.

DRYSDALE PUMPS



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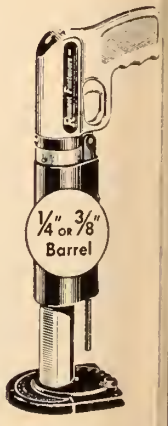

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V-28

• Employment Service

(Continued from page 1466)

England for a year, leaving Canada about January 1st, 1956. Details, several engineering graduates in Canada will be given an opportunity to work in B.I.C.C. Laboratories and factories in England. Applicants selected will receive a salary of $3,900.00 per annum, half to be paid in pounds sterling for living expenses while in England, the remaining half to be retained in Canada for payment as a lump sum in dollars on their return. Travelling expenses from present location to destination in England will be paid in addition to the above salary. Married applicants may take their families at their own expense, in which case all or part of the dollar half of the salary will be paid in pounds sterling while in England. Applicants are requested to forward full details of their education, experience, age, future plans, etc., in writing by October 15th, 1955 to File No. 5409-V.

A VACANCY OCCURS FOR a general works manager, at a plant located approximately 100 miles north of Toronto. Medium and heavy engineering products are manufactured by between 600 and 700 employees. The works include a steel foundry, grey iron foundry, bronze and non-ferrous metal foundry (including centrifugal castings); with pattern, machine and erecting shops. The position is such that only first class applicants will be considered who must have the qualifications of being a trained engineer, a good organizer, a pleasing personality and ability to fulfil a position of trust. The ultimate prospects for the right man are of the highest. Also salary will be commensurate to the candidate's ability and experience. File No. 5413-V.

OPPORTUNITIES FOR ENGINEERS. Mechanical, are required with at least five years' experience In designing heavy machinery and plant equipment. Mechanical, metallurgical, electrical and chemical, interested In training for production supervisory positions are wanted. Mechanical, Engineering Business, Electrical and Chemical, interested in industrial engineering are also needed. Our expanding development on the most advanced specialty steel mill equipment assures you of an excellent salary and good opportunities for promotion with Canada's foremost specialty steel mill. Contributing to your security are extra benefits such as a generous pension, hospitalization and group life insurance schemes. File No. 5414-V.

YOUNG MINING OR CIVIL ENGINEER, preferably bilingual required by mlning industrial plant near Montreal. Must be also good draughtsman and be responsible for plant equipment and plant expansion. Salary in accordance with experience. Write stating age, marital status and experience. File No. 5419-V.

A NATIONAL ORGANIZATION in Ottawa requires 2 engineers; a junior with 2 to 3 years experience in electrical or civil fields, and the other—a senior engineer with 5 to 10 years experience in electrical field. Permanent employment complete with pension plan. File No. 5420-V.

MECHANICAL OR CHEMICAL ENGINEER required by pulp and paper company located in Province of Quebec. This engineer is required for our design engineering department and should have a minimum of 5 years experience with at least 2 years in pulp mill engineering. The salary is open for discussion. File No. 5421-V.

SALES ENGINEER required for leading manufacturer of automatic controls. Duties involve application of limit switches and clutch controls to industrial equipment and the organizing and training of distributors. The applicant selected will undergo a training program in the U.S.A. after which he will be located in Montreal. All replies should state personal particulars, background and salary required. File No. 5424-V.

GRADUATE ENGINEERS FOR JUNIOR positions in the industrial engineering department of a large asbestos mine in the Eastern Townships. Applicants should be between 21 and 30 years of age, and have an engineering background. Experience in industrial engineering in heavy industry or large manufacturing enterprises preferable but not essential. Successful candidates will be given training in wage incentives and job methods. Excellent working conditions, extensive employee benefits. File No. 5427-V.

TECHNICAL PERSONNEL NEEDED FOR integrated petrochemical and synthetic fibre plant located Western Canada. 1) Senior mechanical engineer with extensive experience in materials handling equipment, both application and design. 2) Senior process engineer with extensive experience in oil refinery chemical or allied engineering. 3) Junior mechanical engineer. Recent graduate. Experience in oil refinery, chemical plant or allied industries preferred but not essential. 4) Junior corrosion engineer mechanical, chemical or metallurgical graduate with experience or interest required for work on plant scale corrosion problems and materials specifications. 5) Textile engineer, recent graduate in textile engineering or engineering degree with equivalent training preferably with experience in synthetic yarn plant. 6) Maintenance engineer mechanical, electrical or chemical engineer, 2-5 years' experience in maintenance department of large chemical or synthetic yarn plant or equivalent operation in large chemical or allied industry. 7) Senior piping draftsman. Experienced piping designer including specification, layout and detailing or graduate engineer interested in piping design. Applications will be treated confidentially. Write immediately stating personal details, experience in full. Salary required and date available. File No 5428-V.

ASSISTANT CHIEF ENGINEER required by B.C. Civil Service, Victoria. Salary: $496 $576.00 per month. Should be eligible for registration in B.C. as civil or electrical engineer, knowledge of financing, construction and operation of public utility systems; number of years professional experience preferably in public utility. Must be British subject, preference is given to ex-servicemen. Apply to the Chairman, Civil Service Commission, Parliament Buildings, 544 Michigan Street, Victoria, B.C. Not later than Octoher 28, 1955. File No. 5430-V.

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16,600 copies of this issue printed

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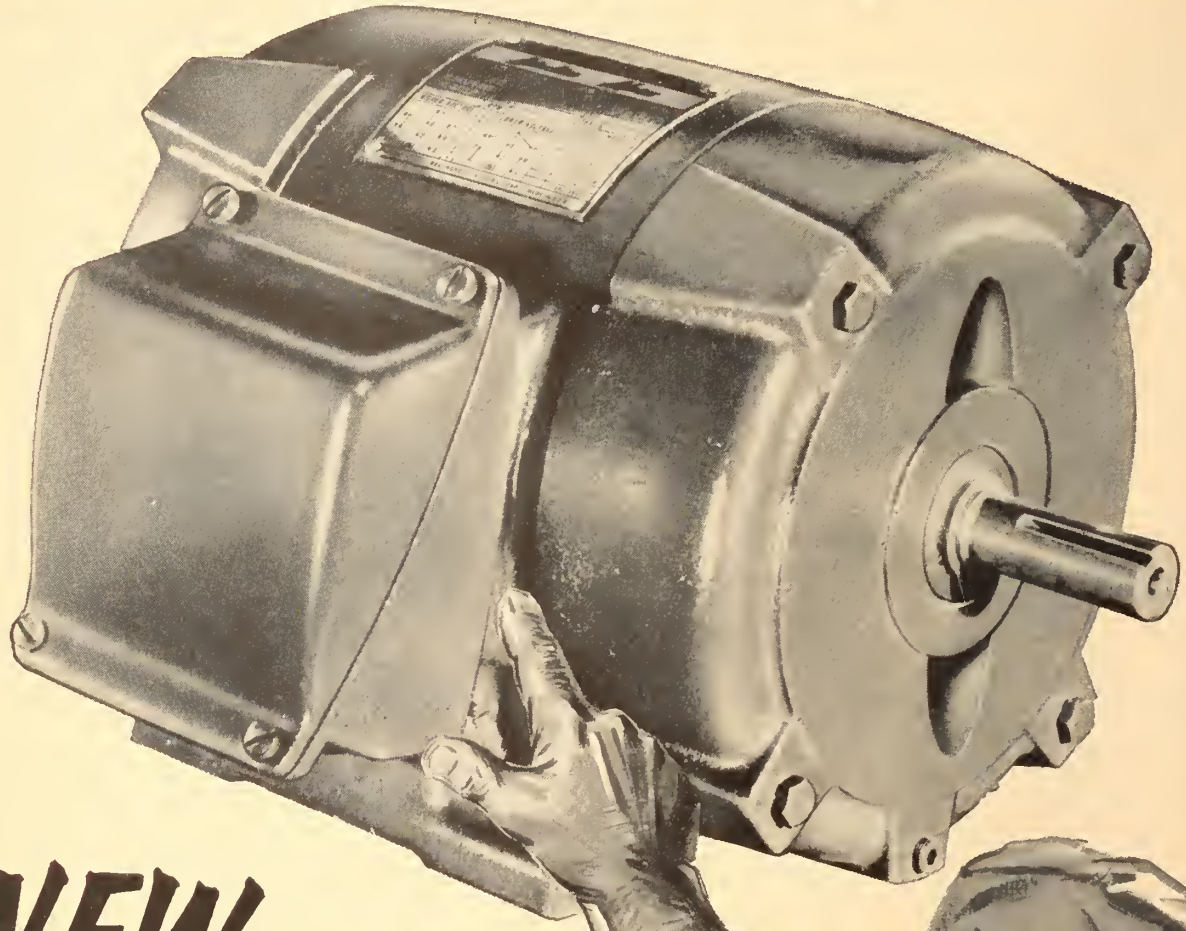

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Electronic Equipment at the Toronto Stock Exchange

by

E. L. Schmidt,

President, The Teleregister Corporation, Stamford, Conn.

Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May, 1955.

Greatly increased market activity has necessitated a new electronic system for processing the tens of thousands of daily calls handled by the Toronto Stock Exchange. Integration of existing and new systems was a major problem.

The electronic equipment at the Toronto Stock Exchange, now in service for more than two years, represents the first use of electronic digital computer techniques for the storage and dissemination of stock quotations.

The problem leading to this application had its beginning some 18 years ago, at about the time the Toronto Exchange moved into its new building at 234 Bay Street. Unlike some Exchanges, the Toronto Exchange does not use stock specialists on its trading floor, which is an open market place for securities. So-called "bid and asked" prices from investors, which are merely offerings to buy or sell at stipulated prices, are thus very important in establishing the "market" (current trading prices) on securities.

In 1937 The Teleregister Corporation installed for the Exchange an automatic, electro-mechanical system for displaying, storing and disseminating bid-asked prices on the more actively traded stocks. The major components of the old system are shown in Fig. 1.

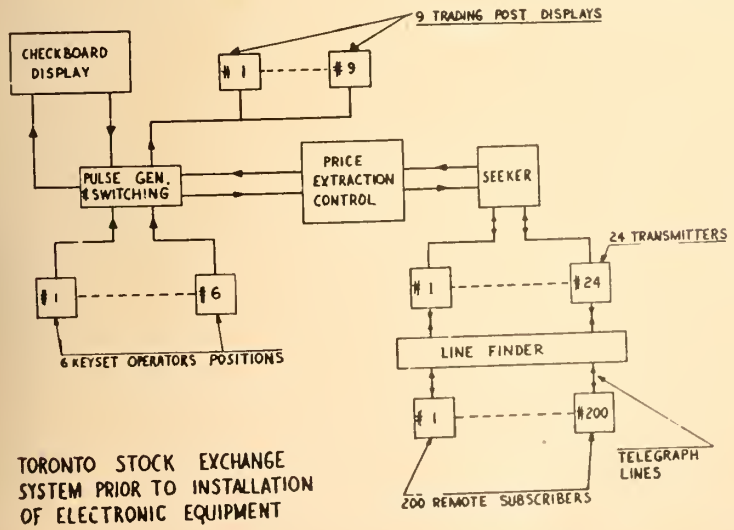
Bid-asked prices, generated at the trading posts on the floor of the Exchange from orders placed on the outside, are transmitted by reporters over an interphone system to keyset operators in the basement of the Exchange building. These keyset operators enter the bid-asked prices into the automatic system. The prices are displayed on electro-mechanical indicator units located at the posts on the floor for the information of the traders at that location. Simultaneously, the same prices are posted on indicators in a "checkboard" located in front of the keyset operators.

The system also includes a Canadian National Telegraphs network from the common equipment at the Exchange to brokers' offices in the Toronto area, who are provided with dial-ticker units. A broker desiring the current bid-asked prices for a particular stock, looks up the three digit code number for the stock in a code-assignment register.

When he is ready to dial, he presses a request button on his dial set. The operation of this button connects his dialling circuit and ticker line, through the line connecting equipment, to one of 24 transmitters which may be idle at the time. When the connection to the transmitter is complete, a ready lamp lights on the broker's dial set, telling him that the equipment is ready to receive his dialling. The operation thus far is similar to that of a telephone exchange when the subscriber picks up the hand set and receives a dial tone. The dialled code numbers are stored in the transmitter, which is now conditioned to extract the requested bid-asked price from the system's memory.

Up until two years ago the display indicators in the check board (see Fig. 2) served a dual purpose in that they were also used as storage devices or memory units. These indicators are pulse actuated mechanisms which display the digits 1 through 0 and blank, on a 11-position rotatable drum. An indicator is set to display the desired digit by transmitting counted pulses to its winding after it has first been pulsed to its blank

Fig. 1. System block diagram before installation of electronic equipment.



TORONTO STOCK EXCHANGE SYSTEM PRIOR TO INSTALLATION OF ELECTRONIC EQUIPMENT

display position. In order to respond to a broker's dialled request, the indicators displaying the selected stock prices were actuated by exactly 11 pulses. This would leave the indicators in the same display position as before, but since it was possible to determine the number of pulses required to move each unit from its display position to its blank position, a coded read-out of the stored prices was accomplished. These prices were then automatically sent by one of the 24 transmitters to a ticker at the calling broker's office.

This electro-mechanical storage system was adequate until recent years, when Canada's dynamic growth inevitably led to increased activity in its security markets. Additional dial-ticker installations and stocks, with increased activity in both, caused serious delays in the transmission of bid-asked service to the brokers. System speed was, in the main, limited by the price extraction and storage apparatus, so that it was imperative that a new type of memory be supplied.

After careful engineering analysis of the problem, it was decided to use electronic techniques and a non-volatile magnetic drum memory to process the 50,000 daily requests which were being received from brokers' offices.

Since the existing display posting system represented a major capital investment, it was necessary to integrate much of the old electro-mechanical system with the new electronic data processing equipment. This integration presented the major engineering

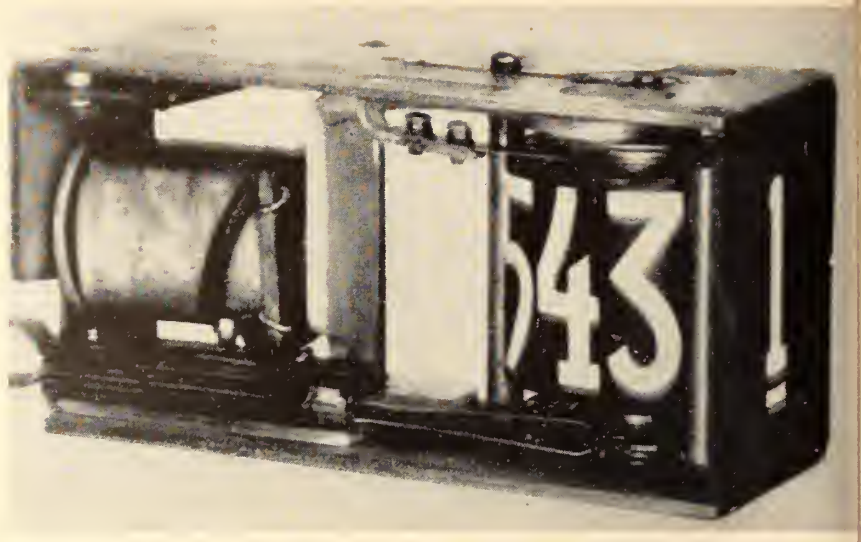


Fig. 2. Electro-mechanical indicator unit used to display bid-asked prices at trading posts. Also used in check board display which formerly served as the system memory.

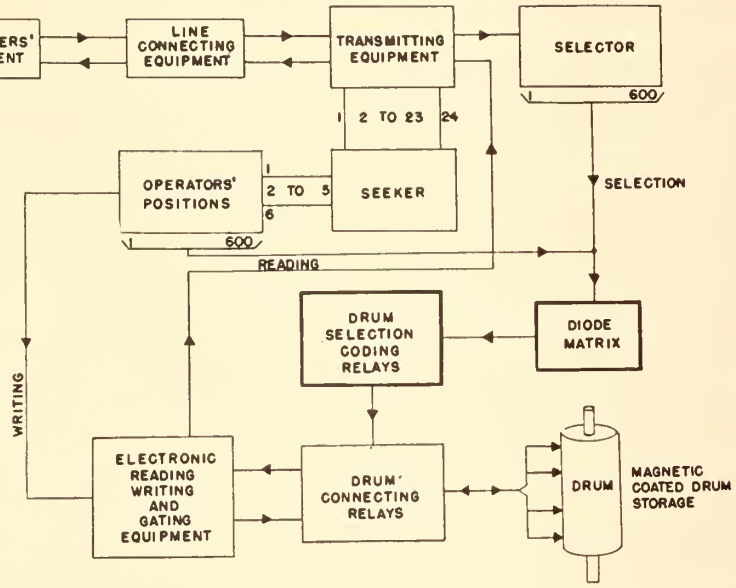
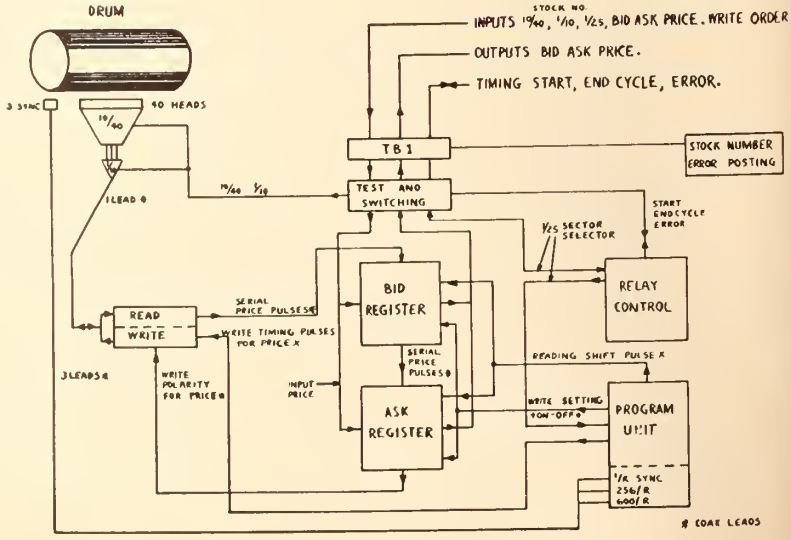


Fig. 3. Block diagram of quotation system showing integration of electronic equipment.

Fig. 4. Magnetic drum memory unit

Fig. 5 (below). Electronic functional system diagram.



problem, since the electronic components had already been developed and proven in service in an American Airlines reservations system, which processes an inventory of airlines seats in place of stock bid-asked prices. It was also decided to use the old price storage circuitry as a fall-back, so that a manual switch-over system had to be provided.

A block diagram indicating the major electronic components of the new system is shown in Fig. 3. The magnetic drum storage equipment is time-shared between the 24 transmitters and the 6 operators' positions by the seeker equipment. The purpose of the operators' positions is to keep the prices displayed at the Exchange and stored on the magnetic drum up to date with the trading.

The seeker is a relay switching device which connects the next transmitter or operator's position awaiting access to the drum storage, which is time-shared to all positions. When a transmitter gets

Fig. 6. Typical electronic plug-in subassemblies. Note printed circuits.

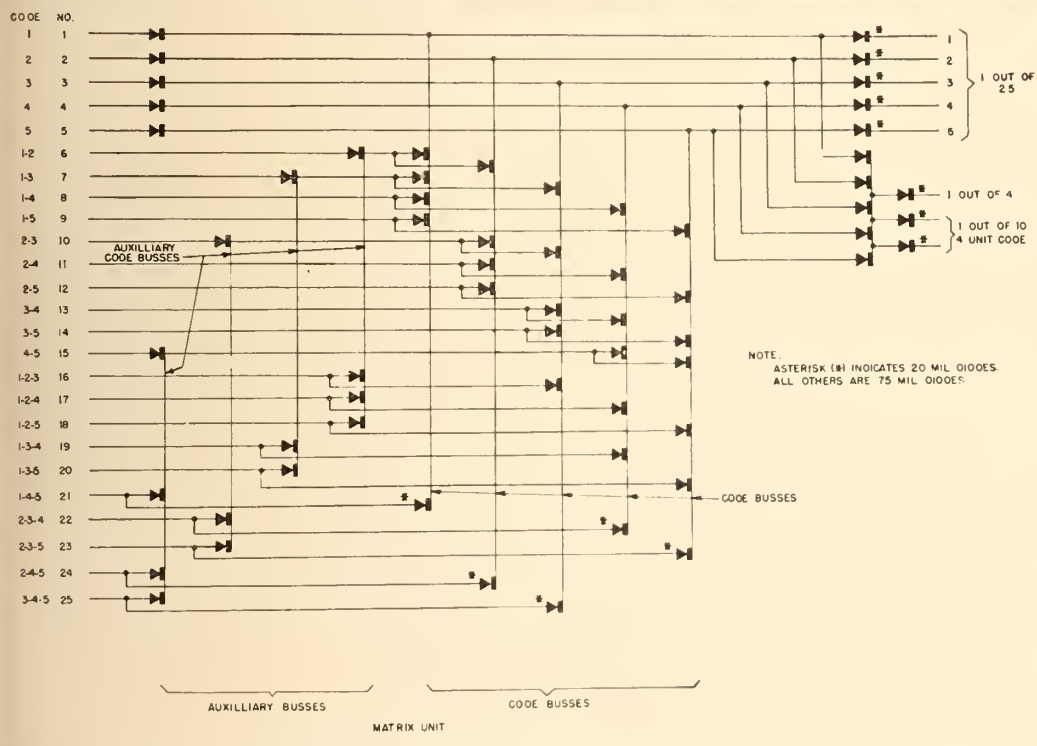


Fig. 7. Diode arrangement for coding 25 leads associated with one channel of the drum storage.

access to the memory, the 3-digit code number, dialled by a subscriber and stored in the transmitter, is translated by the selector into the energization of one of 600 single-wire selection leads which were previously used to connect the transmitters to a specific section of the check-board display when that unit was used as the system's memory.

In the new system these 600 leads are coded by use of a diode matrix with the position code of the same information on the magnetic drum storage. The output of the diode matrix is connected through drum selection coding relays to the drum connecting relays which, in turn, select one of 40 channels on the drum. If one of the six operators' positions has been given access to the storage drum, the electronic equipment is used to write the new price information stored on the operators' keyset in the section of the drum selected by one of 100 keys on operators' keyset.

The magnetic memory unit (Fig. 4) consists of a solid aluminum billet, eight inches in diameter and fifteen inches high, coated with an iron oxide film about 0.003 inch thick. The drum has capacity for storing approximately two thousand sets of prices, six hundred being the initial usage. Prices are stored in permutation code on the drum coating as positively or negatively magnetized spots, the coding being changed as the prices alter.

The drum is divided into circumferential tracks, or channels,

each channel providing price storage for twenty-five stocks. The packing factor for this application is approximately 40 bits (or code elements) per inch along the track. A read-record head is mounted over each channel with a clearance of 0.001 inch from the drum surface. In recording, these heads polarize the magnetic coating as the drum rotates at a speed of 1450 r.p.m. beneath it, under control of electronic writing and gating circuits which are triggered off as the operators send in new prices. In a reading operation resulting from a broker's dialled request, the selected magnetized spots passing under the read-record head induce positive and negative pulses which are amplified and shaped into usable dynamic pulses.

The electronic equipment, shown in block diagram in Fig. 5, is under control of a program unit which is basically divided into seven circuits; starting, function determination, counting, 1 of 25 stock selection, 1 of 6 stock digit selection, read gating and write gating. Counting is in binary code and under control of three permanently magnetized tracks on the drum which are called synchronizing or "clock" tracks. These tracks deliver one, 256, and 600 pulses, respectively, for each revolution of the drum.

The clock pulses to the electronic counters of the program unit open electronic gates at the precise instant that the desired storage area on the drum is passing beneath the selected read-record head. The 1/R pulse is a reference pulse from the drum which assures that the electronic

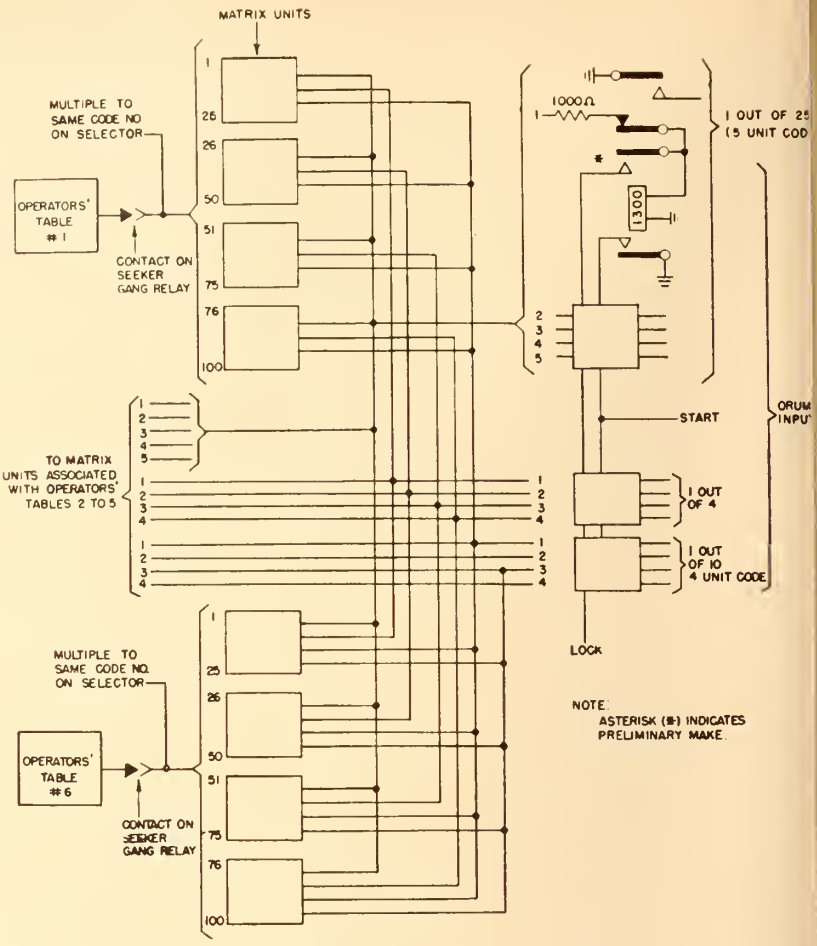
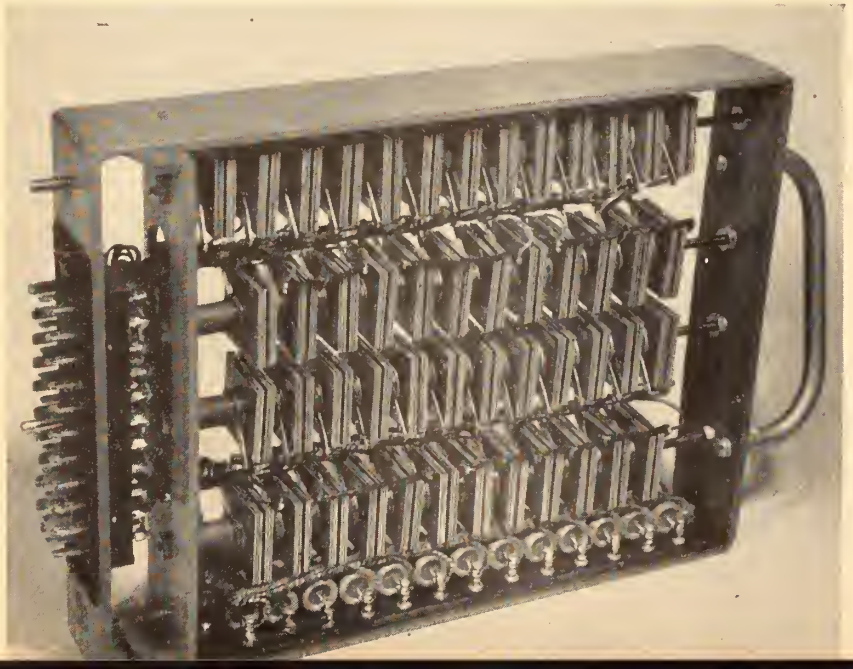


Fig. 8. Multiplying of matrix units to form the complete coding of 600 leads.

counting will always start in synchronism with the drum rotation. The 256/R pulses are used to select one or a combination of the six digits representing a bid-asked price. Since each price digit has a 4-element permutation code, there are 25x6x4, or a total of 600 storage bits in use on each drum track under control of the 600/ sync. track.

Fig. 9. Diode matrix unit assembly with cover removed.



The function of the shift registe is to read the amplified serial bi asked price pulses from the dru and send the price in parallel t the transmitters, 24 elements at time. In the case of a write opera tion, the shift registers contr serial writing into the drum fro parallel price code inputs from th operators' keysets.

The electronic equipment co tains approximately 400 tube e velopes, of which about half a Western Electric 396-A twi triodes and the remainder Weste Electric 415-A pentodes. A fe 6Y6 tubes are used in the dru record circuits. All electronic co ponents are mounted on function plug-in sub-assemblies, using print ed wiring techniques. An ope construction is employed for bett heat dissipation and lower operat ing temperature (Fig. 6).

A novel diode matrix array i used to integrate the drum selec tion coding with the output ci cuits from the previously installe operators' tables and stock selec tor. These diode matrices (Figs. 7 8) provide translation equivalen

(*Continued on page 1506*)

The Possibility of Complete Solar Heating of Canadian Buildings

by

F. C. Hooper,

Dept. of Mechanical Engineering,
University of Toronto.

Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May, 1955.

The author considers that the prospects for economic solar heating of Canadian dwellings in the relatively near future appear to be very good. Results of studies carried out at the University of Toronto are discussed.

Over the past two decades there has been increasing concern amongst many in the engineering profession over the world-wide depletion of the accessible fossil fuel reserves. These fuels, which originated from solar energy over a very long period in the world's geological history, are principally in the form of natural gas, petroleum oil, and coal. Of these coal represents more than 90 per cent, and is not of such immediate concern as the gaseous and, particularly, the liquid fuels.

The Canadian economy, in common with that of the whole world, has become dependent upon the liquid fuels produced from petroleum oil. These fuels are essential to our present air and road transport and are as well a basic raw material for many of our chemical industries, but over one quarter of the liquid fuel consumption is for space heating, a non-essential use which could be served by alternative energy sources. We are, in effect, squandering this valuable resource.

Although time estimates vary widely, it is generally recognized that before the end of the century the demand for petroleum will considerably exceed the readily accessible supply, and that its cost will inevitably rise. A similar situation, although not as acute, appears to apply over a longer term to our coal reserves.

In view of this situation it is essential that immediate attention be given to the development of alternative energy sources in order that they may be available before a profound economic depression arises. It would be wise, as well, to examine means of attenuating the existing fossil fuel reserves by reserving them for uses in which they are essential in order to permit a longer period for the development of new energy sources and, if possible, to preserve petroleum as a chemical resource for the future.

Several minor sources of energy such as wind power, tidal power, and earth heat may in future be exploited; however, the only alternative energy sources which promise to be of significant magnitude and general availability to supplant the present fossil fuels are nuclear and solar.

Nuclear energy is under intensive development, and it may well be that in future it will supply the energy requirements of the world. This is far from certain, and the other promising alternative, solar energy, warrants and is receiving considerable attention. Possibly both energy sources will eventually share the dominant place in energy supply for the world.

There are several mechanisms by which the abundant but diffuse radiant energy of the sun can be converted into useful energy in other forms. Photosynthesis is nature's process for converting the energy chemically to vegetation. Man already utilizes the organic products of nature as a fuel, but the efficiency of vegetation as a solar energy collector is very low, generally under one tenth of one per cent. Through chemical research man may eventually duplicate the photosynthetic mechanism and improve its efficiency. Its product is certainly a useful and readily stored form of energy.

Photocells and thermocouples can convert radiant solar energy directly to the most versatile form of energy, electricity. Efficiencies of approximately five per cent have been attained by both these means, but the apparatus so far devised is clumsy and expensive.

It is easiest to convert the radiant energy from the sun to heat. Although the collection of heat at sufficiently high temperatures to operate heat engines effectively is still difficult and expensive, and at present inefficient, the collection of heat at temperatures sufficiently high to be useful for space heating is relatively simple and can be carried out in practice at efficiencies of the order of 30 to 60 per cent. This relatively simple and efficient utilization of solar energy is at present the most nearly practical and economically competitive application. It is this aspect of the subject in which we have taken an interest at Toronto.

Principle of Operation of Solar Collectors

The flat plate collector or heat trap is the device usually em-

Fig. 1. Small solar heat collector operated at Port Credit, Ont.

ployed to collect low-temperature heat, generally below 200° F., for space heating. It consists of one or more sheets of glass and a blackened metallic plate, lying parallel and separated by air spaces. The cross-section of a flat plate collector is shown in Fig. 4.

The blackened surface intercepts and absorbs as heat the radiant energy from the sun and conducts it to a heat transfer fluid in which it is carried off to be stored or used. The heat trapping effect is achieved because glass is largely transparent to thermal radiation emitted from a source at solar temperatures (about 10,000° F.) but is substantially opaque to thermal radiation emitted at low temperatures. Thus solar radiation passes through the glass to the blackened plate where it is absorbed at a low temperature (say 150° F.). Thermal radiation from the plate will not pass out through the glass, since the radiation originated at a low temperature, and the heat is trapped except for conduction and convection losses. These losses are minimized by the insulating effect of the air spaces between the glass sheets.

A flat plate collector is usually oriented to face due south at some angle of tilt between 30° and 90° to the horizontal. It would be most efficient as a collector if the plane of the face were arranged so as always to face the sun directly. It is more economical of material, however, to compensate by building larger collectors and mounting them in fixed positions rather than to provide the mechanism necessary to traverse the collectors to follow the sun.

Application to Space Heating

The characteristics of the residence space heating load and of its typical physical location appear to lend themselves most readily to the application of solar energy to space heating, and we have generally restricted our considerations to this application.

Various writers have suggested that solar heating could be employed as supplementary heating, supplying heat only when the sun shone, while a conventional heating system carried the balance of the heat load during the sunless hours. This suggestion does not appear promising since the sunny periods are normally those of minimum heat demand and a solar collector system would contribute little more than the large south-facing windows now do on some modern houses. However, whatever validity their argument might have at present, the future requirement would almost certainly be for a complete solar heating system providing all necessary heat at all times and requiring no auxiliary heat sources.

If continuous heating is to be achieved entirely from collected solar energy, means must be provided to store heat from periods of surplus collection, when the heat supply from the trap exceeds the heat demands of the building to periods of deficit when little or no heat is being collected. Several types of heat storage have been investigated, most notably by the workers at M.I.T.* Heat has been stored as sensible heat in reservoirs of water and in gravel beds and as latent heat of fusion in a material of suitable melting point temperature such as Glauber's salt. At Toronto we investigated, but abandoned the idea of storing heat in the ground by means of deeply buried ground coils.

The period over which stored heat must be held depends upon many factors. At the one extreme however, if a heat trap of very large capacity relative to the building heat demand is employed then storage need provide for heating during periods of duration no longer than the longest period between sunny intervals which can be statistically predicted from weather records. If on the other hand the minimum size of heat trap is to be used, then all of the heat collected by the trap over a full year must be conserved and the storage must meet the requirements of the annual weather cycle. Heat collected in summer would be carried over to the following winter, supplemented of course by heat collected during the winter period.

Investigators in Boston and elsewhere in the United States have taken the view that storage capacity to carry for seven to ten days is probably adequate, and that a trap of sufficient capacity to meet the winter heating load can be economically provided. In Canada our heat loads are somewhat higher and the average hours of bright sunshine in winter very low. In Toronto the average number of hours of bright sunshine in January is only 79 compared to our July average of 306. In these circumstances, and recognizing that this situation is more or less representative of the Cana

* Space heating with Solar Energy—Published by the Bemis Foundation Cambridge, Mass.

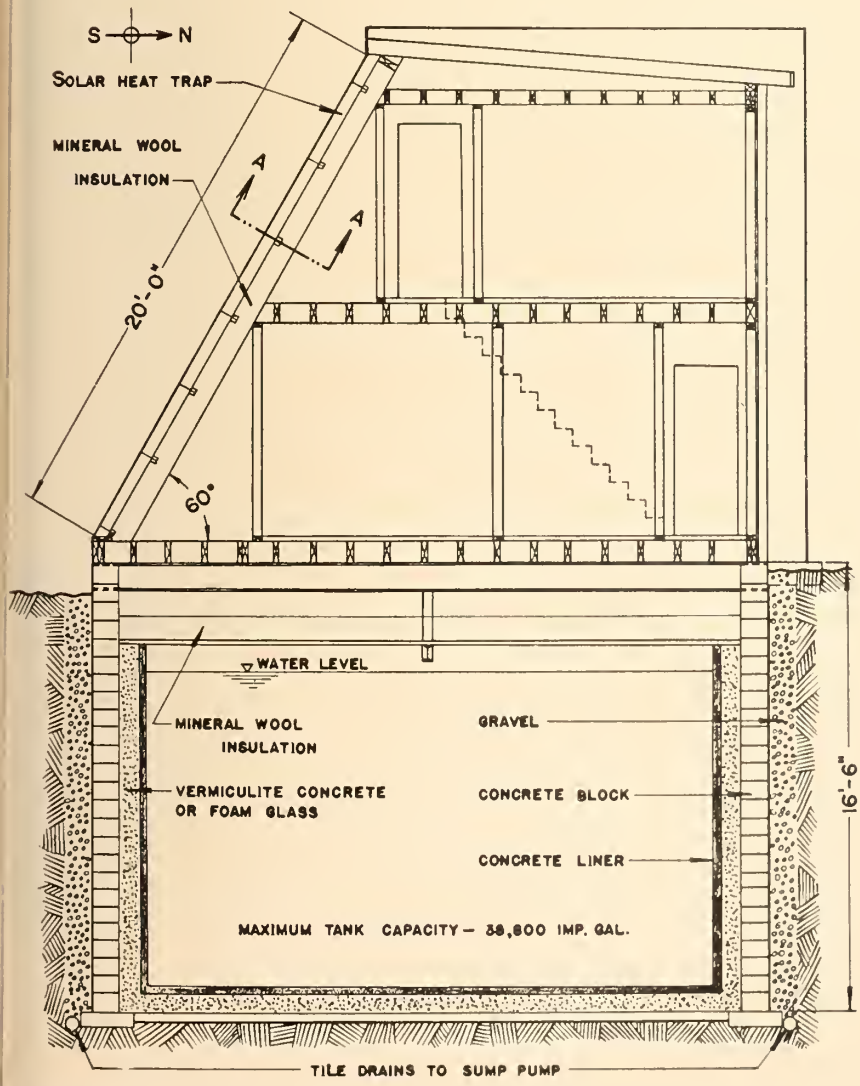
dian problem generally, we have come to the opinion that solar heating systems incorporating annual heat storage offer the most promising line for investigation in Canada. We are inclined to the belief that the eventual application of solar energy to space heating in Canada will be almost entirely on the long-term storage basis.

If we are correct in this conclusion, and if the workers in more southerly locations are correct in theirs, then it may be that eventually quite a different type of solar heating system will evolve in Canada than in the United States. The solar collector of our system would be relatively small and therefore less expensive, although its much higher factor of use, arising because it would operate during sunshine hours throughout the year, would justify a more refined and efficient collector. The angle of collector tilt would probably be between 50 and 60 degrees from the horizontal, this being chosen as the optimum compromise between summer and winter solar altitudes. An angle of tilt much nearer the vertical would be used to catch the low winter sun in a short-term storage system.

The long-term heat storage device would of course be much larger and more expensive than the corresponding short-term storage system. It would probably be located in the basement, a place that fortunately already exists in most Canadian houses because of the necessity for deep foundation walls to avoid frost heaving. With ingenuity in design and in construction techniques this might not prove to be too costly an item.

The actual heating system of the residence would probably be of the panel or radiant heating type because this system can effectively utilize very low temperature heat. Water as low as 80° F. can be used effectively as a heating medium in such systems. The lower the minimum temperature that can be used the higher will be the efficiency of the trap and the smaller the heat loss from storage.

Fig. 2. Detail of house incorporating solar heat trap.



Experimental and Design Work

Our work at Toronto has been guided by this general decision that the possibilities of a system incorporating annual heat storage should be investigated. Much of our attention has been given to the heat storage problem, since relatively, it is more important here than elsewhere.

During the early phases of our work we built at Port Credit, just west of Toronto, a small solar heat trap and operated it throughout the winter of 1951-1952. This collector, shown in Fig. 1, had a four by seven foot frontal area and was oriented to face due south at a tilt of 60° to the horizontal. Data were collected, using both two and three sheets of covering glass, on the collector efficiency and performance under many conditions of weather and temperature.

We were relieved to find that the effect of snow on the collector performance, which had given us some concern, was not in fact important. Even heavy snowfalls cleared from the trap face in a few hours by sliding and melting. Other practical factors, such as internal condensation on the glass, were however the cause of some difficulty.

A typical heat balance from this collector is shown in Table I. This is taken from the records for a one and a half hour period of bright sunshine on April 9, 1952, while two covering sheets of glass were in use. The temperature of heat delivery from the collector was 86°, the outdoor air temperature 54° F.

The general problem of design for a solar heated house involves three major factors: the collector and its performance, the house-heating load and its characteristics, and the heat storage device and its performance.

Of the three, the house-heating load, although complex, is now well understood and adequate information is available on its characteristics from work on conventional heating systems.

The collector design and performance involves many variables, for the most part incompletely in-

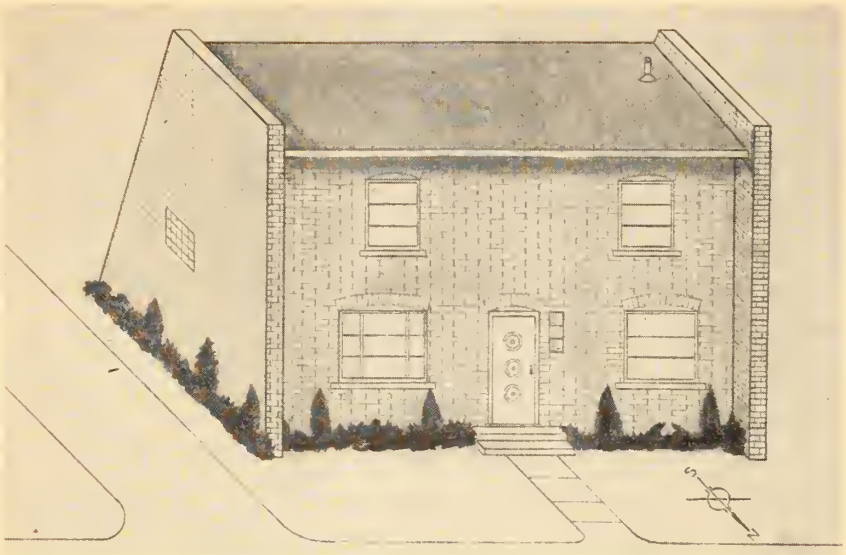


Fig. 3. General appearance of solar-heated house.

vestigated and of which the most troublesome are those relating to variations in the weather.

To a certain extent this weather variable is easier to deal with in the annual heat storage than in the short-term storage case because averages can be taken over longer periods and short-term extremes of weather are relatively unimportant. Whatever advantages for the designer may be gained by annual heat storage in this way are, however, overcompensated by the very much more difficult problems posed by long-term heat storage. The size and importance of the store is greatly increased, the problem of heat loss from the store becomes difficult and critical, and the relationship between trap heat gain, building heat loss, storage temperature and heat loss, and required heating medium temperature becomes a complex relationship with time.

Because of the complexity of the problem, and because some of the required information has not yet been experimentally determined, a generalized approach to the problem did not appear practicable. We therefore limited our problem by undertaking to design a specific house for the specific geographical and climatological conditions at Toronto. In this design we were guided by the data obtained from our experimental heat trap, and of course by data obtained from many other sources.

To confirm our heat trap design which we had modified considerably on the basis of previous experience, we built and operated another experimental heat trap. This was a three by five foot face area unit which we located on the roof of the Mechanical Building at the University and operated during the winter of 1954-1955. This substantiated some of our design criteria.

The outcome of this work has been a design for a two-storey, five-room house, having annual heat storage in the form of a water reservoir of 38,800 imp. gal. capacity filling the deep basement space under the house. The heat trap is 20 by 30 feet and covers the whole of the south wall of the residence which is inclined 60 degrees to the horizontal.

The general arrangement and appearance of the house can be seen in Fig. 2 and 3, and some of the collector detail in Fig. 4.

The house is well insulated and has radiant panel heating utilizing floors, ceilings, and some walls as heating surface so as to require a minimum water temperature of 80° F. at outdoor design conditions of —10° F. In the system used the heat is collected from the trap by water pumped from the lowest and coolest part of the reservoir and returned warmed to the upper part of the reservoir through conventional recirculating blending valves to the radiant coils and finally returned to the reservoir.

The system is, we believe, substantially overdesigned and should carry the entire heating load of the house without difficulty. The overdesign should permit variations in experimental operation. A part of the heat trap surface could, for instance, be taken out of operation during one year, the water reservoir could be partially emptied to reduce storage capacity in another year, and two rather than three sheets of glass cover might be used.

Because the reservoir would initially be cold, as would the surrounding earth, the first year of operation would be the most critical. The anticipated performance for this year is shown in Fig. 5. From the curves of this figure it will be noted that at about December 30th the heat gain is less than one half of the building heat load.

Taking into consideration the fact that this trap is overdesigned, and that short term storage would have to provide not for the average heat loads and gains shown here but for their extreme variations, it can be shown that the annual storage system requires a heat trap of only one quarter the size necessary in a short term storage system. It will also be noted that the storage temperature does not reach its minimum until after the time of maximum heat load. Thus while at maximum design conditions the radiant system might require 85° F. water, the storage temperature could drop later in the season to say 78° F. and still meet the house heat requirements.

Table I. A Heat Balance on the Port Credit Collector

	B.Th.U.	per cent
Total incident solar energy	12,300	100
Energy reflected and absorbed by glass	3,980	32.4
Energy absorbed by dirt and moisture on glass	984	8.0
Energy lost by conduction:		
through glass	547	4.4
through back of collector	73	0.6
through sides of collector	25	0.2
Energy collected	6,150	50.0
Unaccounted for	541	4.4

From Figure 5 it will also be seen that the perennial performance to be expected following the initial year would be even more markedly within the design requirement. This suggests that it would be advantageous in close economic design to give the storage an initial heat charge by portable steam generator or other means and thus avoid the necessity to design for the high loads of the initial year.

Present Status of the Work

We now feel that our next step should be to construct the experi-

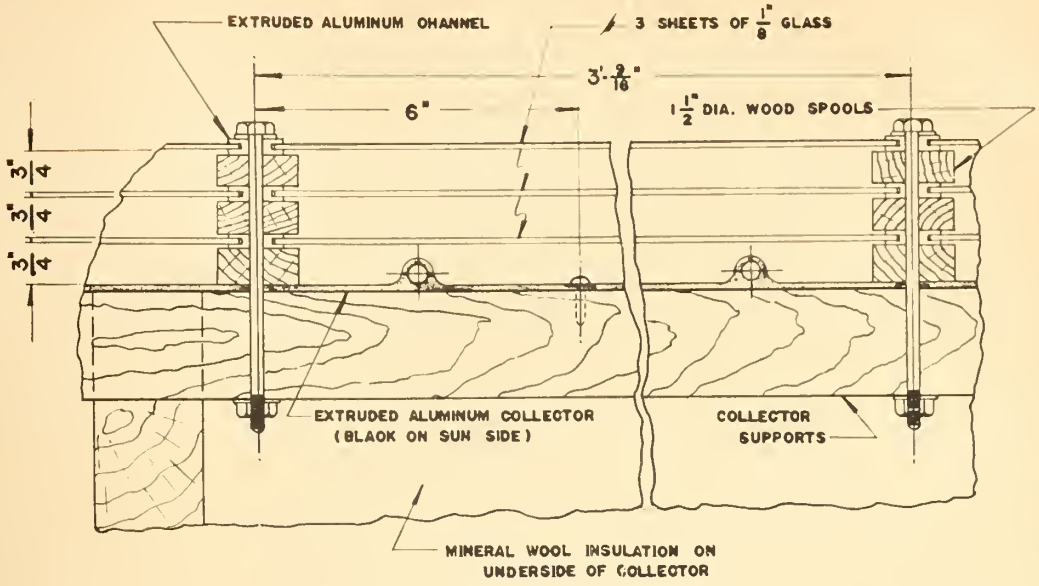


Fig. 4. Cross-section of a flat-plate collector. (Detail from Fig. 2.)

SECTION A-A

Fig. 5. Anticipated performance of solar heat trap during first year of operation.

mental house and to proceed with the accumulation of data on its operating characteristics and on some of the economic factors involved. Parallel with this and assisted by the data obtained further analysis of the problems and preparation of more general engineering design data would be undertaken. At the moment the project is delayed while the necessary financial assistance to proceed is being sought.

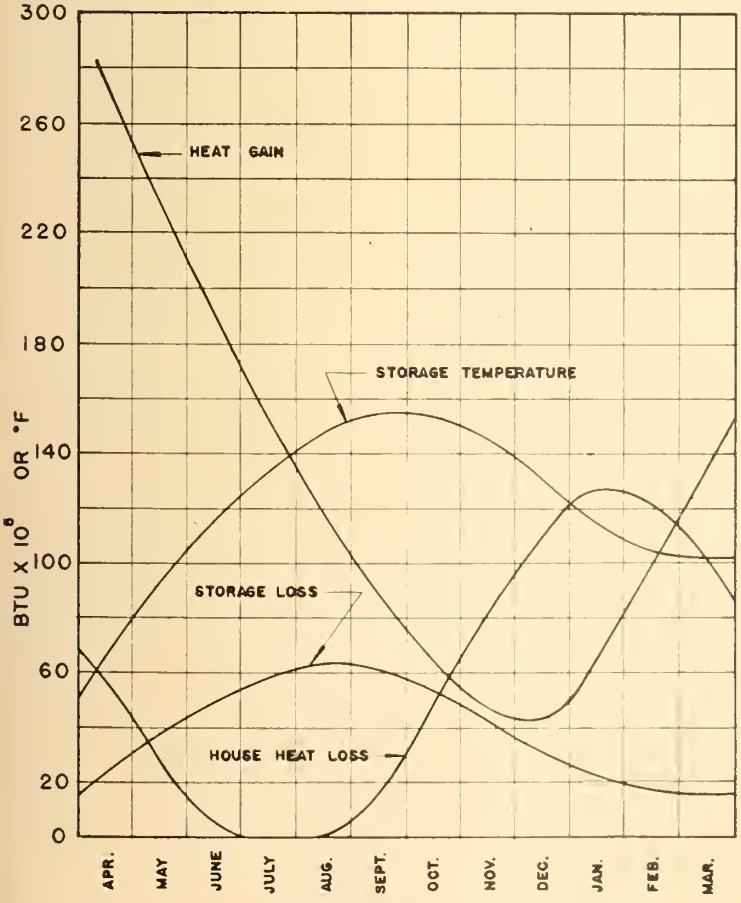
The Possibilities

At Toronto we have been able to do only a relatively small amount of work on this very broad problem. We have in some cases proceeded with our arguments considerably beyond the point to which precise scientific procedures can guide us. Arbitrary choices and informed guesses have been made because complete information is not available and because even that which is available may not be applicable in the changed economic environment of the future.

We may or may not have chosen wisely in pursuing annual heat storage, in selecting water as a storage medium, and in many other things. We have not yet had the opportunity to test our conclusions in practice. The following remarks should therefore be read with this in mind.

It is true that in Canada at the present time solar heated houses of the type we have designed could not be built in lots of three or four to compete on a strict current economic basis with conventional houses of equivalent size. It is not at all equally clear that on a production basis of, say, one thousand units, that carefully designed solar houses could not at the present time compete.

Taking money to be worth 7½ per cent at interest, the capital value of the fuel equivalent in our particular house would be about $1,500. In addition, since a conventional furnace and chimney is not required an additional $700 can be allowed. Thus if the solar heating system could be incorporated in a small house for about $2,200 it would be economically competitive. We are not convinced that this figure is not now within



the reach of a vigorous and competitive building industry.

Excluding the possible large scale intervention of heat pump heating in conjunction with cheaply produced nuclear generated electricity, the prospects for economic solar heating of Canadian dwellings in the relatively near future appear to be very good. The trend toward scarcity and higher cost in fossil fuels will inevitably continue, and it will probably be accompanied by a relative decrease in the cost of manufactured materials such as are required for solar heating systems. The prospects for wide application of solar heating in Canada within twenty-five years are so good as to be considered almost certain.

Perhaps it should be mentioned that a map of North America has been published* and received wide publicity which purported to divide the continent into regions of maximum, intermediate, and minimum feasibility for solar heating. On the map all of Canada was well within the region of minimum feasibility. The work leading to this map did not take into account annual storage and is not applicable to our proposed system. We believe solar heating is economically at least as favourable here as in Florida.

It should be pointed out that solar heating is essentially clean heating. There is no smoke nor other by-product to contaminate the air, and there is absolutely no toxic or fire hazard. The dominating consideration remains that solar heating does not depend upon nor deplete the world resources of fossil fuels. The development of such systems should be encouraged at the highest government levels.

This report has necessarily been brief. No mention has been made of the interesting architectural implications, and of many other allied considerations. We hope to include some details of instrumentation and control and of calculation techniques, and to present some of our test data, in a later report.

Acknowledgments

Financial assistance received from the National Research Council has made this work possible and is gratefully acknowledged. Technical assistance from the Ontario Hydro and from the Meteorological Office has been most appreciated. Acknowledgment is also due to Messrs. F. J. Gwodz, G. H. West, J. S. Watson, P. F. O'Rourke, S. H. Chou and F. Rimrott, all of whom have at various times participated in the work.

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*Space Heating with Solar Energy, loc. cit.

ELECTRONIC EQUIPMENT AT THE TORONTO STOCK EXCHANGE

by E. L. Schmidt

(*Continued from page 1500*)

to that of 362 relays at less initial cost and maintenance expense. The choice of diodes was based on the relay currents involved, the operating voltage, and the ratio of forward to backward resistance of the diodes to give safe operation. For this application, commercial selenium rectifiers were used, mounted on 24-unit assemblies, as shown in Fig. 9.

The electronic system has been designed to incorporate many input and output error detection circuits which check for impossible coding, absence of input selection codes, and the like. After each write operation into the drum, an automatic read-out of the just-written data is performed and automatic error detection circuits are used to check the accuracy of the data stored on the drum against the original input data. Marginal checking operations which are made after the market is closed bring to light most of the incipient tube failures long before the tube causes trouble during actual service. After more than two years' service, most of the original tubes are still in use. The system is currently handling about 60,000 calls per day.

As to the service record, there were but three instances during the first year of operation where it was necessary to switch to fall-back service and use the check-board indicators as the system memory. Since the first year, there have been no major service interruptions. It is interesting to note that the three failures during the first year were actually not caused by electronic components, but rather were due to input relay troubles.

Wings for Supersonic Flight

Recent striking advances in pro duction techniques, announced by two British aircraft manufacturers (Boulton Paul and Handley Page) concern wing construction.

Conventional wing structur used in slower aircraft—a thi skin supported by ample interna framework—permits a certai amount of flexing under loa which causes skin wrinkling. Mod ern high-speed aircraft, howeve demand wings that retain thei accuracy of contour under grea stress, yet which must be thin.

This can best be achieved b using a thick skin of either soli or sandwich construction, thoug this leads to a reduction in th space for internal structure.

Boulton Paul tackle this prob lem by means of solid 'integra construction, and a wing built o these lines, achieved a thick ness/chord ratio of 3 per cent.

The wing halves are made up twelve light-alloy elements tha form the upper and lower surface Each element consists of a spa wise spar which has a section the skin surface as an integral pa of it. Six of these members co nected together form the top bottom half of a wing and a fixed to their opposite numbe by means of specially formed bolt The resulting multi-spar, thick skinned wing possesses a high d gree of solidity which dispens with the need for rib members.

Handley Page have approache the problem in a different wa They decided that double skins relatively thin gauge with a san wich construction in betwee would provide a light, strong an from the production standpoin easily handled wing structure tha would stand up to the arduou conditions imposed by very fas long distance flight.

Various kinds of sandwich ma erials have been used, both befo and since the last war. Handl Page found that the most suitab form of sandwich construction w a longitudinally-corrugated she of aluminum alloy attached the inner skin by rivets and the outer by spot-welding. T use of spot-welding is a bold ste since this process has been r garded with suspicion by aerona tical engineers for years, but faul have been found to be very ra

ICE IN THE GULF

The author discusses the possibility of mixing the lower, warm layer of water with the cold surface layer in the Gulf of St. Lawrence in order to prevent troublesome ice formation.

by

F. S. Small, M.E.I.C.

Apohaqui, N.B.

The article *Miraculous Bubbles*, in the January, 1955, *Journal*, opens new vistas. The men responsible for this use of compressed air have done something entirely novel in engineering and are to be congratulated on their vision and courage.

The interest aroused in what they have accomplished makes this an opportune time in which to call attention to another possible use of compressed air. The Gulf of St. Lawrence is covered by a layer of cold Arctic water having a thickness of about 300 feet in winter and a salt content considerably less than that of the Atlantic water outside Canadian coastal areas. Its winter temperature is close to its own freezing point; as a result considerable ice forms each winter, though the Gulf does not freeze over solidly.

Beneath this cold, low-salinity, surface layer and extending to the bottom of the Gulf there is a great body of warm sea water with a salt content similar to that in the open Atlantic and a temperature which remains quite constant the year round at about 41°F., or roughly 12°F. above its freezing point.

There is a strong anticlockwise circulation of water in the Gulf and all that is necessary to keep the latter ice free the year round is to destroy the comparatively thin, cold, surface layer by mixing it with the much greater volume of warmer and saltier water under it. If the mixing were done at several widely separated points, the general circulation is sufficiently strong and inclusive to carry the warmer, mixed water to all parts of the Gulf and to prevent the formation of troublesome ice anywhere.

Obviously one of the mixing points should be in Cabot Strait. Possibly mixing there can be made so thorough and effective that no other points will be required, but if others are needed, as is most likely, one should be off the north shore of Gaspé Peninsula and one or more somewhere in the St. Lawrence estuary to prevent ice formation there and in the lower river. Probably one of these should be just east of Ile aux Coudres.

There are, fortunately, at least two ways in which the mixing can be done. Very probably both should be tried in order to determine which is the more desirable, after comparing all the essential factors — first cost, operating charges, reliability, effectiveness, maintenance, etc.

The first of these methods is to place suitably designed objects on the bed of the waterway and also anchored at various depths in the current. The latter should be lighter than water, and all of them should be so designed as to produce the maximum of turbulence in the flowing stream. They should be kept well below the surface so as not to interfere with or be damaged by passing ships. A great many will be needed, but if properly designed and placed the first cost will be practically the only cost for a very long time. They could be inspected from time to time by the same sort of radar device as that used in locating fish.

The other method is the use of compressed air and perforated pipes. There is a strong adhesion between air and water and the rising bubbles will be accompanied by large upward currents of water. As the bubbles rise they become bigger, due to the reduction in pressure, and their velocity increases. As a result the upward currents of water become larger and swifter, that is, they will be joined by more and more of the water through which they pass. All this improves the quality of the mixing.

Attention should be called to the observed fact that at Niagara the water surface in the bubbled area stood four feet higher than in the adjacent untreated areas. This was due in part to the momentum of the rising streams of water and in part to the lower specific gravity of the mixture of air and water. It is an indication of the vigour of the operation of mixing.

A note on the effect of the Strait of Belle Isle on ice production in the Gulf should be included in this paper. The main features of the two Straits, sufficient for our present purpose, are given in the table. The data were taken from official charts.

Strait	Length Miles	Least Width Miles	Greatest Depth in Limiting Section, ft.	Sectional Area Sq. ft.	Per cent of Total Area
Cabot	..	65	1500	356,000,000	96.6
Belle-Isle	73	10.8	180	12,600,000	3.4
			Total	368,600,000	100.0

Cabot Strait properly has no length since it may be regarded as the section in a line joining Cape Ray and Cape North, beyond which the waterway widens abruptly in both directions. Usually, nearly all the water interchange between the Gulf and the ocean takes place through Cabot Strait, but there are times when the barometric pressure distribution is such that a strong flow of Arctic water is forced through the Strait of Belle Isle, either inward or outward. This strait is not deep enough to reach any of the warmer and saltier water that lies beyond each end of it.

If the mixing were done by compressed air, the operation could be discontinued during the warm season, but it should start early enough in the fall to ensure that the stratified condition of the Gulf waters is well broken up by the time severe weather sets in. Experience will be the only safe guide in determining the starting and stopping dates, but tentatively we may assume that the compressors should be started about November 15 and stopped on March 15, giving a running time of four months per year. Some such schedule as this would keep the Gulf and the lower St. Lawrence River open the year round. However, the benefits to the climate and to the fisheries might make it worthwhile to aerate continuously.

Mixing Methods

If mixing can be satisfactorily accomplished by using objects designed to cause turbulence in the flowing streams, the currents will supply the necessary power and the first cost will be practically the total cost. Once properly designed and installed the system should work automatically for many years with little or no further cost except for periodic inspections. With such a system in operation, thorough mixing will be a continuous and permanent feature of the Gulf circulation.

Probably the most satisfactory way of deciding upon the best method of keeping the Gulf ice free the year round is to construct scale models of the various places in which it is expected that the necessary works will be installed.

These models can be used to determine in a preliminary way the practicability of mixing the Gulf waters and also to show the value of such mixing. Then the models can be used to determine the relative merits of the two schemes herein proposed and also of any other schemes that may be thought worth investigating. Finally, the details of whatever scheme, or combination of schemes, is adopted can be studied and perfected most satisfactorily only by the use of models.

The Gulf of St. Lawrence is very roughly a huge rectangle of cold water entirely surrounded by three of the Maritime Provinces and southeastern Quebec; it entirely surrounds the fourth Maritime Province. At present, it exercises a tremendous and detrimental influence on the climate of all the lands adjacent to it. But if its existing stratified condition can be broken up so that it will be ice free in winter and warm in summer, it will become a blessing instead of a curse to the climate of all the surrounding terrain. For instance, both farming and forestry should be noticeably improved and if the mixing is done by the use of compressed air the fisheries should be definitely benefited. The outflow from Cabot Strait joins the general oceanic circulation and is carried southwestward along the Atlantic coast of Nova Scotia and thence into the Bay of Fundy. The adjacent coasts would share in the benefits conferred on the lands within the Gulf.

For the effect on fisheries of mixing ocean waters the reader is referred to an excellent booklet written in 1928 by Dr. A. G. Huntsman, then director of the Marine Biological Station at St. Andrews, N.B., under the title "The Passamaquoddy Power Project and its Effect on the Fisheries." This booklet was published by the Department of Fisheries, Ottawa.

The most important advantage that may be expected to result from keeping the Gulf ice free the year round would most likely be its effects on industry and commerce. There are known to be important mineral resources in all the lands surrounding and adjacent to the Gulf of St. Lawrence and it is very probable that more will be discovered there in future. There is a great supply of raw materials in the products of the farms, forests, fisheries and mines. With the ice abolished, the markets of the world would be permanently open to Maritime industries and commerce.

The great water power resources of Hamilton River are within transmission distances of most of Newfoundland and there is a large total of power available from the rivers flowing into the Gulf from the north shore and from Gaspé. The power in the great tides at the head of the Bay of Fundy, the geographical center of the Maritimes, can and doubtless will be harnessed when the demand becomes sufficiently imperative.

The Gulf of St. Lawrence lies at the mouth of the St. Lawrence River. Together these form, excepting possibly the Mediterranean, the greatest commercial inland waterway in the world. The Atlantic provinces also lie very close to the busiest shipping lane in the world, that between northwestern Europe and northeastern America. The advantageous position of the Atlantic provinces on this trade route is shown by this table:

St. John's	to Liverpool	1927 miles	
Churchill	"	2936	"
Montreal	"	2968	" (via Cabot Strait)
New York	"	3707 miles	
New Orleans	to London	4656	"

The Canadian Maritimes have potentially vast power resources; they have great stores of raw materials, either within themselves or readily available from elsewhere; they are ideally situated at the outlet of one of the world's two greatest inland waterways and they occupy a nearly central position on the world's busiest shipping lane. Surely their prospective importance makes it worthwhile to devote some thought to the problem of freeing them from the stranglehold which winter ice now has upon them.

This brief study of the ice problems of the Gulf of St. Lawrence would be incomplete if no reference were made to the intimately related question of winter navigation on the St. Lawrence River, at least on that part of it below Montreal. The works now in hand for the development of the power and navigation resources of the upper river from Montreal harbour to Lake Ontario, may be expected to prevent any avoidable waste of heat in that section which is herein understood to include the two "Back Rivers" at Montreal. If this is done the problem of keeping the river open between Montreal harbour and Lake St. Peter will be greatly simplified.

The range of spring tides at Quebec is upwards of twenty feet and twice a day the lower river is flushed out by a great volume of

salt water. This is heavier than fresh water and flows in along the river bed, lifting the lighter fresh water to the surface. The river is deep up to Point Platon, 30 miles above Quebec, where soundings of 100 feet are shown on the charts. If a compressed air mixing plant is installed at Point Platon and another in the deep water just east of Ile aux Coudres, 60 miles east of Quebec, the two would probably keep the water sufficiently mixed to prevent ice formation in the upper estuary and lower river.

Below Lake St. Peter the river does not ordinarily freeze over under present conditions, but sometimes large fields of bordage ice, loosened by the rise and fall of the tides or otherwise, may move out into and block the channel. If left undisturbed ice from upstream will lodge against these ice fields and freeze into serious obstructions. Timely action by icebreakers easily keeps the channel open. It would seem that the problem of maintaining an ice free channel from the head of Lake St. Peter to Point Platon should not present insuperable difficulties. If so and if the Gulf can be kept open by the means outlined herein, or by some other means, then the whole Gulf and River from Cabot Strait to Montreal will be free for use and development as industry and opportunity may dictate.

At present Canada's industrial growth is hampered and hindered by the fact that its front door is tightly barred for four or five months each year. If it is to attain the stature of a great nation this situation must be corrected. The purpose of the present paper is to point out a way of doing this.

The writer is aware that under present conditions the St. Lawrence freezes over solidly from Jacques Cartier bridge to the lower end of Lake St. Peter and that a heavy traffic uses the winter roads on this ice. He has seen the upper end of Laprairie Basin filled with frazil and huge blocks of hard surface ice pushed up on the Lower Lachine Road, opposite the foot of the Lachine Rapids, by ice shoves in the adjacent river, the normal water level of which at the time was fifteen feet or more below the road surface.

In March, 1887, a survey carried out by the Montreal Flood Commission showed 253,000,000 cubic yards of frazil ice and 100,000,000 cubic yards of hard, surface ice stored in the section of the river lying between the foot of the Lachine Rapids and Varennes, a distance of 20 miles by river. At the same time, there was also, no doubt, a great volume of ice in the lower sections of the two "Back Rivers." Great ice fields occasionally form in the Gulf of St. Lawrence and at times Northumberland Strait freezes over solidly.

These occurrences are the results of long periods of severe weather. The writer is not so Quixotic as to propose that we attempt to destroy them; his idea is to prevent them from occurring. At the beginning an ice sheet is a thin and delicate thing. A slight rise in water temperature, a tiny fraction of a degree, will prevent its formation. This is the point at which to concentrate an attack. Moment by moment ice must be destroyed and moment by moment its formation must be prevented.

Ice is a powerful heat waster. Its thermal conductivity is four times as great as that of water, and its upper surface must have approximately the same temperature as the air above it, while its under surface is at or about freezing temperature. On clear, cold nights this forms a steep temperature gradient through an ice cover, and the upward flow of heat is rapid. In consequence, the thickness of the ice sheet increases rapidly.

Solar Radiation

Ice also reflects solar radiation much more thoroughly than open water does. If the ice field is covered with snow, the amount of the reflected radiation is even greater, but a snow cover reduces the loss by conduction.

On bright clear days, even in winter, open water receives some heat directly from the sun and on cloudy days radiant energy is received from the clouds. Also, especially in the Maritimes, in winter, there are many days when the air temperature is above freezing for all or part of the day. From all these sources open water receives and stores heat in winter. But water covered by ice or ice and snow receives little of this heat.

Another point worth some consideration in this connection is the speed with which Nature disposes of the great accumulations of ice in the St. Lawrence when she gets ready to undertake that job. When winter ends as much as three or four hundred million cubic yards of ice, solid and frazil, may be stored in the Montreal section of the three rivers which here constitute the St. Lawrence. Yet in a couple of weeks, more or less, all, or practically all of this great mass of ice is melted.

Here is another way of looking at it. On March 21 each part of the earth receives exactly the same amount of solar radiation as it does on September 22nd. Yet in our latitudes March 21 is only late winter, or at the best very early spring, while September 22 is harvest time. The reason for this seasonal lag is, of course, the great amount of cold accumulated in one case and great quantity of heat stored in the other. In spring things are warming up; in the fall they are cooling off.

Other Areas

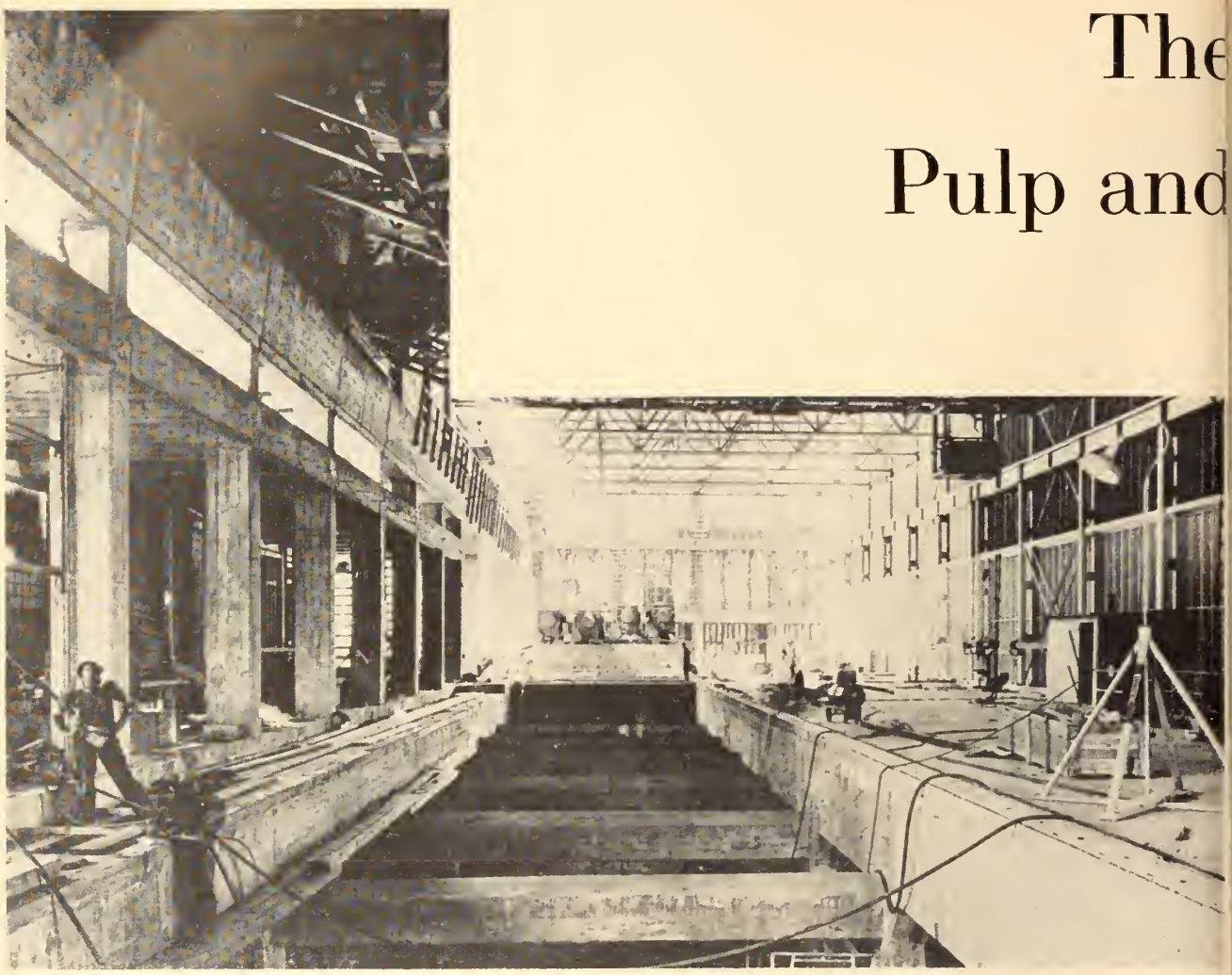
If ice formation can be prevented in the Gulf and in the navigation channel of the St. Lawrence River below Montreal, may it not also, by the same or similar methods, be possible to do something of value elsewhere? Lake Ontario does not freeze over and possibly the channel between it and Montreal could be kept open.

It would be a very valuable achievement if the open season at Port Churchill could be lengthened by a few months. Perhaps the ice in Davis and Denmark Straits can be destroyed in whole or in part. If these things are done, we may expect a marked reduction in the volume of sea ice on the Labrador and Newfoundland coasts and in Hudson Bay, and also a rise in the water temperature in these places and a consequent improvement of climate. If the barren waters of the great Hudson Bay system of inland seas can be mixed and aerated a valuable fishery might develop in these shallow waters.

Possibly something can be done to destroy or prevent the ice moving south through Nansen Strait between Spitzbergen and Greenland. Here warm Gulf Stream water flows constantly northward on the bottom and cold Arctic water flows constantly southward on the surface. For a short time in summer the north bound warm water reaches the surface on the eastern side of the Strait and the cold Arctic current is then confined to the Greenland side of this waterway. There is need of more oceanographic work in Nansen Strait.

The

Pulp and



A view of the paper machine pit a operating floor level.

The Murupara project, which is the name given to the scheme of which the Tasman Pulp and Paper Company's mill at Kawerau is the major portion, had its beginnings in 1913 when the first experimental plantings of exotic softwoods were made on the Kaingaroa Plains.

This area, located in the centre of the North Island of New Zealand, comprised a pumice plain, sparsely covered by vegetation, and treeless except for pockets of native bush in the gullies. By 1925, these experimental plantings had demonstrated that this area, which was capable of only marginal or uneconomical agriculture development, contained a remarkable potential for rapid forest growth. Large scale planting programs were then started which have today yielded an economically mature forest of some 260,000 acres.

Meanwhile, investigations were being carried out to determine the best means of economic utilization of the forest raw material. The results of these investigations showed that *Pinus Radiata*, the major species, was suitable for the manufacture of newsprint and high grade sawn timber. It was natural, therefore, that the most modern overseas practice be followed and that an integrated industry be planned which would minimize or eliminate wood waste and which would allow for the use of the logs in the product to which they were the most suited.

This scheme was generally outlined in a "Proposal for the Sale of Logs" which was issued in 1951 by the New Zealand Government, and which comprised a world-wide invitation to organizations with the necessary technical and financial resources to co-operate with the Government in the development of the industry and to build the integrated plant.

The offer of a New Zealand firm was finally accepted and the Tasman Pulp and Paper Company Limited was formed in 1952.

Nature and Size of Plant

The original offer of the Tasman Company, in line with the outline provided by the Government, pro vided for the manufacture o newsprint, bleached sulphate pulp and sawn timber, and generally outlined the design, equipment and estimated costs of the pro posed plant. Intensive review o this proposal followed and wa pursued until March, 1953, a which time the final scheme wa adopted by the Tasman Board o Directors.

The dimensions of the industry in the final scheme provided fo the use of the maximum fores yield and for the manufacture o products in the following annua amounts:

Newsprint ..... 75,000 long ton
Chemical (Kraft)
Pulp ..... 36,000 long ton
Sawn Timber 72,000,000 board fee

Concurrent with the review o the detailed proposals of the com pany about the nature and size o the plant, a review was also mad of the market information whic had been developed by the Gov

Murupara Paper Project

by

E. S. Barton,

Assistant Chief Engineer, Projects Administration,
Sandwell and Company Limited,
Consulting Engineers,
Vancouver, B.C.

An area in northern New Zealand, unsuitable for agriculture, proved to have great potential for forest growth. To develop the now economically mature forest, an integrated industry has been planned which will make full and best use of the available timber. The plant incorporates much from Canadian and other experience of the industry.

ernment concerning sawn timber and (by various people) newsprint and pulp. The results of this review confirmed the potential of the New Zealand and Australian markets in which the Tasman Company would have the best opportunity of participating, and the economic studies resulting therefrom indicated the financial soundness of the whole scheme.

Site of Plant

The original government proposals visualized the industry centered at Murupara, on the edge of the forest, with the establishment of a deep sea shipping port at Tauranga, some 100 miles away. Various technical and economic considerations having mainly to do with foundation conditions, freight rates, water supply, and effluent disposal, led to the consideration of alternative locations along the rail link. The location finally chosen met all basic requirements and, in addition, gave prospect of future operational savings to the enterprise through the use of geothermal steam.

The site is on level farmland on the flood plain of the Tarawera River about 20 miles from the east coast. The soil consists of pumice to a depth of approximately 90 feet, overlain by approximately one foot of volcanic ash. Aerial top-dressing has converted the surrounding land into relatively fertile pasture.

No special site problems have developed and for purposes of construction it is in many ways ideal, as the soil drains freely, is easy to excavate, and has sufficient load bearing capacity to allow for spread footing design.

The ground floor of the main mill structure is approximately 30 feet above the maximum high water of the adjacent river whence the mill draws its water and returns its effluent.

Plant Design

Layout

The layout of the plant area is made on a rectangular grid. A 20-foot horizontal module has been used throughout which established the most efficient use of the area and provides the most flexible arrangements for future expansions.

In general, the plant has been arranged so that all the manufacturing departments of the pulp and paper mills, with the exception of the wood preparation and chemical preparation plants, are under one roof. This main mill block is constructed about an east-west axis which forms an access-way between the various departments for piping, wiring, and inter-departmental traffic. This access-way is bounded on the west by the finished product storage and shipping facilities and on the east by the heat and power plants.

The sulphate pulp production facilities, and the mill office, stores, and repair shops have been arranged on the north side of the axis and the groundwood and newsprint facilities on the south side. In all cases, design provision has been made for substantial extension of all departments in either the north or south direction.

The chemical preparation plants and the chemical warehouses are located to the east of the main mill block and are connected to it at operating floor elevation by means of walkways which also serve to support the inter-departmental piping.

The log yard, wood preparation plant, and timber manufacturing plants are north of the main mill block, the distance from it being governed by the horizontal distance required to convey chips to the height of the digesters. Covered access to these departments is provided along the conveyor galleries.

Processes and Equipment

Logs are transported from the forest to the plant by rail where they are unloaded in car load lots by a 30-ton Hammerhead crane with a 90 ft. beam. The large percentage of "sinkers" renders conventional handling in a log-pond impractical, so the crane is again used to transfer the log bundles from storage to breakdown decks. Here the bundles are separated and the logs are transferred to log hauls which convey them into the wood preparation plant.

Within the plant, the logs are sawn to length and passed through a hydraulic barker. The barked logs are sorted as to pulp logs or

saw logs, the saw logs being conveyed to the sawmill and the pulp logs being slashed into four-foot blocks.

The blocks are again sorted, those selected for chemical pulp being chipped, and those selected for groundwood being conveyed either to storage or direct to the grinders. Chips are screened and conveyed through storage bins to the digesters.

All refuse from the woodroom conveyors, the barker, and the chip screens is hogged and conveyed to the boiler house for use as fuel.

Between the wood preparation plant and the sawmill a log storage yard, served by an 80 ft. bridge crane provides for segregation of the logs by size and species, as well as for buffer storage between the two plants.

The sawmill comprises three lines, two gang lines and one band line with ample remanufacturing equipment to provide for the maximum utilization of the top grade logs. All suitable waste from the sawmill is fed to a slab chipper from which the chips are screened and conveyed through storage to the digesters. Sawmill waste which is not suitable for chips is conveyed, along with the wood preparation room refuse, through the hogs to the boilers for use as fuel.

Lumber from the sawmill is sorted and stored under a 120 ft. craneway which is served by two high speed bridge cranes. Six kilns have been provided for drying a proportion of the cut and pressure treatment facilities are provided, suitable for use with the common water-soluble preserving salts.

The sulphate pulp is cooked in five 3,200-cubic-foot digesters, each equipped with indirect heaters and automatic cooking controls. Waste heat from the digester blow tank is recovered in a blow heat recovery system and the hot water therefrom is used in the pulp washing. Vibrating knotters and three stage washing is provided.

Pulp from the washers is conveyed to high density storage, two towers being provided to allow for separation of "sales grade" pulp from the "bleachable grade" pulp which is required for the newsprint furnish. Both grades of pulp are screened simultaneously on two separate lines of rotary screens, the sales grade being thickened into a third high density tower which provides a buffer storage ahead of the pulp drying machine.

All rejects from the system are refined and rescreened. The bleachable grade is bleached in a single stage hypochlorite system and is conveyed to storage in fourth high density tower from t bleach washer. The sales gra pulp is dried on a cylind machine equipped with feltle presses and an air dryer.

The chemical plant supporti the sulphate mill comprises se tuple effect tubular evaporators, "direct contact" or cascade ev porator, a black liquor recove boiler, an electrostatic precipitat a continuous causticizing plan and a lime reburning kiln.

In addition to this convention equipment, the lack of chlori manufacturing plant in New Ze land and the consequent relian on expensive overseas supply, h made the provision of a chlori plant an economic necessity. Th plant is sized only to provi chlorine for the needs of that po tion of the Kraft pulp required f the newsprint furnish and con prises twenty electrolytic cells the diaphragm type. The by-pr duct caustic soda is purified an concentrated, either for sale or f use in the sulphate process.

The groundwood portion of th newsprint furnish is produced fro the 48-inch blocks from the woo room on eight two-pocket grin

Late 1954 — nearing structural con pletion. To the left, paper machin building and storage; right, pow boilers and chip storage silos.

General view of the 2,500-foot by 5,500-foot site beside the Tarawera River, northern New Zealand.

ers driven in pairs by 5,500 h.p. synchronous motors. The pulp is screened on rotary screens identical to those in the sulphate mill, and is then deckered into buffer storage ahead of the machine. Rejects from the system are disposed of to waste.

The newsprint machine is of the most modern design and is mechanically capable of speeds up to 2,000 feet per minute. The stock inlet is the constant liquid level air-cushion type designed for an overall machine speed range of 500 to 2,000 feet per minute. The Fourdrinier section has a wire 285 inches wide by approximately 115 feet long and a 54-inch diameter suction couch. Vacuum pick-up equipment is provided to assist the transfer of the sheet from the couch to the press suction which contains two 42-inch diameter suction presses.

The dryer part contains forty-nine 60-inch main dryers and ten 70-inch felt dryers and is provided with forced ventilation and heat recovery equipment. An eight-roll calender stack and a Pope type reel complete the machine, which is driven by a direct current sectional electric drive. The paper machine winder is designed to be suitable for speeds up to 6,000 feet per minute and for a maximum trim of 271 inches.

Steam is provided to the plant by the sulphate mill recovery boiler and two power boilers each rated at 150,000 lb. per hour. The power boilers are designed to burn wood waste from the wood preparation plant and sawmill together with coal or oil. The normal fuels will be wood waste and coal proportioned by the availability of wood waste, the steam demand, and the requirements of the economy of operation. Provision is made for the storage of wood waste for reclaim to the boilers when the wood mills are not running.

All boilers are designed to deliver steam at 650 pounds per square inch and 750° F. The high-pressure superheated steam is used in a 10,000 kw. back pressure extraction turbine which supplies a portion of the plant's demand for electric power. Extraction steam is distributed at 150 pounds per square inch for digester cooking and back pressure steam is distributed at 50 pounds per square inch for process use.

Electric power from the turbo-generator and the public supply is distributed throughout the plant by an 11,000-volt radial distribution system to twenty 1000kva. unit substations.

The power sources and the radial feeder system are controlled from a central control room with remote switchgear control and metering equipment. From the unit substations low tension power is distributed at 400 volts to grouped motor control centres and at 230 volts for lighting and building services.

Process water is supplied to the mill from the Tarawera River. A pumping station at the river delivers water to a water treatment plant where the total mill supply is chemically treated and filtered through pressure filters into a 1,500,000 gallon reservoir. Another pumping station at the reservoir delivers process water to the mill mains.

Fire protection is provided from a separate ring fire main which supplies hydrants, hose reel stations and the mill sprinkler system. Water for this system is provided from four separate pumps at the river, all arranged for automatic starting on demand from the system.

Although the plant is, in general, conventionally designed and

equipped and contains little that is radical or unproven, a unique feature is the variety of sources from which the equipment has been drawn. This has been made possible by the remoteness of New Zealand from centres where pulp and paper machinery is manufactured and this has, in general, placed world sources on an equal footing—at least, in so far as freight is concerned.

This has resulted in equipment being provided from such widely scattered areas as Australia, Canada, United States, United Kingdom, Sweden, Switzerland, Holland, and Germany.

Building Structure Design and Architecture

With the exception of the wood preparation plant and the sawmill, all buildings housing permanent equipment are of reinforced concrete construction. The wood preparation plant, the sawmill and all warehouses are steel frame construction with timber walls.

In all cases where expansion has been planned, "temporary" walls of wood stud frame with horizontal drop siding have been provided.

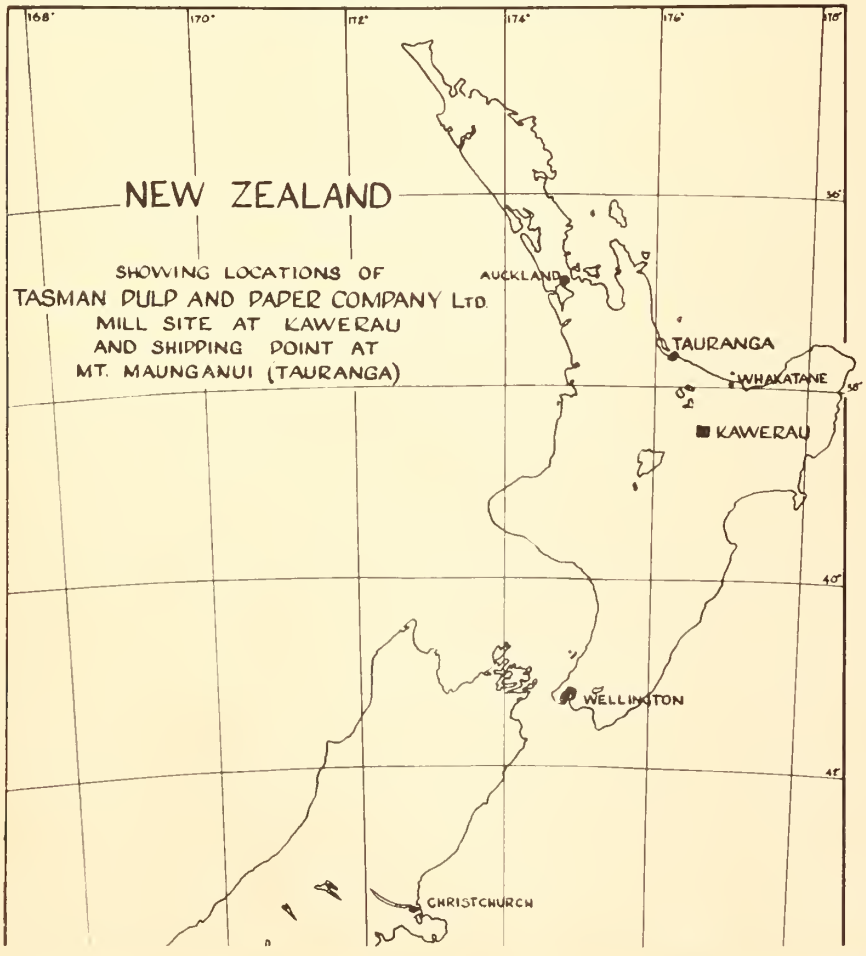
Roofs are dead flat with small overhanging eaves, and generally comprise a wooden roof deck supported from timber purlins on the steel roof trusses with tar and gravel built-up roofing.

Ventilation

Except in areas occupied only by day shift workers, the plant is windowless. Natural ventilation is provided in certain areas by means of fixed timber louvres. In areas where the process requires controlled ventilation conditions, or in areas where humidity is likely to be unpleasant for working conditions, mechanical ventilation is provided.

Because of the mild climate of the country, maximum use has been made of outdoor construction and, with the exception of housings for the electrical gear, controls, and access-ways, building structures are eliminated from the lime kiln, the causticizing plant, the evaporators, the boiler plants, the digesters, and the water pumphouses.

Map of New Zealand, showing locations of Tasman Pulp and Paper mill site at Kawerau and shipping site at Mt. Maunganui (Tauranga).



Construction of Plant

The construction of the plant being carried out by a general co tractor comprising a combin venture of one New Zealand a two American contractors. T contract, which was signed March 1953, provides that the o contractor construct the comple plant including the preparation the site, the construction of a buildings and the procureme and installation of the proce machinery and service equipmen The complete plans, specificatio and instructions for the work a provided by the consulting eng neers and the contractor has responsibility for the plant desig

The schedule for the work call for commencement of constructi in September 1953 and completi in the third quarter of 1955. New Zealand, a schedule of th nature, involving an expenditu of approximately $40,000,000, pr sents special problems not prese to the same extent in more highl industrialized and thickly popu lated countries. These problem are, in general, related to the co trol of deliveries of equipme from overseas sources in conform ity with shipping schedules, t policing of the deliveries of ra materials from overseas source for the manufacture of items wit in the country, and the procur ment of large numbers of skille tradesmen.

The problem of deliveries equipment and material have bee managed, with considerable su cess, by means of intensive e pediting of all orders; the proble of labour supply has been deal with by tapping Australian labou sources and the creation of favou able job conditions.

Other Projects

Concurrent with the construc tion of the Tasman Pulp an Paper Company's plant, the re maining projects of the Murupar scheme have been designed an constructed by resources withi New Zealand. These projects in clude the development of the log ging operation in the forest, th creation of new towns to hous those concerned with the industry the construction of new road an rail links, and the creation of new deep sea port. At the time o writing (May, 1955) it appear that 1955 will see the fruit of th seedlings sown first in 1913.

The Design of a Wide-Band Low-Cost Audio Frequency Oscillator

by

G. W. Holbrook, M.E.I.C.,

Department of Electrical Engineering,
Royal Military College,
Kingston, Ont.

The paper outlines some of the theoretical and practical problems involved in the design of a wide-band audio frequency oscillator. The main consideration in the design of this oscillator was that of cost.

The object of this paper is to outline some of the theoretical and practical problems involved in the design of a wide band audio frequency oscillator, and it is based primarily on the work done on the design of a low-cost oscillator for use in testing audio frequency amplifiers over what is now commonly known as the high fidelity band. It should be emphasized from the outset that the main parameter involved in the design of this oscillator was the factor of cost; all other features were considered to be of secondary importance. The initial specification that was adopted as a basis of design was as follows:

(a) *Frequency Band*

A frequency coverage of 10 c/s to 100 kc/s was required. Although the upper end of this band is well beyond the audio range it is common practice to extend amplifier tests to this figure in order to obtain some idea of their response to transients.

(b) *Output*

Five volts r.m.s. into a load of 5,000 ohms was specified with as little variation as possible in output level over the whole of the frequency band. This feature allows rapid tests of amplifier response to be made without frequent checks of the amplitude of the input signal.

(c) *Distortion, Hum and Noise*

A hum and noise level at least 60 db. below the signal output was desirable. No initial figure was placed on the maximum distortion permissible, but as low a figure as possible was obviously desirable. If the oscillator was to be used purely for response measurements, then a figure of less than 5 per cent was adequate. As a source of signal for harmonic measurements, the oscillator would require harmonic content of less than 0.5 per cent. The oscillator was required to be self-contained, with its own power supply, capable of operating from a nominal 115 volt a.c. line with a possible variation of ± 10 per cent in the line voltage.

Choice of Design

In choosing the type of oscillator for this particular design, the main consideration, other than cost, was the wide frequency band required. The low frequency requirement of 10 c/s eliminates any consideration of a fundamental *LC* oscillator due to the large values of components required at this frequency. It also eliminates the possibility of using a heterodyne system as a difference of only 10 c/s would almost certainly cause locking of the two oscillators involved. Oscillators of the zero phase shift, or Wien bridge types can be constructed to operate at these low frequencies, however, amplitude control over such a wide range of frequencies would be an expensive item. It is also doubtful whether the four decades of frequency could be covered with less than four band switches, again causing an increase in cost.

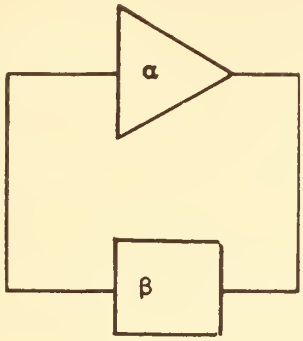
It has previously been shown by the author[1] that an RC oscillator utilizing a three gang variable air capacitor can be operated successfully at high frequencies. However, the size of resistors required with such a capacitor is prohibitive at low frequencies. In view of these factors, an oscillator of the CR type involving three variable resistors was investigated. The general theory of RC and CR phase shift oscillators has been outlined by Butler[2] and Artz[3]. In all oscillators of this type, the frequency is dependent on three or more resistors and is therefore very susceptible to changes in temperature. This has been illustrated by Taylor[4] who suggests the use of temperature control in order to maintain stability. It was felt, however, that in this particular case frequency stability was of secondary importance and a design based on CR methods was implemented as shown below.

Salient Features of CR Oscillator Design

In common with many other types of oscillators a CR oscillator can be considered as consisting of two essential parts — an amplifying section and a phase shifting section. This is illustrated in Fig. 1, where

the conditions of oscillations are given by:

$$a\beta = +1 \quad \ldots\ldots\ldots\ldots (1)$$



$\alpha\beta = +1$

Fig. 1. Basic oscillator.

In its simplest form, such an oscillator would consist of a single tube, giving a voltage gain of α and a 180° phase shift, working into a phase shifting network of voltage gain β (where β is less than unity) and a further 180° phase shift. Such a network is illustrated in Fig. 2 which shows the simplest form of CR network consisting of three equal series capacitors and three equal shunt resistors.

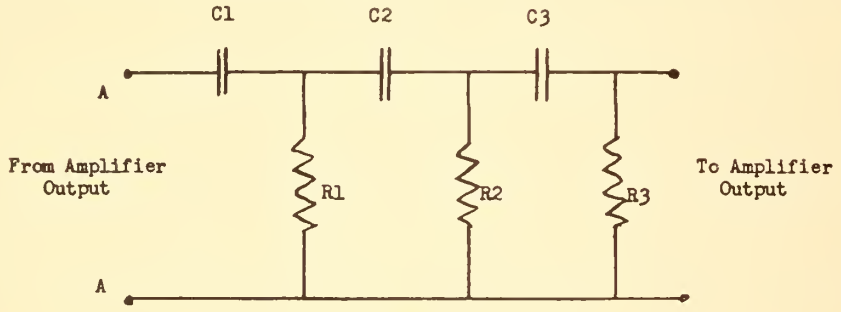


Fig. 2. CR feedback network.

With this arrangement it can be shown (see Appendix) that the frequency of oscillation is given by:

$$f_o = \frac{1}{2\pi RC\sqrt{6}} \quad \ldots\ldots (2)$$

and that the ratio of V_1 to V_4, and consequently the required voltage gain of the amplifier section, is given by:

$$\frac{V_1}{V_4} = 29 \quad \ldots\ldots (3)$$

It will be noted that, for a fixed value of C, the frequency is dependent on the value of R, common to all three sections, but that the voltage ratio is independent of this parameter. The input impedance, looking into terminals AA (see Appendix) is, however, dependent upon R and is given by:

$$Z = 2.82R\sqrt{74.5°} \quad \ldots\ldots (4)$$

Thus, if all three resistors are varied simultaneously, then the conditions of equations (2) and (3) are met, but the input impedance, of the phase shifting network which represents the load of the amplifying section, is directly proportional to the value of R. Unless the amplifying section has an output impedance which is small compared with the minimum value of R then the effective gain of the amplifying section will obviously change with R. This will lead to overcoupling of the oscillator at low frequencies and a cessation of oscillation due to undercoupling at the higher frequencies. This condition can be minimized by employing a cathode follower stage in the output of the amplifying section and by making the minimum value of R considerably greater than the output impedance of this stage.

The upper and lower limits of frequency are dictated in practice by the following factors:

(a) *Resistance*

The upper limit of frequency is set by the minimum value of R that will allow sufficient effective gain from the amplifying section to maintain the conditions of equation (3). The lower limit is established by the maximum value of R that can appear in the grid circuit of the amplifying tube; this is usually in the order of one megohm.

(b) *Capacitance*

The lower limit of frequency i dependent on the quality of th capacitor employed. Capacitors o over 0.1 μF, unless of very hig quality, are subject to excessiv leakance. This causes a further los in the network which, unless th gain is increased beyond 29, wil cause oscillation to cease.

The upper limit is established b the value of the grid-cathode capa citance of the amplifying tube. I the phase shifting capacitance is re

Table I

Condition	$W_o = 2\pi f_o$	V_1/V_4
$R_1 = k_1R_2 = k_1R_3 = k_1R$	$\frac{1}{CR\sqrt{5k_1+1}}$	$10k_1+16+\frac{3}{k_1}$
$R_2 = k_2R_1 = k_2R_3 = k_2R$	$\frac{1}{CR\sqrt{4k_2+2}}$	$8k_2+15+\frac{6}{k_2}$
$R_3 = k_3R_1 = k_3R_2 = k_3R$	$\frac{1}{CR\sqrt{3k_3+3}}$	$3k_3+14+\frac{12}{k_3}$

duced to a value which approache the same order as this interelectrod capacitance then once more an in erease in gain is required to main tain oscillation. With these limita tions it is possible to obtain oscilla tions over a range of frequencie extending in continuous bands, eac of two decades, from 0.1 c/s to ove 100 kc/s.

The simultaneous variation of th three resistors presupposes a three gang variable resistor as the fre queney controlling element. Th degree with which errors in trackin affect the frequeney of oscillatio and the voltage gain required t maintain oscillation are establishe in the Appendix and are shown i Table I.

From this it can be seen that error in the construction of the three gang potentiometer will consider ably affect the frequency control o the oscillator. However, the varia tion of V_1/V_4 is not nearly so grea as the variable k appears both as denominator and as a numerator i each expression.

Practical Design Details

From the preceding paragraph it is clear that a satisfactory osci lator, covering the specified rang of 10 c/s to 100 kc/s, can be bui around the concept of a three section CR phase shifting networ using ganged variable resistors. How ever, in order to produce adequat gain from the accompanying ampli fier section, certain precautions a

necessary, particularly at the low frequency end of the band. At 10 c/s normal capacitive methods of coupling and decoupling are not practicable and other arrangements must be made. The required gain of 29 can be provided by an amplifier section consisting of a pentode directly coupled to a cathode follower stage. By selecting a high slope pentode sufficient voltage gain can be realized without decoupling its bias resistor and adequate decoupling of the screen can be provided by means of a voltage regulator tube. This overall arrangement is illustrated in Fig. 4.

Any attempt to obtain amplitude control by means of grid leak and capacitor bias will fail due to the wide range of frequencies encountered. Amplitude control by means of a ballast lamp or the equivalent adds to the general cost of construction and would not be sufficiently linear at very low frequencies. Adequate control can, however, be achieved by choosing the critical bias point of the amplifier tube. This is illustrated in Fig. 3 which shows the dynamic characteristic of a 6AC7 tube with a resistive load of 50,000 ohms directly coupled to a 6J5 cathode follower. Operating in the region of greatest slope, at the point A, results in automatic limiting. Oscillations involving a peak grid swing beyond the points B and C will carry the operating point into a region of reduced gain and thus limit the output of the oscillator providing that the voltage gain in the region CAB is only just sufficient to take up the loss in the phase shifting network. Limiting by this method results in the production of odd order harmonies, even order harmonies being eliminated by the symmetrical shape of the dynamic characteristic.

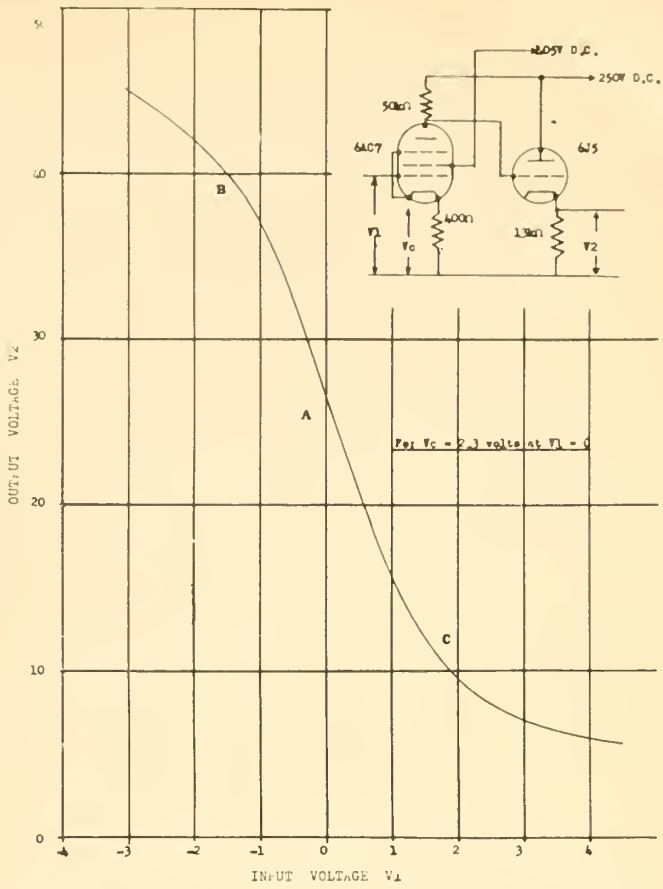


Fig. 3. Limiting action of pentode.

The overall harmonic distortion produced by this method of limiting is in the order of 5 per cent. For any given frequency a lower value of distortion can be achieved by reducing the effective gain of the amplifier section. The effective gain must, however, be slightly in excess of the minimum theoretical requirement to allow for slight discrepancies in the tracking of the three-gang potentiometer. For any given frequency the gain can be reduced to the minimum permissible for oscillation by tapping down the input of the phase shifting section on the output of the cathode follower. This harmonic control is implemented by the manual adjustment of the potentiometer P_2 shown in Fig. 4. With P_2 set at maximum a reasonably constant output is obtained over the whole frequency band. With P_2 adjusted to the minimum value required for oscillation, at any one frequency, a very low level of harmonic distortion is achieved at that particular frequency.

With regard to the detailed design of the phase shifting network, a frequency coverage of four decades can be made in two bands. This requires, for each band, a change in the value of R_1, R_2, R_3 of 100 to 1. The minimum value of the resistors should be made as low as possible consistent with keeping the input impedance of the CR network large compared with the output impedance of the cathode follower. This feature is essential in order to keep the values of C_1, C_2, C_3 reasonably large compared with the grid-cathode capacitance of the amplifier tube when operating in the higher frequency band. Assuming a minimum value of 4700 ohms with an added maximum variation of 500,000 ohms for each of R_1, R_2, R_3, a slight overlapping of the two frequency bands can be obtained as shown in Table II.

Table II

Band	Frequency	Capacitance	Resistance
	c/s	μF.	ohms
w	9.45	0.0138	504,700
w	1000	0.0138	4,700
gh	945	0.000138	504,700
gh	10000	0.000138	4,700

With the values shown above, the minimum value of C_1, C_2, C_3 is in the order of ten times that of the grid cathode capacitance of the pentode. Under these conditions, the loss through the network is slightly in excess of 29. This condition arises when R_1, R_2, R_3 are at their minimum values, causing a maximum shunting effect on the cathode follower. Additional gain to compensate for these conditions is obtained by decoupling the cathode of the pentode with a small capacitor; this is only effective in reducing negative feedback at the higher frequencies.

Using commercially-available three-gang potentiometers of standard taper, with the added fixed resistor of 4,700 ohms, a reasonably

logarithmic frequency control is achieved. This control covers two decades of frequency in a mechanical sweep of about 300 degrees. Details of band switching are shown in the overall circuit arrangements illustrated in Fig. 4.

The low frequency requirement and the general factor of cost eliminate the possibility of using transformer coupling in the output stage. The suggested output requirement of 5 volts into a 1,000 ohm load dictates the use of a fairly high-powered tube as a cathode follow

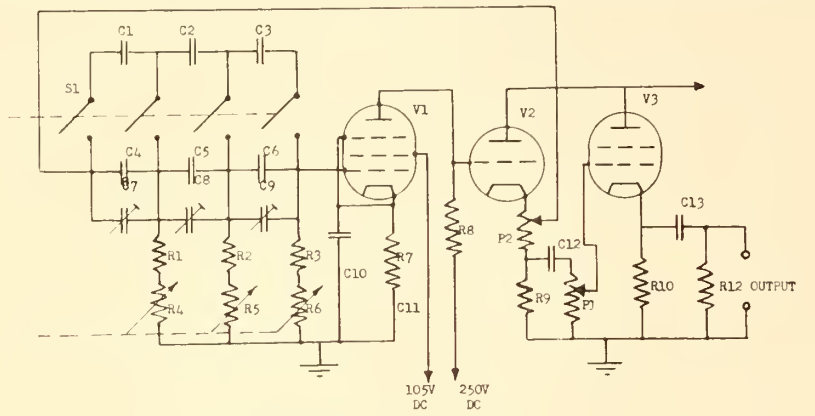
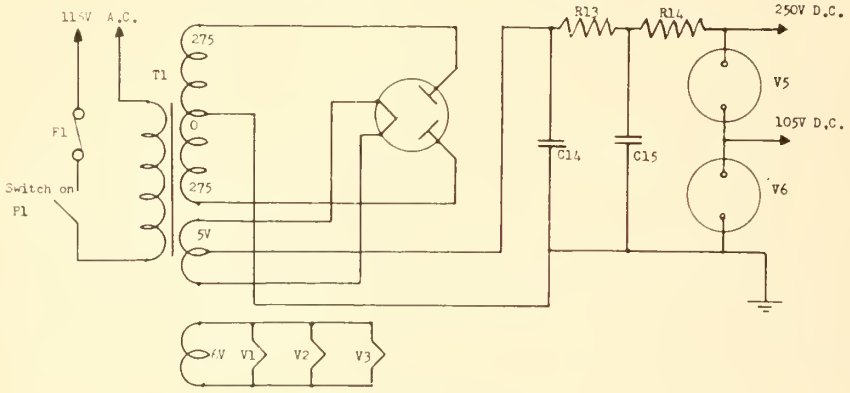


Fig. 4a. Oscillator circuit.

Fig. 4b (below). Power supply.



*Component Values**

(For Designations, see Fig. 4)

Component	Value	Remarks
C1, C2, C3	2×.006 μF	± 5%
C4, C5, C6	100 $\mu\mu F$	± 10%
C7, C8, C9	0-50 $\mu\mu F$	Mica trimmer
C10	0.25 μF	± 20%
C11, C12	0.1 μF	± 20%
C13	100 μF	25V D.C.
C14, C15	20+20 μF	450V D.C.
F1	Fuse	1 Amp
P1	1 $M\Omega$	Logarithmic with on/off switch
P2	10,000 Ω	Wire wound
R1, R2, R3	4700 Ω	± 10%
R4, R5, R6	0.5 $M\Omega$ Taper E	Triple gang pot IRC Type CS
R7	470 Ω	± 10%
R8	50 $k\Omega$	± 10%
R9	10 $k\Omega$	± 10%
R10	3300 Ω	± 10%
R11	1000 Ω	± 10%
R12	100 $k\Omega$	± 10%
R13, R14	600 Ω	5 watt wire wound
S1		4 PST wafer switch
T1	Hammond 270	BX 60
V1	6AC7	
V2	6J5	
V3	6V6	
V4	5Y3	
V5	VR 150	
V6	VR 105	

*Courtesy Measurements Engineering Ltd., Arnprior, Ont.

A single 6V6 connected as a triode adequate and coupling to the lo can be made by means of a 100 μ electrolytic capacitor. A dumm load of 100,000 ohms is required ensure polarization of this capaci at all times.

An inexpensive voltage regulat power supply is obtained by usi the circuit shown in Fig. 4. A resis ance capacitance filter with cap citor input is suggested, using t VR105, which decouples the scre of the 6AC7, together with a furth VR150 tube as the regulating el ments. This arrangement gives ad quate filtering of the power supp The heaters of the tubes may connected with one side ground without produeing excessive hu in the output.

Conclusion

Preliminary tests on a model the circuit illustrated in Fig. 4 ga the following performance figures

(a) *Output Amplitude*

5.5 volts r.m.s. into a 1000 oh resistive level, with less than 5 p cent distortion over the whole fr quency band. There is less than 2 d variation in output voltage over t whole of this band.

(b) *Hum Level*

Hum and noise were better tha 60 db. below the signal level.

(c) *Frequency Stability*

The oscillator exhibits a frequen drift of less than 2 per cent for a line voltage changes of ±10 p cent.

(d) *Harmonic Control*

By adjusting the harmonic co trol to the minimum value a ha monic content of less than 0.5 p cent is achieved for any given fr quency. This control setting mus of course, be altered for each pa ticular frequency and must be s at maximum to obtain a flat outp eharacteristie.

These figures indieate that such circuit combines most of the bett features of much more complicate oscillators with the added attractio of low cost. A photograph of t original model is shown in Fig. which gives some idea of the re tively small size of the finish product.

It is interesting to note that t addition of a further band of cap citors and an additional position o the band switch will allow oseill tions down to 0.1 c/s to take plac The output stage of the oseillat would, of course, be severely limite at these very low frequencies, an

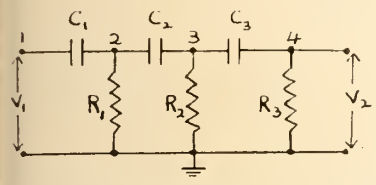
direct coupling to the last stage and to the load would be essential in order to extend the frequency range to this limit.

APPENDIX

The phase shifting network can be set up for nodal analysis as shown below where the conductances and susceptances of the various elements are written as:

$$g = \frac{1}{R_1} = \frac{1}{R_2} = \frac{1}{R_3}$$

$$b = jwC_1 = jwC_2 = jwC_3$$



The main determinant of this configuration can be written as:

$$\Delta = \begin{vmatrix} b & -b & O & O \\ -b & 2b+g & -b & O \\ O & -b & 2b+g & -b \\ O & O & -b & b+g \end{vmatrix}$$

Frequency and Loss

The ratio of input voltage to output voltage is:—

$$\frac{V_1}{V_4} = \frac{\Delta_{11}}{\Delta_{14}} \text{ where:—}$$

$$\Delta_{11} = (2b+g)\left\{(2b+g)\ (b+g) - b^2\right\} + b\left\{-b\ (b+g)\right\}$$

$$= b^3 + 6b^2\,g + 5bg^2 + g^3$$

$$= b\left\{b^2\right\} = b^3$$

$$\text{Thus } \frac{V_1}{V_4} = 1 + \frac{j\,6g}{b} + \frac{5g^2}{b^2} + \frac{jg^3}{b^3}$$

Presupposing a 180° phase difference in these voltages the imaginary part of this expression can be made equal to zero and:—

$$\frac{g^2}{b^2} = 6 \text{ or } \omega = \frac{1}{CR\sqrt{6}} = 2\pi f_o$$

when f_o is the frequency of oscillation. Placing this value of frequency the real part of the expression reads to:—

$$\left|\frac{V_1}{V_4}\right| = 29$$

Input Impedance

The admittance of node 1 can be expressed as:—

$$Y_{11} = \frac{\Delta}{\Delta_{11}} = \frac{b(\Delta_{11}) + b(\Delta_{12})}{\Delta_{11}} = b + \frac{b(\Delta_{12})}{\Delta_{11}}$$

Fig. 5. Original model shows small size of oscillator.

$$= b + \frac{b^2\left\{(2b+g)\ (b+g) - b^2\right\}}{\Delta_{11}}$$

$$= b + \frac{b^4 + 3b^3g + b^2g^2}{b^3 + 6b^2g + 5\,bg^2 + g^3}$$

If the value of b is now written in terms of the oscillating frequency

$$b = j\omega c = \frac{j}{R\sqrt{6}}$$

and the admittance reduces to:—

$$Y_{11} = \frac{1}{R}\left\{\frac{3+j10.6}{31}\right\}$$

This gives the following value for the input impedance:

$$Z_{11} = 2.82\ R\ \angle 74.5°$$

Variation of R_1, R_2, R_3

If any one of the three resistors is varied by a factor k then the frequency of oscillation and the ratio of $\frac{V_1}{V_4}$ can be determined as follows:

Let $R_1 = k_1R_2 = k_1R_3 = \frac{k_1}{g}$ then:—

$$\Delta = \begin{vmatrix} b & -b & O & O \\ -b & 2b+\frac{g}{k_1} & -b & O \\ O & -b & 2b+g & -b \\ O & O & -b & b+g \end{vmatrix}$$

Using the methods previously adopted the following expressions are obtained:

$$2\pi f_o = \frac{1}{CR\sqrt{5k+1}}$$

$$\frac{V_1}{V_4} = 10k_1 + 16 + \frac{3}{k_1}$$

Similarly, if

$$R_2 = k_2R_1 = k_2R_3 = \frac{k_2}{g}$$

then,

$$2\pi f_o = \frac{1}{CR\sqrt{4k_2+2}} \text{ and}$$

$$\left|\frac{V_1}{V_4}\right| = 8k_2 + 15 + \frac{6}{k_2}$$

Also if

$$R_3 = k_3R_1 = k_3R_2 = \frac{k_3}{g}$$

then,

$$2\pi f_o = \frac{1}{CR\sqrt{3k_3+3}} \text{ and}$$

$$\left|\frac{V_1}{V_4}\right| = 3\,k_3 + 14 + \frac{12}{k_3}$$

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Some of the "Whys" of Automobile Design

by

H. Richard Steding,

Chief Engineer, Executive Staff,
Chrysler Corporation,
Detroit, Mich.

A paper presented before the Montreal Branch of The Engineering Institute of Canada, October 28th, 1954.

Automotive engineering is a fascinating subject to anyone when stripped of its technical terminology. There is no area where so much of man's knowledge of nature and natural laws must be brought to bear on the creation of a product, which must then be marketed through the combined facilities of the most advanced technologies of communication and the arts.

Every year a new model is brought out and proclaimed as the most advanced technical achievement ever offered to the public—incorporating scientific advances years ahead of their time. Only a few months later, the sales department asks the engineers, "what are they going to do to fix up the old bucket of bolts so it can be peddled next year?"

Actually, we in the automobile business are fortunate because of the public interest our products enjoy. And we are also fortunate because so much of this interest is approval and enthusiasm for our products.

I do not mean to suggest that everything we hear is approval. People ask plenty of critical questions about the products our industry builds. Let us look at some of them. One frequent one is: When is the family sedan going to have a plastic body?

Plastic Bodies

Plastic bodies are getting lots of attention and there is much development work going on with them. At Chrysler we were building experimental bodies with plastic outside panels in 1939, and we were pleased with some aspects of these parts.

Since that time, apart from the war, research and development have gone on apace. But, at present, we are unable to use plastics for volume-produced cars because known methods do not lend themselves to volume production. Plastics must be moulded and then cured for a period of minutes.

When you appraise that consideration against the need of tens of thousands of hoods, deck panels, doors, for each day's production, you can see that such a time period cannot compete with metal, which can be stamped out in mere seconds. It would take acres of forms to keep enough panels curing and finishing to supply only the hoods our Plymouth assembly line needs in a single day. These space and time factors mean added costs which I doubt if our buyers would care to pay.

Moreover, it is not true, as some people think, that the plastic car has its colour right in the plastic and therefore needs no painting nor polishing in its lifetime. Plastic bodies or body parts must be painted just as metal parts are finished, and our experts tell us that plastic is not quite as easy to finish as metal.

There is an aspect that may, in the long run, mean more to you—the customer—than plastic bodies. That is the promise that plastics have as dies over which to form metal. We have done pioneering research in this field at Chrysler and have met success in certain applications. There is still much work to be done, for plastic dies do not yet have the life of steel.

Nevertheless, they do serve, even now, for limited numbers of stampings, and they are cheaper. If they can be perfected, their lower cost could reduce the die costs for automobiles. And when you recall that tooling costs for a new car can run into scores of millions of dollars, it could be that savings in this category would be worth considering.

I do not mean to reflect pessimism or indifference regarding the use of plastics. After all, the automobile industry traditionally has been alert to the latest in materials or methods that will improve quality or reduce costs or both. As far as body materials are concerned the industry will adopt any material that comes along, provided it can beat steel's desirable qualities and its low cost. So far that material has not appeared.

The Gas Turbine Engine

Another item looming larger in people's interest these days is the gas turbine engine. It is important to understand, at the outset, that automotive gas turbine engines are not jet engines. In other words the reaction force or thrust from a jet of hot gases does not provide propulsion, as is the case with jet aircraft engines.

Rather, it is the automotive application of the familiar turbine principle of the water wheel or the steam turbine, except here the turbine is turned by the movement of hot gases. This rapidly spinning turbine drives a set of reduction gears which transmit driving force to the wheels.

Gas turbines are not new. The first operating gas turbine was built in 1903, more than fifty years ago. But until recently, no practical application of the gas turbine to passenger automobiles had ap-

eared. All attempts in this direction had been impractical because f their voracious appetites for uel, and by the excessive exhaust eat.

In the spring of 1954 a practical *ype* of gas turbine for passenger ars was made public by Chrysler Corporation. Incorporation of a eat exchanger overcame two of he major obstacles to the use of as turbines in automobiles—fuel conomy in this unit was comparble to that of present-day passenger cars, and the exhaust temerature substantially lower, enbling it to operate safely on city trects or on the highway. In addion, the test performance of this as turbine engine is far beyond hat of piston engines of comparble rating.

Much speculation has been cred as to when the average notorist is going to have a gas turine in his car. I should like to e-emphasize that no one should egard the development of this articular experimental gas turine as an indication that we are nywhere near the point where ommercial production of gas turine engines for passenger cars can e considered.

Quoting George J. Huebner, our xecutive engineer of research who irected this development, "many xceedingly complex problems in aterial cost and procurement, as ell as those in the metallurgical nd manufacturing field, would ave to be solved before this might ome about. . . . However, because e are much encouraged by the est results with the present autootive gas turbine, we are going o press the search for the anvers."

Why More Horsepower?

And now let us look at one of oday's more popular whipping oys—horsepower. You have all oticed the controversy about orsepower, and the charges that oo much power is being built into ars today. You have also heard hat this is a contributor to the ounting traffic tolls.

First, high performance engines re traditional with the American utomobile industry. Secondly, alhough year by year the American utomobile industry has offered ars of steadily increasing horsepower, and although the car popuation has steadily risen, it is a fact hat the number of accidents per ehicle mile has steadily diminished.

In 1930 we had 26 million motor vehicles on the road and we drove them 206 billion vehicle miles. In 1930, traffic deaths occurred at the rate of 16 fatalities for each 100 million vehicle miles. In 1952 we had 52½ million motor vehicles on the road. We drove them nearly 522 billion vehicle miles. Yet in 1952 traffic deaths occurred at the rate of only 7.3 fatalities for every 100 million vehicle miles.

In other words, in twenty years we have more than doubled the number of vehicles on our roads. We have increased their use more than two and a half times. And yet we have cut fatalities in terms of use of vehicles more than in half. Moreover, during all this time horsepower was marching right upward and along, from an average of 97 horsepower in 1930 to 160 in 1954.

This paper deals with the policies governing the production and marketing of automobiles, rather than with the more technical aspects of production. Yet it will be of interest to every engineer who owns or drives a car. The views expressed by the author on the advantages of greater horsepower are those of the manufacturer and, being somewhat controversial, may evoke discussion of the subject in future issues of the *Journal* by members who are traffic engineers.

We also should think about these facts. Our traffic safety record in the United States is bettered in only two small countries with very small auto populations. They are New Zealand and the Union of South Africa, and they better us by less than one point! Every other country in the world has a higher traffic death rate than we do.

For example, compared with the U.S., Great Britain's highway fatality rate is twice as great; the Netherlands is almost five times as great; in Germany the rate is seven times; and in Japan fatalities per vehicle mile are ten times higher than in the United States. But note this: all of these countries specialize in low horsepower cars!

We certainly are right in being concerned about our traffic toll, and in wanting to do something about it. But I also wonder if, in our understandable concern, we aren't looking around for alibis for our safety problems? It's easy to blame something like horsepower; rather than to admit that the real reason for most traffic accidents may lie in our driver licensing practices, lack of good driving training programs, law enforcement, and inadequate street and highway systems.

Actually, horsepower is a safety factor in itself, because higher performance engines in today's American automobiles are built principally to gain benefits in the middle speed range. In our own new engines we have concentrated on increasing acceleration in the middle speed range, and not nearly so much on speed.

For example, in increasing the horsepower from 180 to 235, we increased the accelerating ability at cruising speed in the middle speed range by 24 per cent, but increased top speed only some six per cent. This means that you spend 25 per cent less time on the wrong side of the road in passing. That is performance translated into safety. And on today's crowded highways, that kind of performance is important.

But another, more human aspect, is the *attitude* of people toward high performance cars compared with what they say publicly about them. For example, we offered two engines in 1954. One was rated at 195 horsepower; the other at 235 horsepower. I think we listened to too many alarmists because we scheduled production of the 195 jobs at two and a half times the rate of the 235's. The public set us straight in a hurry.

Within two months after announcement of the 1954 model, we had revised production schedules several times, and were forced to build two and a half times as many 235 as 195 horsepower models! In other words, the percentage has been almost exactly reversed—and by the public!

If higher performance cars were endangering them, we would know about it quickly enough. But people who own high performance cars realize what high performance does for them. People who do not now own high performance cars usually aspire to do so. And the industry is exerting itself to serve them.

Today's owners of cars with high power engines enjoy long engine life and appreciate the com-

fortably smooth, quiet motoring of a lightly burdened engine.

They have the satisfaction of knowing that vast reserves of power for passing and hill climbing and swift recovery after slowing down are available. In short, horsepower, as American car builders use it, is power for comfort, economy, dependability, and safety. People do not cast aside things that bring them real benefits.

Styling

And now let us turn to my last item, styling. First is the matter of what we call "lead time." Lead time means different things to different people. To us, it is the amount of time needed from the day the stylists' final sketches are approved until the first actual production car leaves the factory. Many people are surprised to hear that for a completely new design of automobile this takes as much as three and a half years, working normal work weeks.

This time is consumed in translating those drawings into clay models of the actual car, and into mock-ups which are dummy cars that look so realistic you think you might drive them away. It is consumed in building hand-made cars, exactly like those that will be produced, so that they may get rigorous testing at our proving ground and on highways from coast to coast, and in creating the dies and tools that will press out the metal components of the new cars. Work cannot be started on these until the car manufacturer is sure that each part is the way he wants it in the car as it is to be built.

This long period can be compressed a little by using expensive overtime. But, in practice, it usually turns out that the many changes made along the way, each costing much in time and money, tend to cancel out possible gains through overtime.

The result is simply that more than three years pass from conception of a brand new body design to volume production. And the situation, in spite of the many new ideas that have come along to speed up the process, actually is getting worse instead of better. That is because of the growing complication of the product.

Time was that a new model could be projected in January and introduced in September. But that was before the days of built-in heating, air conditioning, automatic window lifts, power steering, tricky glass designs, challenging structural problems, etc. As cars have grown more and more wonderful, convenient, and automatic, so has the problem of designing and developing them become a longer and more expensive process.

From this, you might ask, does this not mean that you have to be at work already on developing your 1957 models? The answer is yes, and that fact should suggest at once that the idea of one manufacturer "copying" basic design from another is simply impossible.

Little things, like some trim gadget or another, could suggest an idea between two rival companies, for trim can be re-worked until quite late in the program. But basic body design has to be "frozen" so long in advance of introduction of the car that to change even a year or so before introduction cannot be done without scrapping basic ideas and costing at least a whole year in getting the car on the streets.

The 'In-Between-Year' Car

What about the in-between year cars, the cars that are not new basic designs, but which have many changes in trim, appointments, etc.? These make my second point. These cars, often referred to as "face-lifts", do not require the same time in design. Changes in grilles, trim, interiors, etc., are accomplished more quickly. This is done about a year and a half in advance of introduction.

Some people dismiss the in-between year car as changed in minor fashion simply to stimulate sales. That is an important factor, of course, but there are other, equally important reasons why the appearance of these cars must be altered. One is for model identity. Cars are identified and priced as used cars on a calendar year basis. People have to be able to tell one year's model from another.

Another important reason is that the in-between basic body change models often carry unseen but important mechanical changes. Making major mechanical changes in these model years has become necessary due to the fantastic cost of any significant changes in cars, mechanical *or* styling.

When you stop to think that tooling for a new engine can cost 50 million dollars, you can see why a car with both a brand new engine and a brand new body, such as the 1953 Dodge or th 1952 Lincoln, is an exception i this business. The cost is so hig that it usually has to be staggere Thus, brand new body desig often incorporate engines formerl used. Or brand new engine d signs more often appear in "fac lifted" bodies. Now those in-b tween basic body change model with a lot of important mechanic changes, need positive identific tion. And trim changes can gi it.

After all, the customer who bu a 1954 car with many fine m chanical changes but which carri essentially a 1953 body, wan people to know he is driving th version of the car with the ne engine, or the new transmission, whatever else was added to it. T him, a new grille or dash panel quite important. And when h goes to trade that car in a fe years later, he expects to be trea ed as a customer offering a 19 and not a 1953 car.

The 'Idea' Cars

The last of the three items und styling has to do with the so-call "idea cars", which have been a pearing in increasing numbers past years. There are all kinds idea cars. Some are what we mig call publicity stunts; others a more properly engineering cars.

The reason I make this distin tion is that we lay down certa rigid restrictions on our designe of idea cars in the first plac Among these restrictions is t warning that they can go as f as they please in dreaming up car of the future, provided th do not create a design we cou not build right now on our assem bly lines, using tools now ava able.

This is a stringent rule, becau it does not allow them to crea fenders, for example, that cou not be drawn from steel in t kind of presses available toda They have to design within us able road clearance limits, too, f another example, which rules o one of those wingless aircraft fus lages on wheels which you cou not back across your garage driveway apron.

Even so, the designers me these challenges and come up wi some pretty exciting cars whi are still practical and, above a they are produceable, should decide to produce such cars.

(*Continued on page 1526*)

Influence of Soils on the Design and Construction of the Trans-Canada Highway

by

R. N. Sharpe, M.E.I.C.,

Province of Manitoba, Highways Branch, Winnipeg, Man.

The author outlines the method of taking and using soils information as it was applied to the Trans-Canada Highway. Soil classifications are discussed and an account is given of the soil pattern encountered on the highway route in Manitoba.

The subject of this paper could cover a lot of territory. It could be taken to cover all soils work carried out in Manitoba and elsewhere, as our thinking about soils is influenced to a large degree by information obtained not only from our own projects but from reports originating in many other countries. However, it is hoped to cover a brief outline of our method of taking and using soils information as it was actually applied to the Trans-Canada Highway.

The first essential is to obtain the required information on the soils on the location of the highway route. This information is generally obtained by taking soils samples from various depths by means of hand auger borings at regular intervals along the location with additional samples taken at points of special interest such as deep cuts, swamp areas and areas containing large amounts of drift soil. For very deep testing the Department owns a diamond drill which can be used with or without casing, depending on the soil.

The soil samples are then taken to our Winnipeg laboratory where they are classified by means of such standard tests as liquid limit, plastic limit, hydrometer analysis or, in the case of granular soils, by sieve analysis. The hydrometer is similar to the sieve analysis in that it is a method of determining particle sizes, in this case silt and clay particles. The liquid limit is defined as the moisture content at which a soil will flow just sufficiently to close a groove of the specified dimensions with 25 shocks of the standard liquid limit apparatus. The plastic limit is defined as the lowest moisture content of the soil at which it can be moulded to a thread $\frac{1}{8}$ inch in diameter. These limits are arbitrary but are definite and can be reproduced accurately for any given soil.

The soil classifications thus obtained from the laboratory are then used in the design and construction of the subgrade and in the design of the base course.

In the design of the subgrade the soils are considered in relation to the location profile and notes made of all areas where special procedures must be adopted. These include areas of soil unsuitable for use in the subgrade which must be excavated and wasted before construction of the embankment is commenced; areas where soils are susceptible to a high water table and which require the use of a higher than usual grade line; and the locations adjacent to bridges or other structures where the elevation of the structure and the subgrade must be co-ordinated to allow for future base course and surfacing material. At this stage, too, the question of whether to design for obtaining material for the embankment from side ditches or from borrow-pits is considered. For example where numerous boulders are encountered close to the surface it is usually more advantageous to take material from deep borrow pits rather than from the comparatively shallow side ditches.

During construction the available soils data is supplied to the resident engineer and to the subgrade inspector. This includes the previously mentioned soil classifications and also the density which can be obtained with the predominant soils and the optimum moisture content of the soils for obtaining this density. The density target used in Manitoba is 95 per cent standard Proctor density; that is, 95 per cent of the maximum density which can be obtained in the laboratory by compacting the soil in a mould under certain controlled conditions. The optimum moisture content for compaction is the moisture content of the soil at which maximum density is obtained in the laboratory.

In order to determine this maximum density a number of samples at different moisture contents are compacted and their density and moisture content plotted. These points form a curve generally of a parabolic nature and the high point of the curve indicates both maximum density and optimum moisture content.

Field control of the density is maintained by testing each lift and section of the subgrade as it is built. The test used for determining field density consists of digging a small hole in the compacted earth and determining its volume by means of a calibrated standard sand. Using the weight

of the material removed from the hole and its volume the weight per cubic foot of the material in place is calculated. Moisture contents of the soil are also taken regularly and where the soil is found to be too dry for proper compaction water is added by means of truck-mounted tanks equipped with spray bars.

In general the soils information on the job is sufficient, but where any special condition is discovered during construction or where difficulties are encountered in obtaining the design requirements the resident engineer can and often does contact our soils section and one of our staff will investigate and make such recommendations as are considered necessary to overcome the difficulty.

The soils information is also used in the design of the base course and surface of the highway. The Trans-Canada Highway agreement provides that the design of the base and surface courses shall be such as to carry an 18,000-lb. axle load. That is about as controversial a requirement as you could find anywhere. There are very nearly as many opinions on what design is required to carry a given axle load as there are highway engineers.

The consideration of soil characteristics in highway design was for many years based entirely on the observations and experience of individual engineers, and no yardstick existed for comparisons of soil behaviour in various locations. It was apparent to many engineers that this situation was far from desirable and in recent years a great deal has been accomplished in providing methods of comparing soils.

We now have several very good soil classification systems of which the one developed by the U.S. Bureau of Public Roads is the most generally used in highway work. Various methods have also been devised for measuring the load carrying capacity of soils but no general agreement has been reached as to the relative merits of the various tests.

In Manitoba we have tentatively adopted the goup index of the soil as our basis for designing the depth of base course required under bituminous surfaces. The group index is a number from 0 to 20 obtained from a formula devised by a committee of the Highway Research Board. The basic factors in the formula are the liquid limit, plastic index and the percentage of the soil which is finer than a 200-mesh sieve. A low group index value indicates a material with a high load supporting capacity while a high group index indicates poor load carrying characteristics.

Our design curve calls for six inches of base course for soils having a group index of 0 increasing to 15 inches of base course for soils with a group index of 20. It should be mentioned that, although 20 represents the maximum value of the group index, all soils so classified are not equal in load-carrying capacity, and in practice it is sometimes desirable to exceed the maximum depth of base course shown. It should also be mentioned that this design curve is intended for average conditions on a heavily travelled section of highway, thus under unfavourable conditions such as in cut sections it is usually desirable to increase the depth of base over that indicated by the curve for the particular soil; similarly under favourable conditions such as light traffic it may be desirable to decrease the depth of base course.

Group Index Curve

It may be of interest to note that our group index curve was developed in 1950, based on information obtained from publications of the Highway Research Board in the U.S., and from our own observations on highways constructed prior to that year. At the annual meeting of the Highway Research Board early this year a paper was presented by engineers of the state of Missouri giving their experience with their group index design curve. A comparison between our design and theirs indicates very close agreement, with our design providing slightly more base course throughout. This would appear reasonable as frost conditions are more severe in Manitoba than they are in Missouri.

That about covers in a very general manner our use of soils information and you may be interested in some of the specific conditions encountered on the Trans-Canada Highway particularly east of Winnipeg.

The preliminary consideration of soils east of Winnipeg was carried out in connection with the general location of the route. Aerial photographs were studied by the location group, preliminary lines were run on the ground, swamp soundings were carried out and the mileage through solid rock determined for several alternative routes.

From this preliminary work and other considerations, the decision was made to swing the route of the highway south through the St. Anne, Hadashville, Falcon Lake area rather than follow the existing route of P.T.H. 1E or the straight east route from Winnipeg to Rennie, as this location appeared to be the most economical on the basis of total quantities of waste excavation, borrow, length of haul and solid rock excavation.

Once the general route was established field parties ran trial lines in areas where alternate locations were available based on a study of the aerial photographs. Soil borings were taken at 500-ft. intervals along all lines and in general the routes chosen were those which showed the least unsuitable material. On the final locations additional borings were taken at 100-ft. intervals through all swamp areas to establish definitely the quantities of waste material, and borrow areas were checked as to suitability and quantity of material. Most of these swamp borings were carried out during the winter months as it was found to be easier to drill through frost than to walk through open swamp.

The general soil pattern east of Winnipeg can be divided into three sections.

(i) From Winnipeg to Ste. Anne the soil is all a heavy gumbo type clay with the exception of a short section of silty clay adjacent to the Seine River. The topography in this section is generally flat with poor drainage characteristics. (ii) From Ste. Anne through the Sandilands district and almost to Falcon Lake the general soil is sand or sandy loam with fairly numerous peat deposits and occasional silty areas. There are a number of ridges throughout the area, in general running nearly north and south. Drainage is generally good but there are some undrained pockets between ridges. A peculiar feature of some of the peat swamps in this area is their location on side hills, at one location in particular there was a difference in elevation of 17 ft. over a distance of 2,500

ft. but there was little apparent movement of water until we constructed our pilot ditch.

(iii) At the eastern end of this section a few rock outcrops are encountered and the third section from Falcon Lake to the Ontario boundary is predominantly rock with peat and sand pockets.

Through the gumbo section all subgrades were constructed from side borrow; that is, with the material obtained from the side ditches.

The gumbo soils are all of the side ditches were not generally required for drainage and where the rolling topography made continuous side ditches impractical most of the subgrade material was obtained from borrow pits located near the right of way.

Before the contracts for grading on this section were advertised the full width of the right of way was cleared of bush and trees and test pits were dug in all borrow areas. Thus before bidding the job, all contractors had the opportunity of seeing the terrain and subgrade, but there is no doubt that it was appreciable.

Fill material through the swamps was obtained from borrow pits and in most cases we were fortunate in obtaining sand or gravel fill for these areas very close to the location.

In the rock area our main objects in the soil survey were to establish the amount of overburden, the depth of peat in the pockets, and the soil conditions below the peat. This information was used in the design in estab-

Table I. Classification of Highway Subgrade Materials (with suggested sub-groups)

General classification	Granular Materials (35% or less passing No. 200)							Silt-Clay Materials (More than 35% passing No. 200)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7
Group classification	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6
Sieve analysis, per cent passing:											
No. 10	50 max.										
No. 40	30 max.	50 max.	51 min.								
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing No. 40:											
Liquid limit				40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index	6 max.		N.P.	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.[a]
Group index	0		0	0		4 max.		8 max.	12 max.	16 max.	20 max.
Usual types of significant constituent materials.	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General rating as subgrade	Excellent to good							Fair to poor			

Classification Procedure: With required test data available, proceed from left to right on above chart and correct group will be found by process of elimination. The first group from the left into which the test data will fit is the correct classification.

[a] Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.

A-7-6 classification with a group index of 20, and are extremely poor in load carrying characteristics. For a bituminous surface they would require more than the 15 inches of base course shown on our design curve. As our experience has indicated that concrete pavements perform extremely well in the Red River Valley this type of surface was selected for this section.

An excellent example of the serviceability of reinforced concrete pavement in this type of soil is on P.T.H. 1E from Winnipeg to Parkdale. This pavement has carried heavy traffic for nearly 25 years and is still giving good service with very low yearly maintenance cost even though the design is now obsolete.

Through the sand areas where the type of material they had to contend with.

The numerous swamp areas provided a problem. In the early stages of design several methods of construction were considered such as displacement of the peat by blasting or by surcharge on the fill; however, it was finally decided that removal of the peat by excavation was the most economical and would provide the surest method of obtaining a stable foundation for early surfacing. Excavation of the peat was facilitated by the construction of pilot drains and off-take drains, by separate contracts carried out well ahead of the major contracts. It is impossible to assess the monetary saving of partially draining the swamp areas well in advance of the construction of the lishing grade lines and widths of cuts in order to utilize rock fill for the undrained swamp areas. Granular fill for topping both rock cuts and rock fills was obtained from borrow pits.

In spite of extensive investigations and testing it is still possible to run into trouble. At one of the locations east of Falcon Lake where we struck a peat pocket between rock ridges our borings showed 8 to 15 ft. of peat over what appeared to be a firm clay base. The peat was excavated without incident but when fill operations were started it was soon apparent that the underlying clay was anything but firm. To date the rock fill at this one location has cost more than $30,000 over the estimate, and there are still indications of movement.

Work through the rock section is still in progress and is not expected to be completed until late next year.

The surface of the highway from Ste. Anne to the Ontario boundary will be a bituminous mat over varying depths of base course designed in accordance with our group index chart. The first 20 miles of this surface from Ste. Anne to just inside the Sandilands Forest was completed this year.

West of Winnipeg soil surveys have been run from Winnipeg to High Bluff, from Sidney to Douglas and from Brandon to the Saskatchewan boundary. The section from Winnipeg to High Bluff is practically all Red River gumbo and the design is similar to that from Winnipeg to Ste. Anne. I cannot say the construction is similar as, due to the extremely damp weather over the past two seasons, the construction has been far more difficult than was the case east of Winnipeg.

The section from Sidney to Douglas is predominently sand and the soils information on this section will be under consideration this winter.

West of Brandon there is practically every type of soil in the book, sand, gravel, silt and clay. The variation in the soils necessitated fairly frequent changes in base course design and these were laid out station by station for the resident engineer. The performance of this highway to date would seem to indicate that our design is adequate; there have been no failures of the surface although some short sections have developed longitudinal cracks. Most of these cracks appeared shortly after the road was surfaced and do not appear to be spreading.

A point of interest on the section west of Brandon is a trial application of seal-coat containing a small percentage of rubber. There has been considerable investigation in the post war period in the use of rubber with asphalt. Claims have been made by several agencies that the addition of rubber to asphalt either in the bituminous mix itself or in the asphalt used for seal coating gives better skid resistance and longer life to asphalt pavements. A number of test sections have been constructed through Canada and the United States, but as yet there is no definite indication that the benefits obtained are sufficient to warrant the additional expense. It will probably be several years yet before the economics of this development will be decided.

There is one more item which may be of special interest; that is, sand-bituminous base course. This method of construction has not as yet been used on the Trans-Canada Highway but was considered for the section of highway through the Sandilands Forest Reserve, and dropped when it was found to be uneconomical for that location. The sand-bituminous base course is only feasible where gravel deposits are not available locally as the cost of the asphalt and processing is fairly high in comparison with a standard gravel clay base course under average conditions.

A section of sand-bituminous base course was constructed on P.T.H. No. 2 from Elm Creek to Rathwell during 1950 and 1951 and has given very good service with only a light surface treatment. This method of construction will probably be considered when the section of the Trans-Canada Highway from Sidney to Douglas is constructed as this area is lacking in good gravel deposits and the sand-bituminous base could be used if found to be economical, particularly as any gravel available will be required for bituminous mat surface.

SOME OF THE "WHYS" OF AUTOMOBILE DESIGN

by H. Richard Steding

(continued from page 1522)

We put these cars on the road, as it were, exhibiting them around the country. Spectators' comments on the cars are recorded and, together with all mail we receive on the subject, are reviewed in Detroit. In that way we find out how the ideas incorporated in the idea cars are being received.

So, in developing these cars we try not to overlook any facets of automobile styling, because we believe that American car styling is in for some profound, long-range changes, and we doubt if the direction of those changes has been fully captured and shown by anybody, either in production or idea cars. But, somehow, out of all this, will develop the kind of styling that will not be a copy of foreign cars, nor will it be a re-hash of contemporary American styles.

These idea cars help us find our way through giving us your impressions of actual cars embodying various styling ideas. But some people ask: "Why can't we have something just like this little two-passenger sports car coupe idea car? Let's have it now, for the price of a standard sedan." Lots of people fall in love with these racy looking cars. But would enough of the public buy them to guarantee the volume production needed in order to produce them at reasonable prices?

Would not such a car necessarily have to be a "second car" in your family, since it could never fill the shoes of the roomy, dependable family sedan? That being the case, and assuming you decided to buy a "second car", would you pay the money for such a car, or would you really end up buying a station wagon?

Eleven per cent of the families in America own two or more cars. How many would accept a sports car as a substitute for their present, more utilitarian second car? We'd have to have many of them say, "Yes, I'll give up the Suburban, for all its utility, for a two-place sports job that can do nothing but carry two people." Are you among those who would do so?

There is doubtless a place for the sports-type car. But market research does not suggest that its place will produce demand that develops really big production which in turn is needed for reasonable prices. It looks as though we shall have our sports-type cars but they will not come cheaply.

Why the low, slinky, sports-car-looking idea cars, then? Because they have much to recommend them. Would it not be a wonderful thing if we could build a family sedan with the roominess and comfort of today's fine product and the sleekness, lowness, and eagerness of a sports-type car?

That is one of the reasons why we design, build, and study these idea cars. Maybe some day we shall be able to give you nearly everything in one package. We are trying. And doing things like that would be no more than in the tradition of our automobile industry but it won't happen overnight even if it should prove to be the thing to do and also prove feasible

Structural Modifications Using High-Tensile Steel Wire Cables

by

T. A. Hughes, M.E.I.C.,

C. D. Howe Company Limited, Montreal, Que.

g. 1. Existing car shed before struc-ral changes.

Post-tensioned high-tensile steel wire cables were used economically to make structural changes to an existing building in order to accommodate new equipment.

During the modernization scheme recently carried out at the National Harbours Board's grain elevator at Quebec, the engineers were faced with the problem of making structural changes to an existing building to accommodate new equipment. The use of high tensile steel wire cables which were post-tensioned enabled these alterations to be made very economically.

The modernization scheme centred around the installation of a grain car dumper machine which automatically unloads grain cars and by means of a receiving hopper feeds it on to a conveyor belt for transfer to the grain elevator.

Figure 3 illustrates the general layout in the area of the car

Fig. 2. A typical roof repair.

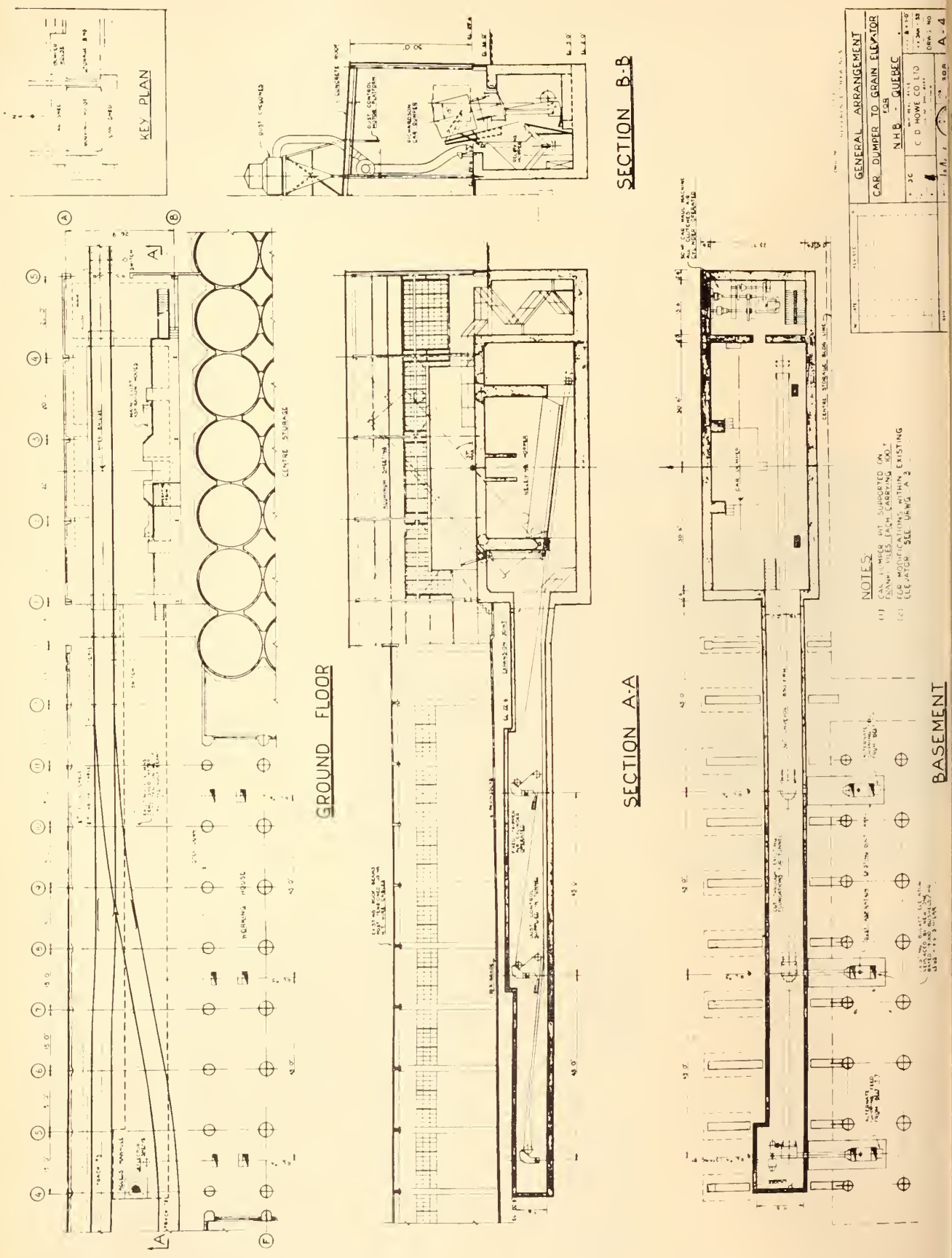

Fig. 3. General layout in the area of the car dumping machine, showing conveyor tunnel to be constructed under the existing reinforced concrete car shed.

dumper machine and shows that it was necessary to construct a conveyor tunnel to transfer the grain from the receiving hopper to any one of the three receiving bucket elevators in the working house section of the elevator. This conveyor tunnel had to be constructed under the existing reinforced concrete car shed. As can be seen from Fig. 1 the car shed was built over two rail tracks with a central row of columns at 15 ft. centres between the two rail tracks.

The location of the conveyor tunnel was dictated by the layout of rail tracks and of existing equipment in the elevator and Fig. 3 indicates that it had to pass under the central row of concrete columns. Underpinning of the columns would have been feasible except for the necessity of providing a rail turnout from the track nearest to the grain elevator to the track immediately north of it.

It therefore, became necessary to demolish the central row of columns for almost the whole length of the car shed.

Three alternatives were then available:

(a) Demolish and reconstruct the whole roof slab for the car shed.

(b) Stiffen the existing car shed main roof beams so that they would carry the roof load over a span of 32 ft. 9 in. This would mean reduced headroom.

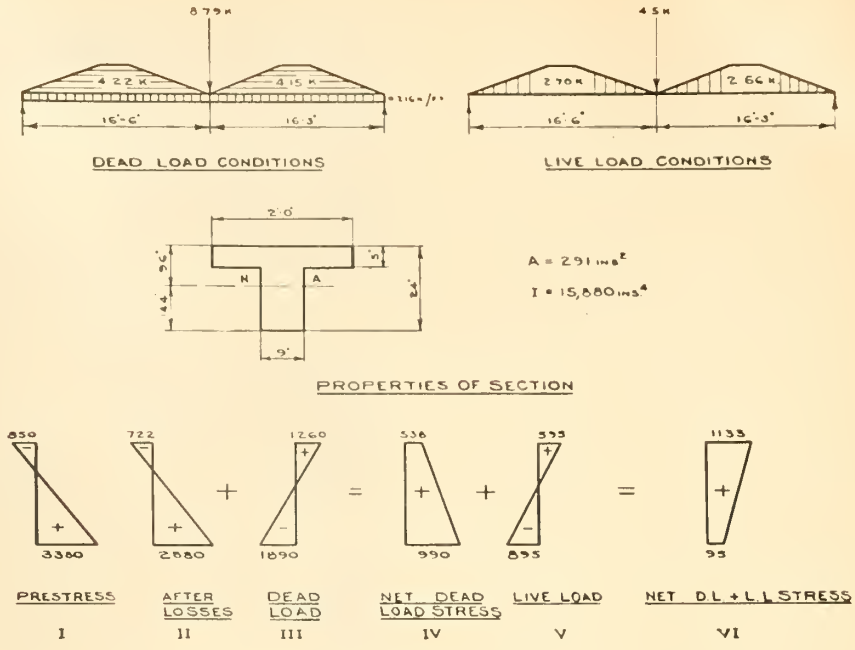

Fig. 4. A typical set of stress diagrams of various load conditions.

Fig. 5. Post-tensioning cable in position.

(c) Persuade the existing roof beams to carry the present load over twice the span using prestressed concrete technique to induce substantial compressive stresses in the roof beams under dead load conditions.

Of the three alternatives the last was the most economical by a substantial margin. The most practical way of inducing the required compression was by the use of high tensile steel wires or bars as is used in prestressed concrete structures.

The existing car shed was constructed in 1913 and in spite of its age the concrete was generally in sound condition. A thorough investigation did however indicate that there were certain rather severe cracks in some beams, some were diagonal and some were longitudinal extending for the full width of the beam, and about one in. below the level of the top of the slab. This latter suggested that roof slab and beams had not been concreted the same day. All such severe cracks were cut out and the areas thus broken out were repaired using expanding cement in the concrete mix.

Figure 2 illustrates such a repair under way.

In determining the post-tensioning force required to induce compressive stresses in the main roof beams for both dead load and live load conditions, some assessment had to be made as to the extent of roof slab which acted with the

main roof beam as a T beam. Several sets of calculations were made using widths from 2 ft. up to 15 ft. for the flange width and the post-tensioning force selected so that under no assumed width of T beam flange would high tensile stresses be induced at any condition of loading. Details of loading conditions and a typical set of stress distribution figures are illustrated in Fig. 4, the width of the T beam flange being assumed to be 2 ft.

Design Change

The design was initially prepared based on the use of one Lee-McCall bar on each side of each roof beam. At the general contractor's request this was subsequently changed to Magnel cables which were available in Canada, whereas the Lee-McCall bars would have to be imported from the United States.

Holes were drilled at the base of the working house bins (a very rigid structure) to enable the cables to be passed through and anchored. Similar holes were also cut through the north spandrel beam one on each side of the roof beam. In addition, a concrete distribution block was formed on the outer face of the spandrel beam. Holes were drilled transversely through each roof beam to receive high tensile steel guide pins at the locations shown. Suitable washers attached to the normal grilles supplied with the Magnel cable fitted over these pins and held each cable in position prior to tensioning. These pins also served to give the cable the required profile.

Fig. 6. Tensioning operation in progress.

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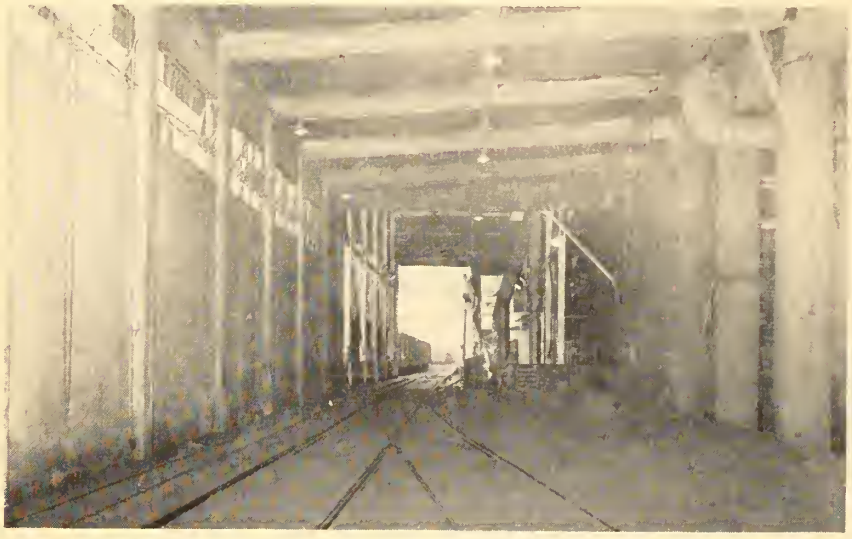
Fig. 7. The completed structural modification to the shed.



Before post-tensioning, temporary supports were erected on each side of the central column and the upper portion of the central column then demolished. Figure 5 indicates this and shows one cable in position.

Each cable was anchored on the bin elevator side and the cables tensioned from the north spandrel beam. Each cable consisted of 32 wires 0.276 in. in diameter and these were stressed in pairs and anchored when the necessary elongation of 2.2 in. had been obtained. This procedure is illustrated in Fig. 6.

The total pre-stressed force applied per beam was 245 kips, and it is to be expected that after all losses have taken place that the residual force will not be less than 210 kips. Only one jack was used for tensioning and a small number of wires on each side of each beam tensioned alternately to avoid the tendency of the roof beams to buckle.

Test Load

During the tensioning operation each beam received an upward camber of 5/16 in. A test load was applied to one of the beams equivalent to a uniformly distributed load of 40 lb. per sq. ft. and with the test load applied the upward camber was reduced to 3/16 in. A thorough inspection did not indicate a single crack in the beam.

On completion of the post-tensioning the remainder of each central concrete column was demolished and each cable encased with a cement mortar mix as protection against corrosion. The completed structural modification is illustrated in Fig. 7.

Consulting engineering was carried out by C. D. Howe Co. Ltd.

Grateful thanks are expressed to the National Harbours Board for permission to publish this information.

TRAFFIC . . .

A panel discussion on the traffic problem in Canadian cities, held at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May, 1955.

One of the liveliest panel discussions we have ever had was held at the Toronto annual meeting in May last. The subject was "Traffic" and the participants were the chairman, W. E. P. Duncan, M.E.I.C., general manager, Toronto Transit Commission; H. F. Burns, M.E.I.C., city traffic engineer, Winnipeg; C. E. Campeau, M.E.I.C., director, City Planning Department, Montreal; Murray Bosley, W. H. Bosley & Co., Toronto, and H. R. Burton, traffic engineer, City of Toronto.

A recording was made of the proceedings, but it turned out to be so poor that not even the most skilled transcriber could make much of it. However, from those parts which are intelligible, this digest has been made, which covers the major part of the discussion. Everybody agreed that traffic was about the most serious problem facing cities and that something would have to be done about it, but there was no unanimous agreement as to what that something should be or as to who should pay the bill.

Naturally, "traffic" was taken to mean automotive traffic. As usual, the unfortunate pedestrian was ignored; he existed only as an individual forced to descend to the ignominy of walking a few blocks because the powers that be could not provide parking space for his car within six steps of his destination.

There was general agreement that any schemes for improving the plans of our cities would have to provide comfortable access to the business districts in passenger cars for those whose affairs required their presence there. Nobody supported peripheral parking whereby suburban residents leave their cars on the fringe of the city and then proceed to their destinations by some form of mass transportation. The scheme had been given a thorough tryout in Detroit and other places, without much success. The Toronto Transportation Commission has made some tentative efforts to establish it. Peripheral parking lots are naturally in residential areas and efforts to establish them frequently run into zoning restrictions and more frequently into voeiferous opposition from the residents.

Real estate interests look with some disfavour on any proposals, such as express ways, which will bring any considerable additional traffic into the business centers. While it is true that the value of any particular piece of real estate is largely dependent on the number of people who have aeeess to it, there is a point beyond whieh traffie congestion leads to decentralization of business, with a consequent deeline in value of central properties, a bad thing both for the owner and for the tax collector.

Even though "these express ways are not . . . designed to bring private automobiles to the center of the city, but to serve . . . vehicles carrying merchandise . . . being human . . . I will drive my car to the center of the city over them. . . . There's only one way I know to solve the traffic problem and that is . . . by discouraging . . . traffic which . . . can't be economically supported in the area concerned."

Mass Transportation

About 120,000 vehieles come into the business centre of Toronto on an average weekday. About 90,000 of these are automobiles earrying about 1.7 passengers eaeh. About 7,000 of the rest are buses and the like and the remainder is commercial vehicles. If half the automobiles are legitimately used by salesmen, etc., there are 45,000 whose passengers ought to use some form of mass transportation, not their own cars. If these 45,000 could be eliminated, Toronto traffic flows would be decreased by about 25 per cent, but increased by the mass transportation vehicles required to serve 76,500 passengers. The net result would be a most considerable improvement.

It is agreed that mass transportation is many times as efficient in the use of street area as the use of private ears, but nobody agrees on how to persuade people to use it. It must be persuasion; in a totalitarian state we could issue an edict, but not in Canada. Cleveland has been experimenting with express buses, with reserved seats at an extra fare, and reports some success.

The panel held out no hope that the peak in traffic volume is in sight. "The number of people employed is dependent on maintaining the automobile industry, including the oil industry and all the other people . . . concerned with automobiles. . . ." The driver expeets to be allowed to go anywhere at his discretion, for he paid a high price for his car and also pays high fuel and other taxes in eonnection with it. He does not submit kindly to restrictions, but he may ultimately have to, if any improvement in the traffic situation is to be attained. It begins to look as though the motor vehicle were a juggernaut which may destroy its own utility through sheer weight of numbers.

One member of the panel held positive views on this facet of the problem: "I would not do away with automobiles. I do think that they are to be used in the proper plaee . . . and that no man . . . has any right to demand . . . that he be allowed to use his particular form of transportation if it isn't the most economical . . . for the community as a whole."

About ninety years ago a elause in the Toronto Street Railway's franchise set the maximum speed of its cars at six miles an hour. Late figures show that the average speed of traffic in downtown Toronto is still about the same. The implied suggestion of one member of the panel that perhaps an increase to, say, fifteen miles an hour could be reached by the synehronization of traffie lights, by the abolition of most curb parking and by other relatively simple and cheap measures, led another member into

(Continued on page 1561)

Modern Management and the Salaried Employee

by

S. M. Finlayson, M.E.I.C.,

President,
Canadian Marconi Company Limited,
Montreal, Quebec.

Any business enterprise, whether it be a one- or two-man affair or a large organization, can be considered as having five principal objectives. The first — and, by the way, these are not necessarily in order of any scale of priority — is to ensure a proper return to the shareholder, the man who has risked his money. The second is to ensure proper service to the customer and to the market. Third is to provide the employees of all categories with an opportunity for congenial and good remunerative employment and, above all, with an opportunity for progress. Fourth: a business organization seems to have an important responsibility to the community; not only the geographical community, but also the human community with which it comes in contact, quite aside from shareholders, customers and employees. And fifth, there is an underlying and all important responsibility to Canada for progress in the economic and social, and perhaps other, spheres.

If we accept those five rather general premises, then the next consideration would appear to be, "How are we going to carry them out ?" This leads almost automatically to the conclusion that we can only do so much through utilizing to the maximum the human resources that are available to us, and by human resources I mean primarily *mental* human resources, because for a long time now we have got past the stage where the muscle or brawn aspect of the human animal is an important factor in the situation. We have developed many mechanical devices which have overcome the limitations of human or animal muscle, and have also released the human population — at least in this country and in North America generally and in large parts of Western Europe — from pure routine drudgery.

While I would not like to discriminate between classes of employees, your committee has asked me to deal primarily with salaried employees, and the committee's first question is "What differences if any exist in the attitude of people looking for salaried employment today as compared with those of a generation ago ?" That is difficult to answer because it is hard to cast one's mind back and arrive at a true assessment of what one thought oneself a few years back; we may think we know, but it's rather difficult to be objective about it. There are a few points, however; one is that the average applicant today is more highly educated. A greater proportion of people have finished high school and a greater proportion have had partial or complete university education. But above all we are faced with a group of young people who have never known anything like what most of us present went through between 1929 and 1936 or 1937 — bread lines, people selling apples, not knowing where the next job was coming from, pay cuts, salary cuts, unemployment and misery of a kind which must have been frustrating to anyone who was trying to start a career at that time.

So without any fault of his own, there does seem to be a tendency on the part of the modern applicant to select the employer rather than the old process of having the employer select the applicant. I would not like to say it's wrong; it's sometimes a little annoying, but who can say which of the two situations is, in the long term, the better ?

Second, "What are the changes in management's concept of what is expected of employees as compared with years ago ?" I think th natural emotional reaction of man gement is to the old saw that " it bleeds and if it breathes we wi hire it". In other words, if the bod is animate enough to present itse at the door or even to be brought t the door, we engage it as a matter *force majeure*. That is a supe ficial way of looking at things an the actual fact is that manag ment's concept has changed and rapidly changing toward a muc more realistic appreciation of th importanee of what these youn people — and some who are not s young — can add to the solution the problems that confront a levels of management everywhere.

We, therefore, come to the answ to the third question, which i "Is there a need for management t have working conditions more sati factory than they were a generatio ago ?" The answer is undoubtedl a resounding affirmative, becaus if we are to attract and to hold th kind of employee we need to me modern conditions, we must in evitably make sure that the co ditions are competitive and ad quate. Thirty or forty years ago was common to have the 50 to 5 hour week, hourly-paid labour 15, 20, 30, 40 or 50 cents an hou whereas today we have a norm, least in salaried employment, of 4 hours or less, and salary scal several times what they were, ev fifteen or twenty years ago. T result of that is, that if we are improve our own individual organ zations, we must meet the cha lenge of the times by being read and able to pay the going rate, even perhaps a little better in son cases, in any given classification. W must be prepared to have o holiday and pension schemes an our other so-called "fringe benefits on a competitive basis, even to th

extent of a clause that we ourselves have in one of our contracts which provides that, in the case of the decease of a near relative, the individual is allowed off for one working day with pay, which seems on the surface to be an extreme sort of measure! But in actual practice I am not so sure that it is, because we will all admit that under the circumstances we all would like to rally round. It doesn't happen very often, and our experience has been that we get a remarkable amount of warmth of feeling from the few individuals who have benefited. The cost to us has been negligible, in spite of the fact that the clause is the sort that is inclined to make you gag a bit when you first contemplate it.

The fourth question poses the need for and the trend toward job evaluation. As you know, "job evaluation" is a modern term for a fairly simple procedure, which attempts to assess on some kind of recognized point system the value of each particular job and the relationship of that job to all the other jobs that go on in a particular enterprise. Much as I would like to decry anything that smacks either of a socialistic approach or over-regimentation, I believe it will be agreed by those who have had experience that a reasonably accurate and sensible job evaluation scheme lies close to the roots of the problem of dealing realistically and properly with the demands and requirements of all kinds of employees, salaried and other. While the institution of a job evaluation system is a bit of a task, and while your first attempt at it is rarely more than just that, experience seems to have shown that, after sincere application for two or three years, a lot of the problems that frustrated you in collective bargaining before you had a job evaluation system, have either disappeared or been greatly ameliorated. After a time employer and employee come to realize that in the job evaluation system they have a common point of understanding and departure, and, therefore, my answer to the question that was posed by your committee would certainly be in the affirmative. We can go much further than we have in job evaluation, not only in instituting it where it doesn't exist, but in trying to improve it and render it more useful in places where it already has existed, perhaps for several years. It is a continuing process, but one that, after the initial stages, is neither arduous nor difficult in comparison with the benefits that appear to flow from it.

These four points lead to the fifth which is "the training of key personnel to enlarge their capacity for greater responsibilities in the future". Here, I would like to come back to the opening remarks. If it is correct that a business enterprise has the five responsibilities outlined, and if it is correct that those responsibilities can only be discharged through the medium of human beings, then I should like to offer the further view that the survival of business under modern conditions and the ability of business to discharge these responsibilities in their broadest sense, must surely impose upon senior management a clear and definite responsibility to develop and to deploy the human resources available to them in the best possible manner.

This address was delivered at a meeting of the Rotary Club of Montreal. We print it here, not only because of its inherent good sense, but also because we think it an excellent example of what engineers have been so often told they cannot do — present a technical subject in language the layman can understand. How best to deal with employees is always a problem. Perhaps our executive readers may get some useful ideas from Mr. Finlayson's remarks, based on his own experience as head of a fairly large company.

The best boss of any organization, whether he be a foreman or a department manager, a general manager or a president, is one who has manoeuvred himself into the position where he has two or three people, each better than himself, each ready to step into his shoes at a moment's notice. That can be argued about of course, but if we take it as a premise, then we must set about developing these people, and our first approach, must be to try to draw them from within the existing roster of personnel. It isn't always possible, but it seems to be the first mode of approach. One can do that in a variety of ways, but some experiences tend to show that it can best be done by the boss himself setting the example and by one means or another making it clear that he doesn't consider himself to be a little tin god, that he doesn't consider himself to have all the answers and that, in fact, he is a poor luckless wight *without* many answers.

We complain a good deal, about the intrusion of government into our business affairs. We complain about socialistic trends on the part of labour. Reference has been made to the impact of the guaranteed annual wage, for example. There is no doubt that that is something we are all going to have to grapple with in one form or another. If we are to grapple with it successfully, I don't believe that we can do so without bringing all of the people in the organization into the discussion.

Some of you who are electrical engineers will know that a magnetized piece of steel differs from an unmagnetized piece in one relatively simple respect. The unmagnetized piece of steel is really made up of a conglomerate of little magnets which are pointing in all sorts of directions, so that they tend to cancel one another out magnetically, just as if you had six horses hitched to this table pulling that way, six more pulling that way, six more pulling that way and six pulling that way, and they were all of equal strength. The table isn't going to move, so no progress will be made; but if you can get all twenty-four of the horses pulling in one direction, the table is going to move with considerable celerity. Going back to our magnetized steel, the process of magnetizing the unmagnetized steel is simply that of bringing all the little magnets into line so that all the north poles point one way and all the south poles point the other way, and you have created within that piece of steel a magnetically organized situation which did not previously exist.

In a business organization we have to go through an equivalent process, only in this case instead of inanimate material we have to work on human brains and we have to do it, by a long and somewhat arduous process of education and of the supply of information, so that the people in the organization feel that they are parties to the problem. Once you are convinced that you are a party to a problem, that you are interested in it, that you have some selfish interest as well as some other interests in it, your attitude toward the problem is much more likely to be constructive than it otherwise would be. So all the manuals and all the talks and all the formulae, that have to do with management training, personnel relations and that sort of thing add up to a comparatively simple concept which says that the boss sees primarily that the facts

of the situation are carefully explained and made known to all the parties in the organization, and that they will share in whatever remuneration or kudos arises from success or progress.

That's an over simplified way of trying to deal with a complicated subject, but if you will think about it in those terms, you will agree that along some such road lies a solution to our problems. You will also agree that our problems are getting more and more numerous. We have arrived at a stage where apparently it isn't possible to get much more in the way of money for the products or services that we offer, but at the same time costs are rising and if we are to survive, we have got to find ways of improving our efficieney. We cannot ultimately improve efficiency merely by firing people but we can very greatly improve effieiency if we can get all the people thoroughly cognizant of the problem and expose them to methods whereby they may help in the solution of the problems.

Some of our modern problems are exaggerated or even created by the tendency to over specialization of which we are all guilty. I know that this criticism may be wrong, but it is perhaps worth debating. A year or so ago I suffered from a nasty irritation which I was told was pruritis, which impressed me very much, until I asked my personal doctor what that meant and he said "You have got an itch". Then we have our friends, the accountants, who present us with complex balance sheets which include a number of very impressive terms, which are almost meaningless to the average individual. How much better would it be if we could have those things presented in the form of "what we owe" and "what we own", and that kind of thing, not from the point of view of the man who is skilled in reading them, but from the point of view of making them less mysterious to the man who should be reading them and who should be studying them.

Then, of course, in the engineering field, we have the same kind of thing. Engineers are about as bad as anybody else in wrapping up the mysteries, or rather the commonplaces, of their professional lives in complex mathematical formulae which can usually be reduced to very simple concepts indeed. And you can go on and on through the list.

I think it's fair to say that you can draw these conclusions from any profession or trade you want to mention — plumbers, steam-fitters and carpenters. They talk about various bits and pieces of their equipment in technical terms which are meaningless to the average chap. Most people you know will understand what you mean when you say that the washer on the kitchen tap is leaking, but very few people will understand that the gasket is worn out.

In addition to the process of self-education, we have got to look at our individual mysteries rather carefully to make sure that we are not adding to our problem by our very method of going at it. If we could simplify our approach, and if we could draw our employees into the disenssion and make it clear to them that there are not many real mysteries, and that their knowledge and their help will be greatly respected, then progress can be made.

Salaried Union

Now in my particular company, we have a salaried union. There are not too many of them even yet in Canada, but their number is growing. One of the committees of our salaried union in one year, some years ago, consisted of five people of whom one was a Doctor of Philosophy, two were electrical engineers, one was a lady Bachelor of Arts from the University of Manitoba, and the last was a Bachelor of Commerce and chartered accountant. When you come to deal and argue with a group of that kind, there is no use trying to pull the wool over anybody's eyes about anything. The only advantage that you as the employer may have is a somewhat greater breadth of knowledge and a somewhat greater term of experience. Now if you conceive of dealing with a crowd like that, it immediately becomes apparent that the only way to fight through to some kind of a reasonable solution of whatever demands or problems exist, is to table the facts and to table them in a clear-cut, understandable way, so that the engineers and the Ph.D.'s and the accountants all have the same perception — or at least a reasonably equivalent perception — of what the problem is. If that can be done, then generally you will find that your problem is considerably simplified.

Thus, I would like to suggest that the subject which I have been trying to deal with today is one which, of course, warrants endless hours of discussion. We have to be realistic about the trends which we face, and we cannot over emphasize the necessity for going back to scho ourselves in the first instance, t find out how we can best handle ou human problems; there are reall no others. If we can find out how t handle these human problems, an if we can equip ourselves and ou employees with a body of trainin and a body of accurate factu knowledge, then not only will th modern tendency toward collectiv bargaining, guaranteed annual wag and all the rest of it become ass milable, but also we will find as byproduct that our organizatio work more smoothly and that tha delightful figure at the bottom o the profit and loss account ge blacker and more interesting.

In sum, the challenge that lie before us in operating any kind o an organization is to understand th human material that we have t deal with and in doing our ver best to put ourselves in the othe fellow's shoes, so that, in the lon run, we will be able to get him, a it were, into our shoes mentally, t get him on our side.

Another way to put the thin might be by referring to Biblica times, when Moses was charged wit the job of leading the Israelites ou of Egypt. You will remember, tha for a variety of reasons, they ge into the wilderness. Then Mose had to get them out and it too him, I recall, forty years. Very fe of us have forty years to get ou of the wilderness that we are all in which seems to lead inevitably t the conclusion that the primary jo that lies before us is to prevent th crowd from even getting into th wilderness. If we can do that, the we are certainly on the high roa to success.

Still another way of putting it i that management can consist of bunch of fellows, not too many, wh spend all their time "putting ou fires" on the basis of expediency short-term policies developed i desperation at the last minute. Bu the successful organization surel will be one which has the foresigh to create an efficient fire brigade; t mix metaphors, if we can create a efficient fire brigade then we won' let the crowd get into the wilder ness and the incidence of grey hai stomach ulcers, heart attaeks an all the rest of it will be greatl reduced. I believe that the firs road of approach to solving ou problems is through the mediu of our salaried personnel, but with out in any sense, in making thi statement, implying that we haven' got an equivalent duty to our othe personnel.

Abstracts of Current Literature

Abstracts of articles appearing in current technical periodicals

OPEN WORLD'S LARGEST OXYGEN STEEL PLANT

Canadian Metals. v. 17, n. 13, December 1954. pp. 25-26.

Canadian steel making moved dramatically forward with the introduction of the "oxygen process" in November of this year. The first of its kind in North America, the oxygen steel furnace is now in operation, with two more planned in the immediate future. The furnace will produce 40 tons of high grade steel per hour.

Iron ore from Lake Superior, Labrador and Seven Islands, Quebec is reduced and the molten iron delivered to the crucible of the new furnace in a huge ladle car. Here, 100 tons of 99.5 per cent pure oxygen can be delivered every day by recently completed plant and equipment.

When the crucible containing the iron mixture is raised up to the stack and the oxygen introduced by means of a long lance there is a brilliant flash of light and clouds of dense smoke and the making of steel begins.

This revolutionary method of making high-quality steel has been made possible by two recent developments: a technique for the use of pure oxygen in the conversion of blast-furnace molten iron into refined steel, and the perfection of equipment which will produce cheap, high-quality oxygen on a tonnage basis.

The use of oxygen in one form or another has been an essential part of steel making processes ever since the art of steel making was first developed. The Bessemer and Thomas processes use an air blast to provide oxygen to oxidize the unwanted elements in the charge. Unfortunately, the nitrogen introduced with the oxygen in the air blast is picked up by the steel, and the end use of the steel is limited by the strain aging effect of the retained nitrogen.

In modern open-hearth high hot-metal practice, the oxygen required is obtained primarily from the oxygen-containing iron-ore portion of the charge. In a practice using 60 per cent hot metal in the charge, about 300 pounds of ore are required per ton of hot metal. This weight of ore provides about 70 pounds of oxygen, but it also introduces an equivalent amount of non-metallic or gangue material into the bath, which must be slagged out in the subsequent refining period.

Since higher percentages of hot metal call for almost proportionally higher percentages of ore in the charge, a point is reached where the volume of ore charged and the volume of slag obtained makes for uneconomical operation. This limitation on the use of new metal (hot metal) in the open-hearth charge has made it more difficult for the open-hearth operator to produce high-quality steels which are low enough in residual alloys to meet the stricter chemical and physical specifications.

The principle on which the process works calls for directing a stream of high purity oxygen into the top surface of the bath. The vessel used is pear shaped. In the case of a 40-ton vessel, the diameter will be 14 to 15 feet and the height about 25 feet. When charged with hot metal and scrap, the bath depth will be about 36 inches. The specially designed water-cooled oxygen lance is suspended vertically in the centre line of the vessel with its end about 35 inches above the bath.

THE INQUIRING MIND

Citizenship Items. Canadian Citizenship Council, v. 8, no. 2, Feb.-Mar., 1955, pp. 2-5.

Many of the greatest material aids to living are with us today solely because some men are possessed of an insatiable curiosity and are ever ready to investigate the experiment. In this there is a lesson for all mankind. The mind is a mighty weapon and how each one uses his own bears directly on his life. The inquiring mind has done great things in the fields of science, medicine and the arts. It has not yet begun to do all of which it is capable in the field of everyday living.

In every walk of life there is a constant battle for the minds of men. Organizations vie, each seeking to persuade us its cause is the most important and deserving of our support. Every newspaper, magazine, radio, television set and highway billboard tells us of products superior to all others in their fields, and politicians lock in a fight for our votes and our minds.

In addition to these battles on a narrow plane which seek to persuade us to a certain course of action or thought, there is a constant fight for men's minds on a world-wide scale between the various ideologies. Very soon now the generation at which this editorial is directed will be in this war; in many countries it is in it practically from birth.

In small things as well as large, one can train the mind to be a strong shield against those things which are not good. The possessor of the inquiring mind will accept no claim vital to his interests at face value, but will investigate. Let no man say, my way is the way—this is truth. There have been many such men since the world began and too few to search for the truth. These men seek the minds of men, for without the minds the bodies are useless to them. Voltaire has said: "In the case of news, we should always wait for the sacrament of truth."

In many cases the duty of confirmation falls upon the inquiring mind and in too many cases it has been a neglected duty.

This is not to say that good will should be replaced by suspicion or that all things should be doubted for doubting's sake, but there is a crying need in this world for men and women who, when confronted by a man or ideology proclaiming that one way is the only way, will apply their minds to the claim. There has been far too much bloodshed and suffering in this world because there were not enough men with inquiring minds. Such men are needed more than ever today.

—Hamilton Spectator

PANEL ON EMPLOYMENT CONDITIONS AND UNIONIZATION

Their Effect on the Engineer

Engineers Joint Council (General Assembly Proceedings) Jan. 21, 1955, pp. 8-14.

(A panel discussion before the general assembly of Engineers Joint Council, January 22, 1955, with G. Brooks Earnest, chairman, Dr. Arthur K. Doolittle, Dr. N. W. Dougherty and E. Lawrence Chandler participating. . . . This account has been much condensed.)

STATEMENT OF PROBLEM AND HISTORICAL ASPECTS

Mr. Earnest: As our population has shifted from totally agrarian to thickly settled areas so did our new and complicated problems develop. The expansion of engineering into a multiplicity of fields has created a host of problems with many ramifications. One of the major problems confronting the professional engineer today concerns employer-employee relationships, or simply, "employment conditions."

There has been a gravitation in the past decade toward unionism of professional engineering personnel in certain concentrated areas of the country. This trend is now spreading at such a rapid pace that the professional status of the engineer is at stake.

Factors which have been indicated by leaders in the collective bargaining movement as being responsible for the trend toward collective bargaining may be grouped under three headings as follows:

Professional Treatment

1. General feeling among engineers that they are not identified with the management team, whether they are industrial employees, government employees, or civilian employees of the military services.
2. Inadequate channels of communication between top management and nonsupervisory engineers.
3. Failure to recognize engineers as professional employees.
4. Assignment of sub-professional work to engineers.

Personal Treatment

1. Failure to recognize and treat each engineer as an individual.
2. Absence of progressive classification levels by which engineers can measure progress.
3. Insufficient formal training and plans for job rotation and promotion.
4. General feeling that progress and promotions have not been commensurate with ability.

Financial Treatment

1. Narrowing of the pay differentials between engineers and wage roll employees.
2. Impression that salaries and merit increases for engineers are below those of other companies for comparable work.
3. Dissatisfaction with merit review systems and impression that performance is secondary to seniority.

Professional engineers have resorted to collective bargaining with the belief that only by pressures on management through collective action can injustices, real or fancied, such as above-mentioned be corrected or at least alleviated.

The crux of the problem centers about the question, "Is collective bargaining compatible with professionalism?"

Returns from a questionnaire circulated among 112,000 civil, mechanical and electrical engineers show that only about 3.7 per cent were actually members of an established collective bargaining group. However, 27 per cent reported as not being opposed to collective bargaining. Furthermore 20 per cent reported that they believed that collective bargaining would be advantageous to them.

It is important to note that the questionnaire results showed that 72 per cent opposed collective bargaining for professional engineers, and that 66 per cent felt that collective bargaining is incompatible with professional status.

The results of the questionnaires present a challenge to the engineering profession. We do not know the thinking of the remaining engineers polled who did not respond but, assuming that it might approximate the thinking of the 57 per cent responding, there would then be 30,300 who are not opposed to collective bargaining for professional engineers. We have the responsibility of trying to alleviate conditions which have created this attitude.

ENGINEERING—A PROFESSION

Dr. Doolittle: At the outset, it should be made clear that I am in no sense representing Carbide and Carbon Chemicals Co. on this panel. My work at Carbide is research, which has no connection with the establishment of employee relations policy. On the other hand I have been thinking about this subject for some time while working with a committee of the American Institute of Chemical Engineers, and therefore my remarks do reflect the philosophy of the Council of that organization.

Before proceeding to develop the subject of "Engineering—A Profession," it is well to emphasize that professional status is not a variable concept with one definition today and another tomorrow. Certainly, the principles that characterize the professional attitude are not subject to an interpretation that depends on the proportion of engineers that favour collective bargaining.

Reflecting on the basic factors that impel men to work hard, one would include, in addition to the necessity for acquiring the minimum needs for survival, at least the following motives: love, duty, the desire for security, the desire for power, the desire for approbation, and the desire to do good to others.

The so-called "learned professions," theology, law, and medicine were founded almost exclusively on the last or altruistic motive. Admission to these professions involved a public oath or vow of dedication and their practice required special skills, high intellectual attainments, and, generally speaking, a confidential and personal relationship with the client.

Since many scientists and engineers are also motivated by high ideals, scientific endeavour and engineering have likewise come to be regarded as professions. Although

the altruistic motive in the field of science may more frequently be found among fundamental research workers, it is by no means confined to a single group.

Engineering is the technique by which the properties of matter and energy are made useful to man in structures, machines, and manufactured products. Accomplishment of these ends requires not only scientific training, but also creative imagination, judgment, and an appreciation of the economic factors involved. From a broad viewpoint, therefore, the work of the engineer is predominantly intellectual and varied.

While the qualifications for professional status in engineering, like those of the other professions, include the acquisition of special skills on a high intellectual plane, the practice of engineering is not always on such an intimate and personal basis as in the cases of theology and medicine. The ethics of the engineering profession nevertheless remain substantially the same as in the other professions, because the specialization of the professional places him in a position where his client or employer is completely dependent on him.

The work of the truly professional engineer is so far from a routine, established pattern that only he can provide the initiative, the discretion, and the judgment to achieve the successful accomplishment of his tasks. Because he alone knows with what comprehension, capability, and likelihood of success he approaches his assignment, the professional must accept individual responsibility or else advise his client or employer that other help is needed.

Therefore, to those who enter the engineering profession with either altruistic motives or the desire to gain approbation, it is clear that the professional attitude involves the following four basic concepts:

1. A sense of social consciousness; a desire to contribute to rather than simply to benefit from civilization; a resolve to place the public welfare above other considerations.
2. The acquisition of special skills on a high intellectual plane, generally evaluated by means of self-imposed standards of excellence.
3. A sense of trusteeship—personal responsibility to protect the client's or employer's interest.
4. Display of individual initiative and acceptance of individual responsibility, both of the highest order.

Effort is constantly being made through the engineering societies to encourage the professional development of their members and to promote an appropriate recognition on the part of the public of the professional character of the engineer's work.

Prestige, however, is something that must be won. It cannot be bought or automatically accorded through affiliation with an organization. It is something that one can command but never demand. The most that the engineering societies can do is to encourage professional achievement. In the final analysis, engineering is a profession only to the extent that the individual concerned accepts his responsibility to himself, to his client or employer, and to society.

IS COLLECTIVE BARGAINING COMPATIBLE WITH PROFESSIONALISM?

Dr. Dougherty: Of necessity there must be a period of training; the doctors call it internship, engineers call it "engineer-in-training," where the beginning professional must be initiated into the methods and responsibilities of his work. The period must be more than days, or months; it may comprise a number of years. For some workers it is prolonged to many years, thus simulating the employment in the skilled trades, where it its expected that the tasks will be routine and the judgments will be very modest. Under such conditions there is a strong tendency to adopt the group methods which have been so highly lauded for the skilled artisans.

That the labourer is worthy of his hire applies to professionals as to other workers, but the pay-check is not his only, or his greatest, compensation. He has the satisfaction of seeing his brain-child take the form of a factory, or a machine, or a process to render service to industry and to all mankind.

Collective Bargaining

Bargaining groups are established to deal with wages and working conditions. Were all the problems in these areas solved for the professional it would be but the beginnings of professional advancement. Bargaining groups cannot grow into unity groups or professional associations. They are limited in their membership to non-supervisory employees, who after a few years, must graduate into supervision and management.

The patterns of their activities are in conflict with professional attitudes and professional practices. They are committed to the concept of jurisdictions rather than performance with requisite knowledge and skill. They must emphasize seniority to hold their membership and strength. Jurisdiction and seniority are in direct conflict with the concept that ability must be recognized and given first place. To a professional, the sole criterion of the work he must do is his ability to perform with needed knowledge and responsibility. He resents job classifications which restrict his activities to limited areas and routine responsibilities.

His duties are such that he must see the task well done regardless of time or over-time. On routine work fixed hours may be desirable, but on professional tasks the professional must make his services available as needed.

All unions talk about the effectiveness of the strike as a bargaining weapon. Strikes cannot be called without expense to the group and to the industry. Professionals are committed to the protection of the interests of their employers as well as the protection of their own interests, and ethically the interest of the client comes first. Therefore, strikes are not a satisfactory tool to achieve professional ends. Besides, professionals are often acquainted with company information which can only be used after a breach of confidence with the employer. Under such circumstances an employer must restrain himself in making information available to employees who use the method of collective bargaining.

When working conditions are determined by group action the very nature of professionalism is violated. Each professional is an individual and his hours, working conditions, and place of work must be determined by the task at hand. If, however, they wish to ultimately attain professional status they must get their beginning experience in a professional atmosphere.

Why should a professional have to turn to collectivism to get a salary raise? If such conditions exist, it is because professionals in management are not assuming their responsibility. Every engineering society should add the following item to its codes of ethics—the professional employer must consider

himself an advocate of his professional employees. No one in industry, except professionals, can determine the worth of the engineer-in-training, and certainly there is no method devised by collective bargaining to distinguish between the good and the best. Indeed, collective bargaining is not able to distinguish the poor from the best.

Unionism for professionals seems to overlook the fact that manager and worker are both employees. Their need is a method of communication rather than a method to force each other to do that which should be done. It is essential that the company or industry be successful or neither manager nor worker will have meat to divide rather than bones to pick.

RESPONSIBILITY OF MANAGEMENT AND EMPLOYEE

Mr. Chandler: The responsibilities and loyalty of every engineer to his profession are the same. However, the capacity and opportunity to meet those responsibilities are greatly enhanced for one who has advanced to a position of management. It is important that he take advantage of every proper and ethical opportunity to serve the professional interests of employee engineers within his sphere of influence, with realization that he is, at the same time, furthering the interests of his organization.

Problems of unionization and collective bargaining in engineering firms are minor as compared with those in large industrial and manufacturing organizations. One reason, of course, is that many more engineers are engaged in industry. But, there must be other reasons why numbers of engineers believe collective bargaining to be desirable.

Why is this so? We need to explore the reasons and try to delineate responsibilities so far as may be possible. Young men of professional spirit want to be recognized and accepted as individual members of their profession. They want opportunity to prove their abilities. They need encouragement. Another basic responsibility to the engineering profession is management's obligation to see that the young engineer is properly oriented and indoctrinated into the practicing technological world. Most important is the need to be certain that employee engineers are assigned to engineering work.

These general principles may be boiled down to a simple statement that, if engineers truly are a present or prospective part of management, they must not be deemed as just industrial employees along with clerks, toolmakers, production-line operators, and other classes of workers.

Perhaps one of our great sources of trouble is that our use of the term professional engineering is too inclusive. There is little incentive toward collective bargaining among those who appreciate the individual and professional nature of engineering services. The appeal of unionization appears most among those who possess lesser attributes even though, under present usage, they may be classified as professional engineers.

If those who are really technicians, or engineering assistants, or however they might be classified were accepted as such, the problems of employment conditions for those properly classified as professional people would be simplified and the status of the profession as a whole be enhanced.

The managements in many organizations, large and small, have recognized the importance of the problem and are conducting programs directed toward the establishment of mutual understanding and cooperation between management and the engineer as a professional employee. Some phases of these endeavours may be noted as:

1. Development of understanding of company policies and procedures.
2. Appropriate recognition of educational accomplishments and individual technical ability.
3. Assignment to work commensurate with individual capacity.
4. Opportunity for advancement.
5. Sound salary policy with increases based upon merit as determined by periodic appraisal and rating of individual performance.
6. Profit sharing in the form of bonuses or opportunity to purchase stock.
7. Encouragement for personal development through continuing education, adequate training, and participation in civic affairs.
8. Encouragement of membership in professional societies including preparation of technical papers.

What about the responsibilities of engineers in their capacities as employees? Much can and should be said.

As an employee, one surely should realize that untold thought and energy plus financial investment have been devoted to building the organization that furnishes him the opportunity to gain his living. If, for any reason, he cannot feel a sense of loyalty to his employer and a desire to advance the interests of the organization of which he is a part, he will do well to move elsewhere.

Definitely, there are obligations and responsibilities resting on both employer and employee. Each, of course, has responsibility to advance his own welfare. Beyond that, and yet a part of it, each has responsibility to the other and to his profession.

ISOTOPE LIQUID LEVEL GAUGE

Mass Production. v. 30, n. 11 (349th issue), November 1954, pp. 97-99.

As research into the development of atomic energy for industrial purposes progresses it is continually discovering the immense possibilities of simplifying and speeding up industrial production and control methods by use of radioactive isotopes. As supplies of radioactive sources increase so the field of application is widened. Many applications are found in such processes as the thickness determination of paper, cellophane or other sheet materials, for detecting cracks or flaws in metal, in checking the assembly of mechanisms inside opaque cases or examining welds. The radioactive materials used in these processes provide a wide range of radiations and can be chosen to suit a particular job.

A system which has been developed for indicating, recording or controlling the level of liquid in industrial plant operates by passing a radioactive beam through the walls and lining of a furnace forehearth directed at a position along the level of the liquid material inside. The radiation passing through the entire plant is then picked up by a suitable watercooled detecting unit on the far side. As the equipment is mounted externally, the gauge is particularly suitable for measuring levels of liquids contained under drastic conditions of temperature or pressure and of a corrosive

nature, such as those of molten glass in a furnace, slag in a blast furnace, liquids in high pressure polymerisation vessels and liquid handling in the oil industry.

The equipment consists of a radioactive source, usually Cobalt 60, with a working life of approximately five years; a detector unit, water cooled if ambient temperature exceeds 60 deg. C.; and an amplifier which may be located up to 60 ft. from the detector. The source and detector are mounted on opposite sides of the vessel. When the liquid level is high the radiation entering the detector is reduced, and when the liquid level falls the amount of radiation in the detector increases. Over a given vertical distance, therefore, the amount of gamma radiation entering the detector is proportional to the level of the liquid. The precise accuracy achieved and the specified limits depend on the diameter of the vessel, wall thickness and nature of wall, and the amount of surround, such as lagging, etc. In general, the gauge will accommodate an internal diameter of plant which does not exceed 10 ft., but under certain circumstances with reduced accuracy it may be possible to accommodate up to 20 ft. in diameter. The maximum vertical change in liquid level over which the gauge operates is 15-18 in. Over this change, the order of accuracy of indication or control is +2 per cent. The gauge has already been applied in the glass industry to a glass furnace feeder, the internal diameter of which is approximately 9 in. thick. Under these conditions, the gauge indicates or controls the liquid level over a rise and fall of 0.5 in. The accuracy achieved over the centre 0.25 in. is 0.02 in. or, over the whole 0.5 in., is 0.04 in.

Since the liquid level gauge operates completely externally to the industrial plant and the detector unit is water-cooled, the instrument is independent of internal charges in the plant which involve high temperature, pressure vacuum, or the processing of extremely corrosive liquids.

APPLIED BASIC MECHANICS SOLVES A CIVIL ENGINEERING PROBLEM

Louis C. Lundstrom

General Motors Engineering **Journal**, v. 2, n. 1, January-February 1955, pp. 10-15.

The General Motors Proving Ground at Milford, Michigan, is an outdoor laboratory where all types of automotive vehicles are scientifically tested and analyzed. There is a test track at the Proving Ground which is five lanes wide, 3.8 miles long, and triangular in shape with curves at the three rounded corners. The upper lanes of two curves have a maximum slope of 77 per cent, providing an equilibrium speed of 85 mph.

When this test track was constructed in 1926, reinforced concrete was used throughout. One of the curves had to be reconditioned in 1935. Because the reinforced concrete provided good paving qualities, it was again used on the curve. Although it was used successfully it had two drawbacks: (a) it was necessary to completely close the track to all traffic for many months and (b) the large amount of hand labour made the job relatively costly.

The extreme degree of the sloped curves presented a problem during winter operation when conventional snowplow equipment proved useless. In an effort to clear away the snow and ice from the upper lanes, the use of large amounts of ice and snow melting chemicals became necessary. As a result, deterioration of the original concrete surface began. This deterioration was accelerated during World War II when the track was used for testing heavy tanks and other vehicles for military purposes. The testing of military vehicles, coupled with the use of large amounts of snow and ice melting chemicals, made necessary resurfacing of the entire track.

When resurfacing of the track was undertaken in 1945, it was decided that bituminous concrete would be used as the resurfacing material.

Conventional road paving machinery was used to apply bituminous concrete to the straight sections of the track and to the nearly level inside lanes of the superelevated curves. This machinery, however, would not work on the steeply banked outside lanes of the curves. After much effort, a hot bituminous mixture was spread over the upper lanes and then cross-rolled by winching a conventional pavement roller up and down the steep slopes. The resulting surface, however, was too rough for high speed operation and it became necessary to remove the bituminous mat—once again leaving the original weathered reinforced concrete surface on the upper lanes of the curves. By 1952, the condition of the curves made resurfacing imperative.

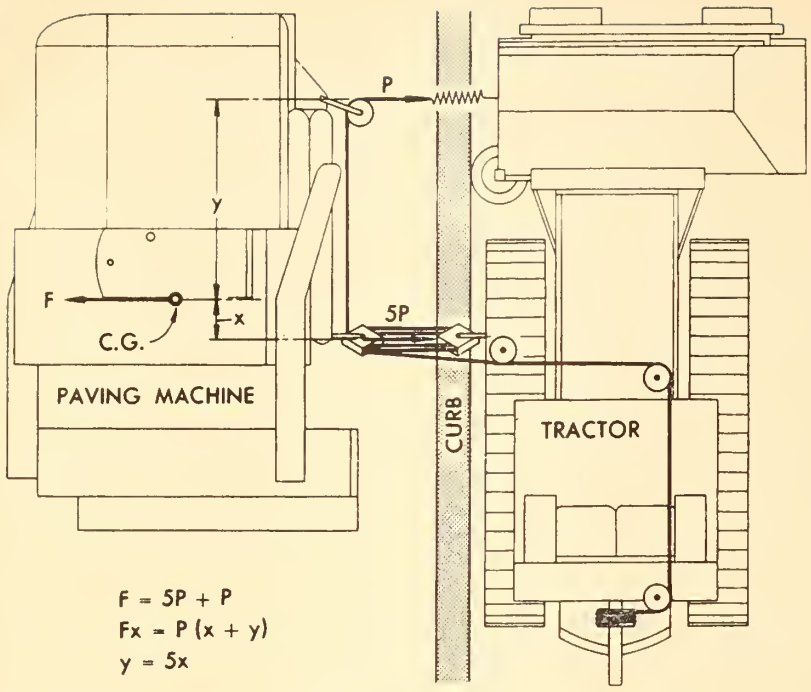
It was realized from the start that resurfacing the curves with bituminous concrete would be a difficult job. The experience gained from the attempt at resurfacing the curves in 1945 showed that, if a satisfactory surface was to be attained, a paving machine must be used to spread the bituminous mixture and that another method must be found for compacting the surface with a pavement roller—different from the method of winching the roller up and down the slopes. With the economies of the problem in mind, it was evident that special machinery was impractical. Conventional road paving machinery might be used if certain modifications were made to allow for satisfactory operation on the steep slopes and if a way could be found to properly support the machines when in operation. Through the application of basic mechanics, a solution was found to these problems.

Method Of Support

Successful operation of bituminous paving and rolling machinery on the side slopes required special mobile supports. A truck and a tractor were selected as the mobile supports and these were operated on a 10-ft. wide dirt roadway specially built around the top rim of the curves. To properly guide these vehicles and to absorb the large reactions, a special reinforced curbing, 1-ft. wide by 3-ft. deep, was placed against the top edge of the original concrete pavement slabs. This curbing, placed 2 ft. into the ground, now serves as support for the guard-rail posts.

Both the tractor and truck were cable-connected to the machines they supported; but, in both cases, a complete analysis was required in order to design the necessary cable-supporting mechanisms.

One of the reasons for choosing the track-laying tractor for support was its slow-speed operation which allowed it to inch along at



The calculations and the force diagram determined by the use of basic mechanics the location for the points of attachment. A specially calibrated spring, attached to the anchor end of the cable on the front of the tractor, served to indicate the amount of side pull and aided the tractor operator in adjusting the winch to carry just the right amount of support for the paving machine.

the same speed as the paving machine.

Conventional block and tackle rigging was first tried, with the lower sheave fastened to the only available attachment near the center of the paving machine. During initial tests, it was found that the front of the loaded paving machine was too heavy and would drift down-slope; that is, the center of gravity was ahead of the support cables. As it was impractical to move the main attachment, the anchor end of the block and tackle was moved to the front of the tractor and one line was passed through an additional snatch block attached to the high-front corner of the paving machine. This forward cable produced a turning couple to balance the couple produced by the forward location of the paving machine's center of gravity.

The added side pull on the front of the tractor required the installation of a horizontal guide wheel to support and guide the tractor along the curbing. In addition, a special calibrated spring was used at the anchor end of the cable to indicate the actual amount of side pull. The tractor operator, therefore, adjusted the winch to carry just the right amount of support for the paving machine.

The three-axle tandem pavement roller was supported on the steep slope of the curves by a cable which was connected to a winch positioned on the flat bed of the supporting truck.

Side forces on the supporting truck were absorbed by two horizontal and two vertical truck tires which were free to roll along the special curbing. The four support tires were mounted on a heavy cross-frame that was pivoted along the right side of the truck frame. The floating action of this framework allowed the truck to operate on the irregular dirt roadway without seriously affecting the position of the four support tires. Two tons of weight placed on the far side of the support-wheel frame approximately balanced the couple produced by the cable pull and left the truck lightly loaded.

While the roller and the support truck were being driven side-by-side around the super-elevated curves, the cable length between the roller and truck was able to increase or decrease without changing the cable load, due to the winch being powered by a torque converter transmission which operated at or near a stalled condition at all times. This meant that the winch engine was constantly running under load and, therefore, delivered a relatively constant torque to the winch. The arrangement was such that the winch would automatically release or take in cable depending on the path along which the roller was operating. To allow continuous operation of the transmission at the stalled condition, special oil cooling was necessary.

To eliminate all shoving and grooving of the fresh bituminous mix, the road reaction on the roller had to be normal to the road surface and equally distributed across the roller face. This was accomplished by using a special hydraulically controlled hitch mounted on the side of the roller. The hitch permitted both longitudinal and vertical adjustment as required by the roller's operation on the upper and lower lanes.

Due to the parabolic cross section of the track, direct calculation of the forces on the roller would have been very complicated; therefore, the problem was solved graphically—to find the required height H of the hitch and the roller cable force F as the distance of the roller from the curb varied. During the actual rolling of the pavement, the operators adjusted the winch engine throttle to obtain the required cable force and adjusted the hydraulically controlled hitch to obtain the required height. A special electrical scale in the cable anchor gave a continuous indication of the actual load in the support cable.

Modification Of Tamping-Leveling Paving Machine

The major requirements that had to be fulfilled by the paving machine, which spread the hot bituminous mixture to the desired depth and then compacted it, were to provide a negative crown and a curved surface finish which would closely match that of the original parabolic cross section of the upper lanes. This meant that the bottom of the machine had to be curved.

These major requirements constituted the greatest amount of modification on the paving machine. Production paving machines are made in two halves that can be adjusted to give flat inverted V's necessary to produce *positive* crowned road surfaces. By increasing the clearance between the two halves and extending the range of adjustments, the paving machine was modified to produce the high *negative* crown condition required on the super-elevated

curves. As the cast iron frame of the machine was very rigid, specially machined steel shims were used to bend the screed bars to the desired curvature. Tamper bars were then machined to the same curvature.

Due to the parabolic cross section of the track, the radius of curvature varied from a minimum at the top to a maximum at the bottom. If a perfect reproduction of the original cross section was to be desired, different shims and tamper bars would be required for each lane of operation. This was impractical, and it was decided to use a circular cross section that would closely approximate the parabolic section in the high speed traffic lane. The calculations necessary to determine the radius of the circular cross section resulted in a basic 60-ft. radius.

After determining the radius of the circular cross section, additional calculations were made to determine what deviations would be encountered when using this 60-ft. radius on other portions of the parabolic cross section. As the deviations were within practical limits, a single set of shims and tamper bars was made for the paving machine.

The deviations would have been beyond practical limits if it had not been possible to vary the amount of negative crown in the paving machine.

With the maximum of 2½ in. of negative crown in the screed and with the screed shims installed, the bituminous mat, laid by the paving machine, had a circular cross section with a radius of 60 ft.

Minor modifications that were necessary on the paving machine, in addition to the major ones listed above, were many and varied. They included wedge steps on the working platforms to permit operators to stand on the machine, a three-position tilt seat for the convenience of the driver, a guard to protect the radiator from being damaged, a lock to keep the tamper bar clutch lever from dropping out of engagement, a negative crown indicator, high-strength steel pins as replacements for cotter pins where side loading was encountered, change in the gasoline fill pipe to the high side and the outlet to the low side, new deeper oil pan for the engine, lower oil pump inlet pipe and longer oil dipstick, wedge to tilt the carburetor, and clearance for the universal joint on the tamper-bar drive shafts.

In order to control the flow of material through the machine from the forward hopper to the rear strike-off plates while it operated on the steep slopes, wedge plates and baffles were used in conjunction with the standard machine's conveyors and lateral spreader screws to keep the material from falling to the low side.

Modification Of The Three-Axle Tandem Pavement Roller

A three-axle tandem pavement roller was selected for the rolling operation because it effectively leveled out any irregularities left by the paving machine. Modifications of the roller started with the use of special rollers machined to a radius of curvature of 60 ft. Thus, in the high speed lane, the most ideal condition was obtained. Fortunately, the compaction and operation of these special rollers on surfaces of smaller radii of curvature was very satisfactory.

Adjustment of the rollers was required so that all three rollers would simultaneously be in contact with the surface of the saucer-shaped track. In effect, the center roller was ¼ in. lower than the end rollers.

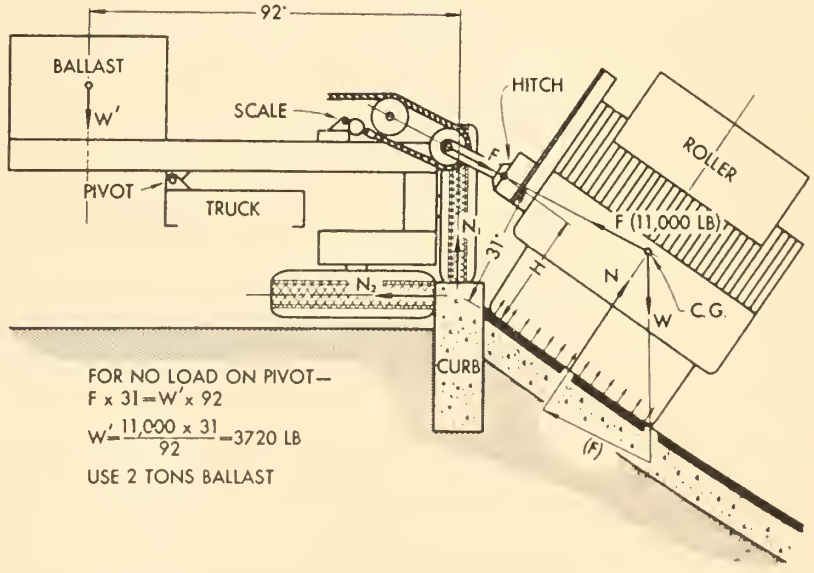
The fore-and-aft position of the cable-support hitch was manually adjustable so that the driver could balance the machine for the proper "feel." When compacting material adjacent to the curb, the drivers usually preferred to operate slightly off balance to the rear so that the guide (rear) roller would be several inches lower on the slope than the lead or drive roller. This enabled the drive roller to compact loosely spread material adjacent to the curb and eliminated all hand tamping.

Delivery Of The Bituminous Concrete To The Paving Machine

The hot bituminous concrete mix used for resurfacing was prepared at a mixing plant and delivered to the job site in dump trucks. Delivery of the mixture from the dump trucks to the paving machine presented a difficult problem.

Conveyors from the lower inside lanes of the track would have been too long and difficult to manoeuvre. It was decided, therefore, to attach a belt conveyor and hopper to the front of the support tractor. Hot bituminous mix, delivered to the site in trucks, was dumped into the hopper and then carried on a 14-ft. belt across the curbing to the hopper of the paving machine. The conveyor was not operated continuously as it was desirable to move the material in batches to retain as much heat as possible.

As the roadway behind the curbing was narrow, the dump trucks could not turn around in the vicinity of the paving operations. This required backing the dump trucks as much as 2,400 ft. Fortunately, the back-up distance was the greatest to the transitions of the super-



The force analysis illustrates how forces were balanced to obtain uniform compaction of the bituminous concrete. The road reaction on the roller had to be distributed across the roller face. This was accomplished by controlling the amount of cable pull F and by adjusting the hydraulically controlled hitch until its height H was of the amount required to pass the line of action of cable pull F through the roller's center of gravity.

elevated curves, where paving operations were necessarily slow. As the supply distance decreased, normal speed of paving could be maintained.

Summary

The resurfacing of the three super-elevated curves was a project that presented problems which were largely solved by the application of engineering fundamentals. The solutions generally were not difficult when reduced to single problems. The experience and knowledge gained will be applied when similar resurfacing again becomes necessary in the future.

The success of this paving operation has also demonstrated to bituminous engineers the feasibility of applying bituminous linings to steep dam facings and canal linings by the use of paving machines. The same precision of form and rolling operation specified for the roadway would not be required but the methods of application could be the same.

IS THE ART OF CONVERSATION DISAPPEARING TODAY?*

According to Dr. A. Whitney Griswold, president of Yale University, conversation in the United States has fallen on evil days. "The great creative art whereby man translates feelings into reason and shares with his fellow man those innermost thoughts and ideals of which civilization is made, is beset by forces which threaten its demise," he says. Continuing, he holds that:

"It is forsaken by a technology that is so busy tending its time-saving devices that it has no time for anything else. It is drowned out in singing commercials by the world's most productive economy that has so little to say for itself it has to hum it. It is hushed and shushed in dimly lighted parlors by television audiences who used to read, argue, and even play bridge, an old-fashioned card game requiring speech.

"It is shouted down by the devil's advocates thrown into disorder by points of order. It is subdued by soft voiced censors who, in the name of public relations, counsel discretion and the avoidance of controversy like so many family physicians breaking the news gently and advising their patients to cut down on their calories.

"It starves for want of reading and reflection. It languishes in a society that spends so much time passively listening and being talked to that it has all but lost the will and the skill to speak for itself.

"I wonder how many of us are aware of this predicament and interested in its possible consequences.

"It was conversation, reaching its orderly and exalted climax in the dialogue of Socrates, which in an age without books or their latter day substitutes, laid the foundation of the civilization we are dedicated to defend. It was conversation of which the New Testament, the greatest teaching ever recorded, was composed. It was conversation among small groups of university scholars still in a bookless world that revived learning at the end of the dark ages.

"Conversation is the oldest form of instruction of the human race. It is still an indispensable one. Great books, scientific discoveries, works of art, great perceptions of truth and beauty in any form all require great conversation to complete their meaning; without it they are abracadabra — color to the blind or music to the deaf.

"Conversation is the handmaid of learning, true religion and free government.

"By this path I return to this university and the extraordinary opportunity that is yours who are about to enter it. Where else save Elysium itself is life so congenial to conversation as it is in a residential liberal arts college?

"How, then shall we make the most of it? Shall we have courses in conversation? Perish the thought. Let us have conversation in courses but no courses in conversation. By conversation in courses, moreover, I do not mean whispering in lectures. I mean as much give and take between teachers and students as is possible in this day of soaring enrolment teacher shortage and financial deficits.

—Niagara Falls Evening Review

CHINESE WISDOM*

Sometimes, as we read about the explosive and destructive properties of atomic fission, we find ourselves thinking about the Chinese. Not the modern Chinese we hasten to say, but the Chinese of 2,500 years ago, who were a remarkable civilized and interesting people.

Why do we think about the Chinese? Because, in that far-off time, they discovered gunpowder. As all of our readers are undoubtedly aware, gunpowder is made of saltpetre, charcoal and sulphur; the Chinese were able to make it because they had a monopoly of the world's supply of refined saltpetre just as certain nations now have a virtual monopoly of uranium. And what did the Chinese do with gunpowder? Did they use it to blow up their enemies? No; they used it to make fireworks.

It was about the year 1300 A.D. that gunpowder became known in Europe, and the ingenious Europeans could hardly wait to begin blowing their enemies up with it. As their knowledge of the substance was limited they sometimes blew themselves up, as well. But they knew that they were right because they were Christians and could always produce a good argument in favour of anything they wanted to do, whereas the Chinese were heathens, and did not know how to deal with serious things like gunpowder. All the Chinese knew was that gunpowder was dangerous and might hurt somebody if it were carelessly handled. The Europeans, with their superior civilization, had mastered the great secret that it is always all right to hurt somebody else if you can produce a sufficiently convincing reason for doing so.

We wish that some modern nation as civilized as the ancient Chinese (if such a civilization existed in our time, which it does not) had a monopoly of the sources of atomic energy.

—Peterborough Examiner

* Citizenship Items, Canadian Citizenship Council, v. 8, no. 2, Feb.-Mar., 1955, pp. 2-4

Month To Month

JAN. FEB. MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Confederation Advances

A long step forward was taken on October 12 when the Institute's Committee on Confederation met in Montreal. The most unique and encouraging condition of the meeting was that every member of the committee from Halifax to Vancouver was present. When it is pointed out that every committee man has heavy commitments in his own office, and that no allowance was made by the Institute for travel expenses, the contribution of these people really can be appreciated.

The meeting held at Headquarters started at 9 a.m. and finished after 5 p.m. At noon, luncheon was had at the University Club, when Herbert Smith, chairman of the committee of Dominion Council, joined the group. This afforded an excellent opportunity for constructive exchange of ideas.

The committee first reviewed the report of Council, made by the original committee under the chairmanship of R. E. Heartz, and then went on to a study of the latest progress report made by Mr. Smith's committee to Dominion Council. Each member of the committee stated that in his area there was a keen interest in Confederation and a sincere desire to see it accomplished as soon as possible. At the end of the day there was an abundance of evidence to give great encouragement to the proposals for Confederation.

The committee's concluding business dealt with proposals for a meeting with the committee of Dominion Council. It was felt that as each committee had now studied their own ideas and the ideas of the other committee, they should now get together to produce a single report, for the consideration of the bodies concerned, so that Confederation might be realized at the earliest possible date.

The membership of the Institute's committee is as follows:

H. R. Tait, Montreal, chairman
H. Gaudefroy, Montreal, vice-chairman
H. W. L. Doane, Halifax
T. Foulkes, Ottawa
W. S. Wilson, Toronto
J. McMillan, Calgary
H. T. Libby, Vancouver
Leo J. Hammerschmid, Montreal, secretary.

The Confederation Committee. H. W. L. Doane is in the centre foreground, and around the table from his left are: Henri Gaudefroy, T. Foulkes, Chairman H. R. Tait, L. J. Hammerschmid, J. McMillan, H. T. Libby and W. S. Wilson.

Cover Picture

For studies in radio astronomy the National Research Council Laboratory is equipped with the 10-inch parabolic radiotelescope shown on this month's cover.

ECPD Meets in Canada

For the second time in its twenty-three years of existence, the Engineers' Council for Professional Development met in Canada, this time at Toronto, on October 13 and 14.

The official program covers just two days but for some of the committees the work began two days ahead of the publicized dates. This is particularly true of the Committee on Education. They started their sessions on Monday morning and worked through morning, afternoon and evening for two days before being ready to report to the meeting on the 13th. When it is remembered that the work of this committee involving about 350 prominent educational people and businessmen is all done on a voluntary basis, one gets some appreciation of the contribution they are making to engineering education in the United States and to some extent in Canada as well.

Thursday morning, the 13th, was devoted to the executive session of the Council itself and the meetings of the various standing committees, such as the Committees on Guidance, Student Development, Training, Ethics and Recognition.

At lunch that day, with the president of ECPD, L. F. Grant, HON.M.E.I.C. in the chair, a welcome was extended to the visitors by Dr. R. E. Heartz, president of the Institute. The speaker was S. C. Hollister, dean of the college of engineering, Cornell University, Ithaca, New York, who spoke on "Survey of Education and Utilization of Engineers". Dean Hollister's comments and proposals are among the most important that have been made available to engineers for a long time. It is not proposed to discuss them now but instead the full context of his address will be published in this issue of the *Journal*.

In the afternoon there were further committee meetings and then an open meeting of the Council, at which the reports of the committees were presented.

That evening prior to the dinner a reception was tendered by the Engineering Institute of Canada, with about 180 people present. President R. E. Heartz and Mrs. Heartz received the guests.

At 7.30 that evening the annual dinner took place in the Great Hall of Hart House at the University of Toronto. M. D. Hooven, vice-president of ECPD, and president of the American Institute of Electrical Engineers presided. The speaker was to have been Dr. Sidney Smith, president of the University, but unfortunately under doctor's orders he was unable to attend. In his place the Council was fortunate to have Dr. C. T. Bissell, vice-president, University of Toronto.

The concluding event of this meeting was the announcement that Thorndyke Saville, dean of the college of engineering, New York University, had been appointed to the presidency to replace Dr. L. F. Grant, whose term of office covering three years expired at this meeting.

Friday Program

The morning was devoted to a panel discussion on ethics, in which the various members of the Ethics Committee participated. The hall was crowded to capacity. The Canadians participating were: G. Ross Lord, M.E.I.C., professor of mechanical engineering, University of Toronto; J. E. L. Roy, M.E.I.C., chief engineer, auxiliary services, Quebec Hydro-Electric Commission, Montreal; W. Stuart Wilson, M.E.I.C., assistant dean and secretary, faculty of engineering and applied science, University of Toronto.

At luncheon that day, with Dr. Grant again presiding, the speaker was Russell G. Warner, vice-president, United Illuminating Company, New Haven, Conn., who was also chairman of ECPD Recognition Committee and the chairman of the joint ECPD and Engineers Joint Council committee on the practice of engineering. The subject was "Professional Aspects of the Practice of Engineering".

During the afternoon there was an open forum for the discussion of the proposal made by Dean Hollister, that exhaustive study be made of engineering education and the present supply of engineers.

The closing session for th afternoon was devoted to studen development, with N. W. Dough erty, chairman of the Studen Development Committee, presidin

The Engineers' Council for Pro fessional Development has as it objective the enhancement of th professional status of the enginee through the co-operative efforts o the following national organiza tions, concerned with the profes sional, technical, educational, legis lative phases of engineers' lives

American Society of Civil Engi neers

American Institute of Mining an Metallurgical Engineers

The American Society of Mechani cal Engineers

American Institute of Electrica Engineers

The Engineering Institute of Can ada

American Society for Engineerin Education

American Institute of Chemica Engineers

National Council of State Board of Engineering Examiners

No mention has been made ye of a delightful program which wa arranged for the ladies. This in cluded a social hour on Thursday morning and a reception at th home of the lieutenant governo of Ontario, The Honourable L. C Breithaupt.

On Friday the ladies drove by bus to the Guild of All Arts jus outside of Toronto, where they hac their lunch.

The arrangements for the con ference as far as E.I.C. was con cerned were handled through th Toronto office, with Dr. Grant, th president of ECPD and field secre tary of the Institute in charge. It must be a matter of satisfactior to them to have had so many people turn out both from Canad and from the United States, and to see all events carried off so ex peditiously. It is likely that th 23rd annual meeting of the Engi neers' Council for Professiona Development will be remembered for a long time by everyone who took part in it.

E.I.C. Annual Meeting in 1956

May 24-26, The Sheraton — Mount Royal Hotel, Montreal

In Memory of a Pioneer Engineer

A further report on the memorial ceremonies held recently in Ottawa in honour of Lt.-Col. John By.

As recorded in the October issue of the *Journal,* The Engineering Institute of Canada, on October 5th, 1955, paid tribute to Lt.-Col. John By, builder of the Rideau canal and founder of Bytown, which is now the capital city, Ottawa.

In these pages are reproduced the words of the distinguished men who dedicated the two memorial plaques and the memorial fountain that, in their delightful setting, form a lasting tribute to a great pioneer engineer.

A further record will be found in the photographs taken at the memorial luncheon, which preceded the dedication ceremonies, and in a biographical summary. It has unfortunately proved impossible to publish in this issue the excellent luncheon address given by the mayor of Ottawa, Dr. Charlotte Whitton, C.B.E., but this will appear shortly.

At the luncheon, the president of the Engineering Institute, Dr. R. E. Heartz, read a cable he had received from Sir George Nelson, president of the Institution of Electrical Engineers, and president of the English Electric Company. The message read:

> Congratulations and good wishes from Institution of Electrical Engineers on the occasion of the dedication of the Colonel By memorial in Ottawa. Linking our cities by its origin the memorial can testify to our joint regard for Ottawa's engineer founder.
>
> George Nelson, President.

THE DEDICATION ADDRESSES

The first memorial plaque was unveiled by the Hon. R. H. Winters, Minister of Public Works, who said:

"It is always a great souree of pleasure to me to find myself in a gathering of fellow professional engineers, a company in which I naturally feel very much at home. And it gives me even greater pleasure to be with you today to take part in the unveiling of a memorial to Colonel John By, who by reason of his great engineering exploits played an important part in developing the history of Canada.

My colleague Mr. Marler, the Minister of Transport, asked me to express to you his regret that he is unable to be here this afternoon. As you know, the canals of Canada now come under the jurisdiction of the Department of Transport, but this was not always the case. The Department of Public Works, as established in the year of Confederation, had control over canals from 1867 until 1879. In that year a separate Department of Railways and Canals was set up which later developed into the Department of Transport. So it is not inappropriate that the Minister of Public Works should participate in this commemorative event honouring the builder of the Rideau canal.

The construction of the canal was a masterpiece of engineering. Between the Ottawa River and Kingston there are 47 locks and 24 dams, covering a lift of 277 feet between here and the Upper or Little Rideau Lake which marks the summit, and a drop of 161 feet between the summit and Kingston.

The troops of the Royal Engineers under Colonel By's direction built for future generations. I have been told that the four-foot by six-foot limestone blocks which make up the stonework are in as perfect condition today as they were 120 years ago. It is amazing to think that the builders had no machinery to assist them in laying these tremendous blocks; it was accomplished by human sweat and mule power. Every stone was cut and fitted in place by hand.

While it was originally constructed for military purposes, the Rideau canal served an important function in developing the area of Ontario between Ottawa and Kingston. It is interesting to think that it was, in effect, the first St. Lawrence Seaway, built to provide an alternative route from Montreal to Kingston. For almost 20 years, before the St. Lawrence canal system was completed in 1851, it was the main route for ships going to the Great Lakes.

While the Rideau canal system is no longer considered important as a commercial transportation route, it still makes a contribution to the nation through its attractiveness to tourists. Its quiet waterways are ideal for small-boat owners who want to enjoy a leisurely cruise and the beautiful scenery of the Ontario rural countryside.

Like many engineering projects, the canal cost a great deal more than its planners had hoped. The original estimate was £169,000 sterling. Colonel By's own estimate after a year's work was £463,899, and the final cost turned out to be approximately £800,000. For this reason Colonel By was exposed to much unfair criticism when he returned to England, in spite of the local success of the canal. He retired from the Army and died in comparative obscurity.

It appears to be the lot of nation-builders that full understanding and appreciation of the part they play is not always experienced during their lifetime. However, it is to the credit of the generations that followed that they have evaluated the contributions and erected monuments and memorials marking our outstanding historical figures and events.

I am glad that the achievements of Colonel John By have been so clearly recognized here in the city which he helped to found, and which originally bore his name. The last few years have seen the

opening of the Colonel By memorial museum, the Bytown bridges and the Colonel By Drive. It is most appropriate that the Engineering Institute of Canada has now brought about the erection of this beautiful fountain in memory of an engineering pioneer—on this spot which used to be a beaver meadow which Colonel By converted into the turning basin for the original canal freight terminal.

I now have great pleasure in unveiling this memorial plaque, in tribute to Lieutenant Colonel John By of the Royal Engineers, and with thoughts for all those associated with him in the building of the historic Rideau Canal.

The text of the plaque reads: "This fountain honours the memory of Lt.-Colonel John By, Royal Engineers, builder of the Rideau canal 1826-1832, founder of Bytown, renamed Ottawa in 1855.

Sponsored by the Engineering Institute of Canada with the assistance of the Federal District Commission, the Historic Sites and Monuments Board, the National Gallery, and the City of Ottawa."

Second Memorial Plaque

The second memorial plaque was unveiled by Brig. J. L. Melville, C.B.E., M.C., E.D., Honorary Colonel Commandant of the Royal Canadian Engineers, who paid particular tribute to By as a soldier.

"This fountain commemorates Lieutenant-Colonel John By of the Royal Engineers, builder of the Rideau canal. Between 1826 and 1832 this canal was built in the untouched forests of early Canada under Colonel By's direction, and to his design. When he arrived here, there was nothing but the forest. When he left five and one-half years later, the canal was in operation all the way to Kingston. In that short span, he had completed a waterway almost 130 miles long, with its 47 locks and more than 50 dams.

Above his great skill as an engineer, however, he was all his lifetime a soldier, a sapper, who epitomized the highest traditions of the Corps of Royal Engineers in his devotion to duty, the vigour, enthusiasm and vitality with which he carried his task to completion, and his concern for his junior officers and men.

It is fitting that in this city, which he founded and planned, he should be honoured jointly by the city, by the Federal Government, and by the civilian and military engineers of Canada and Great Britain.

The Corps of Royal Canadian Engineers, which perpetuates the high traditions of the Corps, rejoices in this tribute to the memory of a great sapper, and as Honorary Colonel Commandant of the Corps, I bring this message from General Sir Edwin L. Morris, K.C.B., O.B.E., M.C., of London, England, who is the Colonel Commandant, Royal Engineers.

My dear Melville,

On the occasion of the dedication of the fountain erected to commemorate Colonel By, who was so closely connected with the founding of the City of Ottawa, I send you the best wishes of the Corps of Royal Engineers. We are indeed proud that Canada has seen fit to perpetuate in this fashion the memory of an officer of the Royal Engineers.

We have many links with Canada which are rooted in the past, and for the future we look forward to the continuance of our happy association with the Royal Canadian Engineers.

Yours sincerely,
E. L. Morris.

I now unveil this Plaque which honours and perpetuates the memory of Lieutenant-Colonel John By, Royal Engineers."

The plaque refers to the central feature of the memorial and reads: "This fountain played in Trafalgar Square, London, from 1845 to 1948. It was designed by Sir Charles Barry, R.A., architect of the British Houses of Parliament. Given to the National Gallery of Canada by the National Art Collections Fund of England. Dedicated on this site October 5, 1955."

The Memorial Fountain

The ceremonies culminated with the dedication of the fountain by Dr. R. E. Heartz, president of the Engineering Institute of Canada.

"Today will long be remembered in the annals of the engineering profession in Canada. I hope that it will have significance to Canadians in other callings as well. The man whom we now honour was not only an engineer—he was a great citizen as well. He was not only a builder of engineering structures, but also was a builder of law and order, at a time and in a place where strong men were needed.

All Canadians can be proud of John By, but in particular the engineers can be proud of him. The written record shows he did his great works quickly, efficiently and economically. The works themselves still show that he designed and built them well. Here we have an engineer who a hundred and twenty-five years ago set high standards in all that he did. His leadership in these things must have aided the profession materially in establishing and maintaining the high standards of today.

Too frequently we forget the achievements of those who have gone before us. This is particularly true of engineers. Therefore, we now rejoice that in this one instance at least, we have remembered. Perhaps the success of this endeavour will inspire us to go on to even greater things.

Recognition

It is a matter of satisfaction to the committee and to the officers of the Institute that the work of this man has been recognized by organizations that are not of the engineering world. Without the combined assistance of the National Gallery, the Federal District Commission, the Historic Sites and Monuments Board and the City of Ottawa, this memorial would not have been possible. I am happy to acknowledge before this assembly our indebtedness to them. We are proud to be so closely associated with them in so fine an enterprise.

You all know the honourable history of this fountain. For a hundred years it stood at the center of the Empire and Commonwealth, admired and beloved by millions of people from many lands. Let us hope that here in Canada, in these lovely surroundings, it may continue to give pleasure to countless thousands. Is it too much to hope that in some way it may bring to us a message of goodwill from the great mother country, and that it will help to hold these two great nations together in mutual respect and admiration and affection? The special background of this fountain makes it more than ever suitable as a memorial to Colonel By, and endears it to us more than if it had just come from the sculptor's studio.

Ladies and gentlemen, on behalf of The Engineering Institute of Canada and of engineers everywhere, with this great audience as my witness, I now dedicate this memorial to the memory of Colonel John By."

The Col. By Memorial Luncheon

There were many distinguished guests present at the luncheon held in the Chateau Laurier, Ottawa, before the dedication ceremonies. Here are those at the head table.

Mrs. W. A. Capelle; J. R. Baldwin, Deputy Minister of Transport; Mrs. J. L. Melville; Maj.-Gen. Howard Kennedy, M.E.I.C.

Mrs. R. G. Robertson; His Excellency Lieut.-Gen. Sir Archibald Nye, United Kingdom High Commissioner to Canada; Mrs. R. E. Heartz; Dr. J. B. Stirling, M.E.I.C.; Her Worship Dr. Charlotte Whitton, C.B.E., Mayor of Ottawa.

Dr. R. E. Heartz, president, The Engineering Institute of Canada; R. F. Legget, M.E.I.C., chairman, Ottawa Branch, and acting chairman of the Memorial Committee; Lady Nye.

R. G. Robertson, Deputy Minister of Northern Affairs and National Resources; Mrs. Kennedy; Brig. J. L. Melville, Hon. Colonel Commandant, R.C.E.; Mrs. J. B. Stirling; Col. W. A. Capelle.

Lieutenant-Colonel John By . . .
Some Biographical Notes

Once before (August, 1931) the *Journal* published a short biography of Col. By, giving the principal facts of his career, which we shall therefore merely summarize here. However, considerable additional material has become available since then which puts some life into the otherwise dry recital of appointments and dates and makes him a real human being, rather than an indistinct shadow of a man of the past.

Col. By was born in London in 1779, probably in August, of a family long in the customs service. His paternal grandfather was "chief searcher" and his father, George By, his three paternal uncles and his elder brother were also customs men. Of his mother we know little, save that her maiden name was Mary Bryan. After passing through the Royal Military College at Woolwich, he received a second lieutenant's commission in the Royal Artillery in August, 1799, transferring to the Royal Engineers in December of the same year.

His association with Canada began in August, 1802; he was then a first lieutenant. Stationed at Quebec for nine years, he supervised extensions of its fortifications, the construction of the four martello towers outside the city walls and also the building of the Cascades Canal on the St. Lawrence River above Montreal. In his spare time he got up the celebrated model of the city of Quebec which was sent to England for inspection by the Duke of Wellington and is now in the Dominion Archives.

From 1811 to 1821 he served in the Peninsular War and in three of the Royal Gunpowder Mills and was then put on the "unemployed list" because of a reduction in army staff following the defeat of Napoleon. During this period he designed a thousand-foot span "on the truss principle" and built a model of it still in the possession of the Royal Engineers at Chatham.

The War Office having decided that some water route, away from the threat of attack from the United States and connecting the St. Lawrence river with Lake Ontario, was a military necessity, sent Capt. Jebb, R.E., to Canada to make a survey for a canal from the Ottawa River to the lake by way of the Rideau and Cataraqui rivers. Samuel Clowes, an engineer in the employ of the Upper Canada government, made a report on this project sometime after 1815, setting the cost at £145,802 or about $725,000. Events proved this to be a gross underestimate, but it is only fair to say that Clowes figured on a canal for military use only, with wooden locks 20 x 180 feet, whereas the locks as built were of stone and about 30 x 134 (sic) feet, to provide for commercial traffic.

A letter from the Colonial Office to Earl Bathurst, dated April 3, 1826, mentions that "Col. By is to go to Canada to build the canal", which by now had been named the "Rideau". But it was September, 1826, before Col. By arrived in Hull. There were then only a few settlers on the south bank of the Ottawa opposite Hull; the first was Nicholas Sparks, who had cleared a farm there in 1820.

The Earl of Dalhousie bought a block of land here in 1823, extending from the Chaudiere Falls to the Rideau River, and instructed Col. By to subdivide it into lots, which he did, persuading the Earl to reserve the present site of the Parliament Buildings for "public buildings".

Also concurrent with his work on the canal, was Col. By's construction of a bridge across the Ottawa River at the Chaudiere Falls.

Col. By moved from Hull to a tent on Nepean Point in June, 1827, his sappers and miners having arrived in May. These he housed in barracks on Parliament Hill. He himself built a house of "boulders and wood" in what is now Major Hill Park—"Colonel's Hill" in his day — probably just north of the present Chateau Laurier. Nearby were a stable, bakehouse and workshop, the last still standing. This was the beginning of "Bytown" and Bytown it remained until chartered as the city of Ottawa in 1854.

It is not necessary to say much here concerning the construction of the canal; that has been well described elsewhere. It was opened to navigation by the passage of the *S.S. Pumper* from Bytown to Kingston on May 29, 1832.

The Rideau Canal is now of little commercial importance, but it served its purpose in its time though it is doubtful if the traffic through it ever reached what Col By anticipated. It was soon put out of business by the railway and, of course, it never served any military purpose. However, it remains as a permanent monument to Col. By's engineering genius.

> "Nobody disputed the excellence of the work or questioned its necessity, but it was complained that the outlay had been excessive, and that he (Col. By) had proceeded in the latter stages of the undertaking without the necessary parliamentary grants."

These complaints led to Col By's return to England for questioning in August, 1832. In his own words:

> "The present Government throw blame on me for not waiting for parliamentary grants, forgetting that it was ordered by His Grace the Master-General and the Board (of Ordinance?) that I was not to wait for parliamentary grants, but to proceed with all despatch consistent with economy, and the contracts were formed by the Commissary-General at Montreal. Accordingly, by which the engineering department was bound to pay for the works as they progressed which precluded the possibility of stopping the works or laying the Government open to pay heavy damages for so doing. I was never ordered to stop the works until I was so unjustly recalled, when thank God! they were all finished, and the canal had been open to the public for some months, or I should have been robbed of building the magnificent erection."

Col. By's language is somewhat involved, but it is easy to understand that he was highly annoyed

(*Continued on page 1640*)

St. Lawrence Seaway and Power Project

In this section the *Journal* reviews the news and progress of the St. Lawrence project.

The period from early September o late October, usually bringing ine settled weather, is traditionally ne of intense construction activity – one for making a good showing efore winter sets in. It is also a avourite time for guided inspec- ion tours. Most of the big con- racts have been let. There is some- hing to show for the summer's ork. Yet most of the structures re still just holes in the ground. On the main structures being uilt by NYSPA and Ontario Hydro, efforts have centred on oundation excavation within the offerdams, on bringing in materials nd in the readying of construction lants for placing concrete. The otal force employed on the power rojects on both sides of the river anged around 4,800. During the eriod some delays were occasioned y truckers strikes on some of the eaway channel contracts.

Progress By Ontario Hydro

Good weather in September en- bled favourable progress on the ower-house excavation work, dike nstruction, railway and highway location, and on the St. Lawrence ansformer station construction. redging operations also continued the Chimney Island area, while bstantial progress was made on e Galop Island sector dredging. The power - house contractor ade favourable progress excavat- g on the site in the dewatered ver bed. Work also was well ad- anced on the protective dike up- ream from the power-house. The cess road on the canal embank- ent from Lock 19 Bailey bridge ea to the power-house site was rtually completed.

Work on the Cornwall dike was ncentrated on Section 3, where earing and stripping have been sentially completed. About 53,000 . yds. of fill were placed and the ft. horizontal filter layer is in lace in that section of the dike.

At the St. Lawrence transformer ation site, fencing of the 4,500- ot perimeter of the station ounds has been completed. Foot- gs have been installed for all ildings and other structures. The relay building construction is well advanced. All work on the Cedar Rapids transmission line and the Massena line has been completed.

The 9-mile Road improvement has been about 75 per cent completed. Track laying has been completed on the railroad siding from the main line of C.N.R. to the warehouse area near the power-house site. The relocation work on No. 2 highway from Cornwall to Moulinette is 85 per cent completed.

Considerable progress was made on railway relocation. Much headway occurred in the sector from Cornwall to Dickinson's Landing. The Dickinson's Landing to Morrisburg section was about 60 per cent completed, while the section from Morrisburg to Cardinal was continued on a large scale.

The $28 million channel improvement work made favourable headway during the month. Dredging continued on the Chimney Island area and considerable progress was made. A total of 103,000 cu. yds. have been excavated to date. The Galop Island channel improvement work also was marked by substantial progress. Clearing of the island is 75 per cent completed and 325,000 cu. yds. of material have been excavated.

Moving of houses in Ontario Hydro's large-scale rehabilitation program in the valley was well advanced during the month, when twenty homes were transported from the old town site and placed on prepared foundations in the new Iroquois. Two huge house-moving machines, one with a lifting capacity of 200 tons, and the other of 100 tons, were assembled previously.

Ontario Hydro and the provincial authorities concerned have decided to start at once on developing their chain of parks and recreation areas adjacent to the new lake, instead of waiting till the navigation and power projects are completed. This decision was spurred by a strong brief from the United Counties of Stormont, Dundas and Glengarry, who saw the profitable seaway tourist traffic being lost to promoters across the river.

Contracts have been awarded by Hydro for a 14.4-kv. isolated phase bus for the Canadian powerhouse to Eastern Power Devices Ltd., at $496,494, and for construction of a new eastern regional office building at Ottawa to Thomas Fuller Construction Co. Limited of Ottawa, at $499,652, the lowest of 11 tenders.

Progress By NYSPA

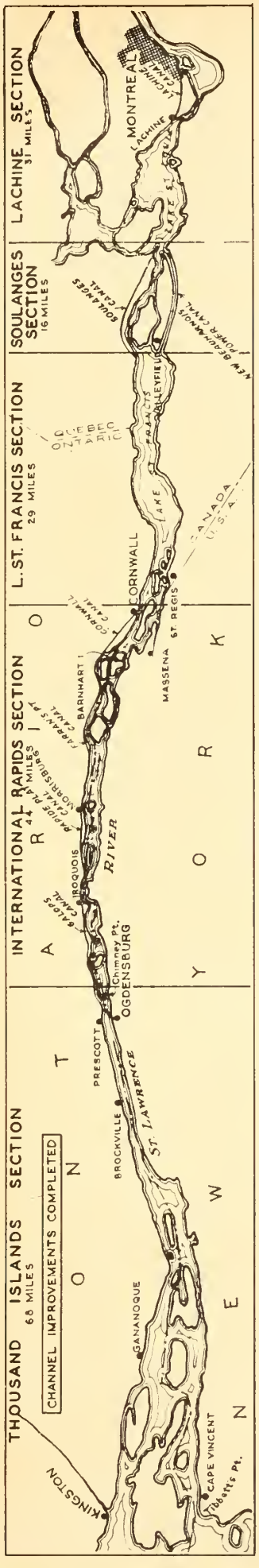
During September the Robinson tunnel road was completed and opened to traffic. Erection of the construction plant, and excavation for Cut "F" were continued at Long Sault dam, as rock excavation for the dam progressed below the original river bed. The first locomotive was run to the Long Sault construction plant area. At Iroquois dam, erection of construction plant and excavation for the dam foundation continued as construction power lines were brought in. Hauling of concrete aggregate was started.

The project aggregate plant, practically complete, is now producing coarse aggregate in all sizes and sand. The access railroad and highway to Barnhart Island bridge is nearing completion. Crossing signals are being installed at all grade crossings. Construction of substructure for the permanent bridge continues and erection of superstructure continues from both shores.

Grass River bridge piers progressed, with road approaches nearing completion. Construction was started on the Massena intake by excavation and erection of the construction plant. Excavation of the Galop Island south channel and Red Mills Point is progressing. The contractor moved into the Chimney Island channel enlargement area and started preliminary work.

At Barnhart power plant, erection of contractor's construction plant continued, as clearing and grading for the access railroad and highway are well under way. Excavation of the cut off trench and placement of earth and rockfill in the south forebay dike continued. Excavation for the power plant, and drilling and grouting in the foundation area are well advanced.

The work on engineering drawings and specifications continued on schedule. Specifications for the gantry cranes and travelling crane for Barnhart Island power plant and the fixed hoists for Long Sault dam were issued during the month.



Tour of Seaway Works

One of a series of tours arranged by the St. Lawrence Seaway Authority to visit construction works now in progress took place on October 5. A group of about 150, including members of the government, of the diplomatic corps, and leaders in the fields of transportation and business, took part in the all-day tour between Iroquois, Ont., and the Montreal harbour.

First stop of the party was at Iroquois Point, where the most westerly of the seven new locks which are to be built is situated. Excavation for the canal and lock is taking place day and night, six days a week, and must be completed by November 30, 1957.

Access over Galop canal was over a swing bridge which had been transferred from its former site across the Lachine Canal at Atwater Avenue, Montreal, to provide a means of crossing the canal by heavy construction equipment. From Iroquois Point the party could see construction on the opposite shore for the upper control dam of the power-pool, which will be by-passed by vessels using this lock. The damwork in progress there was in United States territory.

At Maple Grove, three miles outside Cornwall, a look-out structure had been built and the party made a stop there to view the site of the major power-house and dam. In the distance were seen the two United States locks and joining canal which are being built.

Speaking at the luncheon in Cornwall, seaway president Lionel Chevrier, who was host of the tour, said that work on the seaway was progressing close to schedule and that approximately 5,000 people were now employed on the seaway, with 10,000 expected by 1956, and 15,000 in 1957. He also said that about one-quarter of the seaway contracts had now been issued.

In the afternoon the party continued along the seaway route, passing by the Lake St. Francis and Soulanges sections, and viewing the power-house at the downstream end of the Beauharnois canal, where descending navigation will enter Lake St. Louis by means of twin-flight locks. Two vertical lift bridges will also be built to cross the canal; work in this area is expected to cost $50,000,000.

A stop was then made at the site of the Cote St. Catherine lock. Considerable progress was noted on the excavation within the cofferdam here, where work continues almost twenty-four hours a day to remove 340,000 cubic yards of common material, 490,000 cubic yards of shale, and 800,000 cubic yards of limestone. The party also inspected the two large pumps which will drain this cofferdam in approximately 50 hours at the rate of 20,000 gallons per minute.

Between Victoria Bridge and Jacques Cartier Bridge the group saw great progress on the scheduled work. This includes excavation of 7,600 feet of channel and construction of a dyke requiring the removal of some 3,000,000 cubic yards of rock, hundreds of thousands of cubic yards of other materials, and the laying of hundreds of thousands of cubic yards of roadway base and filler. This contract is due to be completed by June 30, 1957.

Progress By SLSDC

The St. Lawrence Seaway Development Corporation reported that by mid-October excavation of the Long Sault canal and lock sites, on the American side of the international section, had reached 21 per cent of completion after the first six months operations, with 4½ million yards of material moved out of a total of 22,800,000 cubic yards. Besides the excavation the four contractors concerned had placed 1.4 million yards of material in embankments. Excavation for the Robinson Bay and Grass River locks was 50 per cent complete.

Construction of the easterly two-mile section of the east-west highway leading to the proposed new bridge across the river at Polley's Gut was 41 per cent complete, and is scheduled for completion early in December. As a result of model tests at Hydro's Toronto model testing station, the problems of adverse cross currents at Big Snye near the upper end of Long Sault canal, have been solved.

Members of the International Joint Commission, accompanied by representatives of Canada's Department of External Affairs, the U.S. Department of Northern Affairs and National Resources, the St. Lawrence River Board of Control and the St. Lawrence Joint Board of Engineers, made a tour of inspection of the seaway project on October 11 and 12. General MacNaughton, chairman of the Canadian Section, IJC, expressed himself as "being deeply impressed with the evident progress on the project".

Diversion Of Cornwall Canal

Seaway Authority and Hydro engineers have worked out an ingenious scheme to give Canada a comparatively cheap and simple private passage through the Great Lakes, if the partnership with the United States on the current international scheme doesn't work out satisfactorily. It is, moreover, an insurance against the day when seaway traffic justifies two seaway channels. U.S. authorities have been kept fully informed of the plan, and assured that any fears of an immediate decision to create an all - Canadian seaway are groundless. It is merely a long term precaution that could save months of work and millions of dollars.

The hinge of the plan is a huge concrete structure nearly 300 feet long, with a 50-ft. gap, to be built into the main dike west of Cornwall. It was approved months ago at all levels. Wings extend up and downstream across the dike. The canal diversion joins on to the east or downstream wings. When the Cornwall canal is closed to permit building the dike, shipping will travel up the diversion and through the gap once the seaway channel is ready. Stoplog gates will close the gap in the dike and hold the waters when the level builds up behind the power-house. Thus there is no large dike to be pierced later at great expense. Contract for this work was awarded October 7 to G. A. Pitts, General Contractor Ltd., the lowest of four tenders, for $3,043,690. Completion is scheduled for November 1, 1957.

Advice on Port Development

Speakers at the joint convention of the American Society of Planning Officials and the Community Planning Association of Canada, meeting at Montreal in September, heard H. C. Brockel, municipal port director of Milwaukee, discuss planning in relation to the seaway. "Before Great Lakes ports can assume the stature of salt water terminals," he warned, "they must offer the services and facilities that ocean operators have been accustomed to for centuries."

"These ports will need deep draft channels and anchorages, modern port facilities, adequate terminal handling equipment, warehousing and storage, rail and truck access to their waterfronts and good lines of communication to the interior," he continued. "An adequate supply of longshore labour must be on hand when the first ship arrives. The peak seasonal supply of waterfront labour must be absorbed in the community during winter months, or will require community support through social services."

In planning their future ports, the speaker urged lake officials to make some public agency responsible for port affairs, be it port authority or its equivalent. He advocated protection of waterfront areas by intelligent zoning, and a reasonable, realistic and economic balance between parkway, port and recreational needs.

It was no coincidence, he pointed out, that only three representative public port developments had made progress in the entire Great Lakes basin. These were Toronto, Hamilton and Milwaukee, cities which long ago created port bodies to develop and plan their ports aggressively.

Dr. Harold B. Mayer, who was engaged by the Province of Manitoba to study the economic impact of the seaway on that province, says the general cargo terminals at Lakehead ports will be inadequate to handle the increased traffic resulting from the seaway. Built many years ago, they are not designed for handling cargo from modern ocean vessels that load and discharge through vertical hatches, requiring larger shoreward areas and modern sheds, heavy floor load capacities, wide wharf aprons and access by both rail cars and trucks. Better co-ordination is also needed, he points out, between Fort William and Port Arthur, and better planning for future development. The highway system from Lakehead to Winnipeg needs improvement for heavy truck traffic.

The group of McGill University economists and Montreal businessmen, sponsored by the American Committee for Economic Development to study the potential impact of the seaway, met for the first time in Montreal, September 26.

Mayor Jacques Simard of Préville told the meeting that, while he foresaw great expansion for Montreal's south shore communities . . . "We can plan only in our own small field, but can do nothing on a regional basis. Regional planning will be necessary," he pointed out, "if we are to take the greatest advantage of the seaway . . . we must have good planning. Today planning too often only corrects mistakes made in the past".

Tolls to Pay Navigation Aids

Seaway tolls will be higher than expected, to cover the cost of navigation aids. This is the ruling of the U.S. Budget Bureau, which holds responsibility for building and maintaining navigation equipment for the SLSDC and on other waterways around the United States shoreline. The U.S. Coastguard does the job and gets the money from Congress to pay the costs.

The Seaway Development Corporation will set its tolls high enough to include these costs. Aids will include lights, buoys and shore markers along the international section of the river some hundred miles from Lake Ontario to below Massena, N.Y. The coastguard may end up doing the job, but as a private agent or sub-contractor for the Corporation, rather than as a public service agency.

The toll group set up by Canada's Seaway Authority and the SLSDC last spring, to make studies and recommendations on toll rates for seaway traffic, will inspect facilities on the Panama canal system early in 1956.

Royal Commission on Coastal Trade

The Coastal Trade Commission held hearings in Montreal on October 4 to 14, after a cross country tour to British Columbia, the Prairies and the Maritimes. Submissions either (1) criticise Canada's Cabotage Treaty with Britain, which permits British flag vessels to carry cargo between Canadian ports, requesting its repeal, or (2) argue strongly against any change in existing legislation.

Among those of the former group requesting protection for Canadian built and operated vessels are: Canada Steamship Lines, Canadian National Railways; Quebec Chamber of Commerce; Quebec Board of Trade; City of Montreal; Dominion Marine Association, Canadian Industrial Preparedness Association; Project Sales Ltd.; Canadian Fairbanks-Morse, Ltd.; Canadian Marconi; Crane Ltd.; Darling Brothers Ltd.; Canadian Vickers Ltd.; and Marine Industries, Ltd.

Supporting the view that no change in shipping regulations should be made were the Shipbuilders Conference of the United Kingdom, who pointed out Canada would face a comparable restriction in her U.K. export trade if British ships were pushed out of Canadian coastal trade. Also favouring no change in regulations were the Consolidated Paper Corporation; Saguenay Terminals,

Ltd., whose ships are transferred to British registry; The Shipping Federation of Canada; Guy Tombs.

The Canadian Pulp and Paper Association asked postponement of any drastic action until it is shown that Canadian shipping is unable to meet the competition. Briefs from Canada's two major railway systems stated they will face unfair competition from ships using the seaway. Both urged that if British ships operate in coastal waters their owners should be forced to pay their crews Canadian wages. They asked that ships not covered by the Transport Act be placed under its provisions. The C.N.R. called attention to the Australian Navigation Act, which obliges foreign vessels in coastal trade to pay Australian wage scales and to have the same complement of officers and the same accommodation as vessels under Australian registry.

Finishing their Montreal sessions with a weekend tour of the seaway, the Commission will reopen hearings October 24 in Toronto, Hamilton, Collingwood and Meaford before returning to western Canada.

Other Seaway News of Interest

Governor Averill Harriman of New York State warned a chamber of commerce meeting at Potsdam, New York, on September 28 that . . . "The boom development of the seaway and power projects represents a great new resource, but that in itself will not transform the new seacoast of New York State into an industrial and commercial complex. Much can be accomplished, but it will take initiative and hard work, and the use of natural resources including minerals, which have not been fully utilized."

Smoke control and air pollution may increase when the seaway goes into operation, according to Dr. Morris Katz, chairman, Canadian Section, IJC Technical Advisory Board on Air Pollution. Ships from overseas now using the Great Lakes have intensified the problem and the situation will grow more complex in the future. "It may be necessary to work out a system of fines against owners of ships which do not conform to our Smoke Commission standards", he said. "Many ships are modern and efficient and will give no trouble, but others will create a serious problem."

The U.S. Maritime Administration is expected soon to declare a Great-Lakes - to - Europe shipping route "essential", and thus make American ships on the route eligible for government subsidies, aimed at getting U.S. ships operating on foreign routes out of the Great Lakes in the next shipping season.. The offer would cover the interim period till completion of the seaway, and would involve only 'canalers' that can pass Canada's 14-foot canal system.

Dr. Harold B. Mayer of the University of Chicago, addressing delegates to the provincial government's Trade and Industry Council at Quebec City in September, predicted forty or more additional cargo lines would go into service in the Great Lakes overseas trade as soon as the seaway was opened. "Several American companies as well have announced plans for new cargo liners. It is inconceivable," he said, "that the U.S., having participated heavily in construction of the seaway, would not declare it essential to the national interest".

Correspondence

Role of the University

Dear Mr. Editor:

I feel forced to crave your indulgence to record very firm opinions, opposing the lukewarm regard for research expressed by the writer on Evaluation of Engineering Education in the September, 1955, *Journal* (Page 1227).

The author regards research, i.e., original thinking, as a secondary or, at best, an equal attribute to teaching ability in a university.

Nothing could be farther from the truth. The aim and function of a university are being confused with those of a school. The university lecturer is required, ideally, to have something worth saying. He is not a teacher reproducing standard material. While the lecture system originated when there were no books available to the student, retention of the formal lecture is the only way by which the student has access to the thoughts and opinions of an agile, active mind.

How much better for the student to hear stimulating ideas and criticism, however badly delivered, than to sit through a word perfect exposition of material he can read in any one of a dozen texts, and indeed, hear again word for word the following year if he desires?

The thoughts and opinions are the vital features, not the delivery.

May I quote from "Bruce Truscott"? "He who learns from one occupied in learning, drinks from a running stream. He who learns from one who has learned all he is to teach, drinks the green mantle of the stagnant pool".

I need state my opinions no further but would emphasize that much present, and justified, criticism of the university stems from past disregard of the above and from mistaken ideas of the nature of a university.

H. M. Nelson,
Chartered Civil Engineer,
Royal Military College, Kingston

Papers for the Annual Meeting Montreal, May 1956

It is Council's wish to make it known to the membership that papers are being sought for the annual meeting in Montreal next May. The Papers Committee is ready to receive submissions, which should be addressed to Headquarters.

W. H. Gauvin, Montreal, is chairman of the committee, and the members are H. S. Van Patter, Roger Brais, E. R. Smallhorn, of Montreal, R. M. Hardy, Edmonton, W. H. Paterson, Toronto, A. R. Harrington, Halifax, W. D. Pennock, Ottawa.

Survey of Education and Utilization of Engineers

by

S. C. Hollister,

Dean, College of Engineering, Cornell University

From the program of the annual meeting of the Engineers' Council for Professional Development, Toronto, October 13, 14, 1955

There is no doubt that during the past quarter century the tempo of the whole world has increased to an astonishing degree. Through developments in engineering our communications and transportation systems have shrunk the world so that it is now practically only a fraction of the size it used to be. Because of this tremendous change in communications and transportation the world political arena has been completely altered. Mass attitudes are being built up or broken down.

The engineer is at the core of this development. He has created so many of the technical means which have brought about this change and in many instances has participated in the direction of its development. To an increasing degree he is becoming a practicing sociologist, and active economist, a political planner, all in addition to his functioning as one who interprets scientific principles into useful works.

While human and international relationships have been shifting at a remarkable rate—a shift in which the engineer's work has been an active ingredient—the very basis of his technical accomplishments, namely the fund of scientific knowledge, also has been enormously expanded in this period of time. One can only partially dream of the tremendous ramifications of this new knowledge and the extent to which it may be applied to human service.

The public has become aware of the many accomplishments of the engineering profession having a bearing on our daily life—accomplishments that bring men closer together, that unify their problems and common concerns, that lighten their burdens and extend their capacities, and that enhance the common welfare.

Engineers have accomplished so much that now it is taken for granted that what they produce will function without difficulty. It is further taken for granted that they will safeguard the life and property of the public. Nobody stops at the end of a bridge to make computations to see whether or not he should cross the bridge. There is still another public assumption that puts a tremendous responsibility upon the engineer. He has worked so many miracles in the eyes of the public that it is now assumed that he will bail mankind out of any crisis that may arise. Take for example our present headlong dash toward consuming our natural resources. If the question is raised that perhaps we should be more cautious we are told at once that when the pinch comes they will find something else that probably will be better. "They" in this case meaning the engineer.

Engineer in the Community

It is easy to see therefore that the engineer has assumed in the mind of the community a professional status. As a group, engineers have become a definite entity both as to function and accomplishment in the public mind. This is his status regardless of the arrangements of his employment.

The services engineers are being called upon to render are increasing not uniformly with time but actually exponentially. We know that there are many things on the shelf waiting to be worked upon. We know that new knowledge, useful for the engineer, has been increasing at a tremendous rate. We know also that even with the normal development of former lines of engineering, new avenues of approach are opening in many directions. Thus, not only as time goes on, but also with the increase in population, the services engineers need to render are increasing at a faster and faster rate.

There is much evidence to show that only a certain proportion of our population has the necessary qualifications to undertake the engineering profession. Many of those qualifications are similar to those required for success in other lines. Out of a given age group, that is for example, out of the number of boys reaching age eighteen in a given year, only about seventeen per cent have the necessary intellectual capacity to undertake work in our profession. This same seventeen per cent, however, must also supply the talent for other professions, as law, medicine, science. They must also supply the top-level people in the crafts, including the better chefs, cabinet makers, glass blowers, tool makers, and the like. The interplay of interests, the degree of enterprise or of fortitude will have a bearing upon which field the boy enters. Several years ago I pointed out that only about 47,000, amounting to one-fourth of the seventeen per cent I spoke of, could be expected to enter the engineering profession at the freshman level. We have, through the beating of drums and the shaking of bushes gone higher than this number. A study of performance in college, however, points out that it is quite apparent that after we passed approximately 47,000 the mortality rate took a sharp increase. In other words, it would seem we are dipping a little further into the supply and reaching a little below the likely level of capacities.

In speaking of this matter of intelligence, the capacity for receiving a certain kind of education, etc., it must be borne in mind that we are doing so in the light of our educational methods, our guidance systems, and the manner in which we communicate to the oncoming youth the possibilities and attractiveness of the various professions and other occupations which he might conceivably be capable of entering. We need to make improvement in all of these methods of communicating with the youth and we need improvement all along the line in educational operation. These, however, are not going to be changed suddenly. It will be a long process of evolution if we are to make any changes at all but we must continually try.

Demand Exceeds Supply

Returning now to the meaning of our experience of the success and failure of boys attracted to the engineering profession, it is apparent that we have reached a fixed percentage of the population that will enter engineering. When we look again at the services that engineers are being called upon to perform and the fact that these service needs are increasing at an accelerating rate, we see that the demand for services is outrunning the rate of supply of people to perform them. This does not necessarily mean that we have to go without such services, at least not for the present. It does mean, however, that the pattern of utilization of engineers must be modified considerably. We know that in many fields the beginning engineer soon progresses to paper work and from there to administrative duties and frequently to less and less engineering contribution. The pattern of advancement is often in lines other than engineering. It is necessary to modify this state of affairs so that the path and the rewards lie closer to engineering practice. In this respect we can take a leaf out of the book of the medical profession where the number of doctors is about half the number of engineers in the population. Any doctor performs as the nucleus of competent but less trained people and in such a way the ability of the doctor is proliferated over a wider contact area. To some degree the legal profession is organized along similar lines. The engineering profession, if it is to render the services that we know are ahead of it, must be considerably overhauled both in the manner of utilization and in the pattern of preparation for such a career.

There are already signs of threats to the profession that should motivate us to give heed soon to a re-evaluation of our professional activities. On the one hand, scientists are entering the field, in many cases with telling effect. They have better fundamental training and for the most part they are able to stay in the professional field without shift to administrative function. At the other end of professional activity we are feeling the effects of unionization in areas where large numbers of young engineers may be used in more or less standardized and routine functions. We have become, in part of the profession at least, slaves to job classification rather than men working toward the utilization of individual talents in their highest form.

I have made here a number of statements as to my impressions of the situation in the profession. Most of them are qualitative. Many of them are in some degree controversial. What is lacking in this critical situation is an accurate, carefully made appraisal of both utilization and supply.

Suppose, for example, we have a scientific sampling of each school of engineering and we follow the progress of each graduate in the sample. If we did this for different classes of graduates we would amass a body of material that would give us a consolidated picture of the training, development, growth, utilization, and accomplishment of the individuals of the profession. We would then be able to note with some assurance the factors to which we could most profitably give attention.

New Demands on Engineers

This is not all the looking that we need to do. We need to make some estimate of the oncoming problems the engineers are most assuredly going to be called upon to solve. We need a careful estimate of the new frontiers and some notion of the time when we are going to be called to enter upon them. Some of these frontiers are in urgent need of development and will render great benefits and profit to the community. The need for developing any of them stems from the fact that some of our material resources are becoming exhausted, and many other important ones threaten short supply. We need a study pointed toward improvement of the supply of our necessary manpower. We need studies of possible patterns of utilization; in short we need some objectives defined in terms of the responsibility the community has placed upon us.

It is clear, or so it seems to me, that the profession is badly in need of a comprehensive survey having as its objective the evaluation and appraisal of its present and likely future adequacy and an appraisal of the areas in which action must be taken to effect indicated improvements.

Survey of Future Adequacy

This Council asked in 1952 for an appraisal of the preparation of engineers and referred the matter to the American Society for Engineering Education. That Society has completed such a study and during the current year has published its report. It is a useful and important study and if implemented will, I am sure, contribute to the progress of the profession. But at the same time one is impressed with the fact that it deals with but one facet of a very much larger problem, a problem that the educators may see but can do nothing about.

A notable study was made of the medical profession about forty years ago which culminated in the famous Flexner Report. This report has had a profound effect upon the development of the medical profession and has strengthened the effectiveness of that profession in its services to the community. In consequence it has contributed greatly to the stature of the medical profession in the eyes of the community.

More recently, a similar study has been undertaken in the legal profession. It is too early to mark the results but undoubtedly similar benefits will derive from it.

It would seem clear that everybody stands to gain by a well-executed study of this sort. First of all the community would be served by any improvement that could be brought about in the functioning of our important profession. Those immediately concerned with function, namely, the employers of engineers and the engineers themselves, would profit both individually and collectively by such a well-designed and well-executed survey. And finally, such a survey should lay the groundwork for improvement and better definition of the engineering profession as a whole.

Who should sponsor such an undertaking as this? It has been suggested that each of the professional branches should undertake a study on its own. One only needs to recall the interweaving of the services of the separate branches, the extent to which they have a relatively common background, the fact that in many cases their talents and efforts impinge upon the same general problem, and the fact that many, trained in one branch, actually serve through their professional lives in another branch, to realize that there would be duplication, waste of effort, waste of money, and in general unnecessary confusion if the study were to be

made in that manner. Furthermore, it seems to me that such a study needs background that can be obtained only through the guidance of an organization whose principal objective is the development of the engineering profession in all aspects. Clearly then, the sponsor for such an operation should be the Engineers Council for Professional Development.

What is needed to accomplish such a survey? It would seem appropriate to set up an advisory board from the engineering profession to give guidance to the inquiry itself. This board should represent the various branches of engineering. It should represent different elements of the structure of the profession and different ways in which these elements function. It should be as small and compact as possible. It should report to this Council.

Under such a board should be organized a competent full-time staff to conduct the survey. It should be headed by a full-time director. It should be staffed with specialists appropriate to the different line of inquiry.

It would be essential that the operation be adequately financed since it is conceivable that the cost of such a survey would in the end amount to as much as a million dollars. There seems no question, however, that the benefits to be derived by the community are so great that such a sum becomes unimportant in proportion to the benefits.

Wider Responsibility to Come

As I view our profession and with quiet pride appraise its accomplishments, I feel at the same time a sense of the heavy responsibility that is placed upon us to discharge the enormous volume and range of function that we face. As I look ahead it seems to me that this range and volume grows to staggering proportions and must develop within us all a great sense of urgency to perfect the structure of our profession so that it may continue in its great tradition. I see no greater service that this Council can perform, either to the profession or to the community, than to bring into being such an organization, designed for the appraisal and for the guidance and further development of our profession. I believe that both for the profession and for the community we have arrived at a stage where time is now of the essence.

New Method of Recovering Materials

A new method of chemical recovery from solution has been developed in Montreal. Prof. W. H. Gauvin, M.E.I.C., associate professor of chemical engineering, McGill University, has led a group of scientists to the development of the atomized suspension technique, which will bring about utilization of great quantities of materials now wasted in industry.

The technique has been discovered and tested at the Pulp and Paper Institute of Canada research laboratories, the National Research Council and McGill University, at a cost of some $250,000.00.

A reactor is being built at the Montreal laboratories which will perform the separation of solids from solutions or slurry in a simple manner without scaling or corrosion. The recovery of solids from solution, while a very common operation in chemical processing, is often costly and complicated. With the new technique, excellent heat recovery is also obtained.

There is great profit to be gained in the pulp and paper industry, for example, by the application of this method to the problem of waste of the solids of wood in the sulphite manufacturing processes. The material recovered from waste liquids would go back into the manufacture of newsprint.

There are many important uses for this technique in other industries, and it is possible the reactor will be adopted by manufacturers as new possibilities of recovery of usable materials arise.

Professor Gauvin described this major development at a meeting of the chemical section of the Montreal Branch on November 8. The *Journal* will carry a full report in a later issue.

Canadian Management Council

The first management conference sponsored by the Canadian Management Council was held in Montreal on September 22, 1955.

The theme of the conference was "Education for Management—whose responsibility?" The subject was chosen after member societies had expressed the need of an opportunity for its discussion by top management.

With an attendance of well over one hundred senior members of industry, the meeting appears to have been very satisfactory to all concerned. Opened by the conference chairman, J. Gordon Campbell, and the president of the Council, A. M. Mackenzie, the proceedings included four papers and a panel discussion during the day, and a dinner address entitled "Humanity in Business" by S. M. Finlayson, president, Canadian Marconi Co., and president of the Montreal Board of Trade.

The other subjects and speakers during the session were:

"The responsibility of a university for the education of those entering business", by Prof. Walter A. Thompson, associate dean, School of Business Administration, University of Western Ontario.

"The responsibility of those in business for their own education", by Bruce A. Hills, M.B.E., M.E.I.C., president, Urwick Currie Ltd., Montreal.

"The responsibility of business for the education of those in its service", by J. R. White, president, Imperial Oil Limited, Toronto.

"Tools required by management in a changing world", by Sir Robert Watson-Watt, C.B., F.R.S.

The papers are to be published, and copies may be purchased from the secretary. The proceedings of the panel discussion, however will not be available in published form.

Function of the Council

The Canadian Management Council (CMC) represents Canada in the International Committee of Scientific Management (CIOS). This organization is composed of twenty-four national associations; its function is to facilitate international collaboration in the use of the principles and techniques of scientific management through exchange of information among its member nations.

Member societies of CMC are:

Society for Advancement of Management.
Institute of Administration.
Engineering Institute of Canada.
Chartered Institute of Secretaries.
National Office Management Association.
Canadian Industrial Management Association.
Society of Industrial and Cost Accountants of Canada.

Porcupine Institute of Administration.
Montreal Personnel Association.
Toronto Personnel Association.

The officers of the Canadian Management Council include:

President — A. M. Mackenzie, asst. vice-president, Bell Telephone Company of Canada, Montreal.

Secretary — J. A. Coote, chairman, Institute of Administration, Montreal.

Aluminum in the News

Three major developments affecting the aluminum industry in Canada were prominently in the news during October. A new British venture into primary production, a stock issue related to one of the three largest aluminum interests in the United States, and an addition to the existing capacity of the Aluminum Company of Canada.

The British Aluminium Company Limited announced plans to build a $130-million primary aluminum producing plant at Baie Comeau, some 200 miles east of Quebec on the north shore of the St. Lawrence river. Viscount Portal, chairman of British Aluminium, Hon. Geoffrey Cunliffe, deputy chairman and managing director, and W. J. Thomas, joint managing director, completed negotiations for the project, which is to produce 320 million pounds of aluminum ingot annually. The Canadian operating subsidiary will be Canadian British Aluminum Company Limited with head offices in Montreal. Completion will be in four stages, the first in 1957 and the entire plant by 1965.

Reynolds Aluminum Co. of Canada offered $4.5 millions of debentures and preferred shares, all quickly oversubscribed. A subsidiary of Reynolds International Inc., and hence of Reynolds Metal Co., the new Canadian company is acquiring the outstanding stock of Foils Investments Ltd., which owns the outstanding capital stock of Dominion Foils (Canada) Ltd. now operating a modern fabricating plant at Cap de la Madeleine, Que.

The Aluminum Company of Canada is to start an addition to its Ile Maligne smelter designed to increase plant capacity from 92,000 tons to 114,000 tons at a cost of some $15 million.

C.G.R.A. Meets at Banff

The 36th annual convention of the Canadian Good Roads Association was held at the Banff Springs Hotel, September 13 to 16, with an attendance of over 800. Delegates were welcomed by the Hon. John J. Bowlen, Lieutenant-Governor of Alberta. Greetings from the International Road Federation were extended to members by John Plum, director of information for the federation. Hon. Antonio Talbot, Quebec minister of roads, was elected president of the association for 1955-56.

Keynoting the convention with the theme, "Canada's Golden Future Will Be Built on Better Roads", President the Hon. Gordon Taylor told the meeting that more than $600 million would be spent this year on Canadian roads which, based on 30 years experience, would be divided 60 per cent for road construction, 36 per cent maintenance and 4 per cent administration.

There was no appreciable alleviation of city street congestion in sight, he said, in spite of expensive reconstruction of traffic routes in many cities. Foremost among the means of finding the revenue for an expanding roads and streets program was federal participation. A bold enterprising program by federal authorities for throughways and defence roads was long overdue.

The first general session was addressed by Roy E. Jorgensen, engineer consultant to the National Highway User's Conference, Washington, D.C., who described the PAR project, a nationwide good roads program, and reported on the present status of the proposed $100 billion U.S. Highway expenditure.

Roads Roundup—1955

In this session, now an annual feature, provincial officials outline the progress for the current year in their respective provinces.

British Columbia awarded contracts in 1955 for 125 miles of road which, added to 24 miles carried over from 1954, made 149 miles on half of which work is well advanced, including 40 miles of Trans-Canada Highway. At year's end, B.C. will have 3219 miles of pavement, 223 miles of which were surfaced this year. Total B.C. road mileage stands at 22,850 miles, of which 4041 miles are arterial highways, half of them built to an approved standard. To bring the remainder up to standard would cost some $292 million.

Of the 685 miles of Trans-Canada within the Province, 230 miles are now built to TCH specications, 210 miles are substandard and paved, 210 miles are in gravel and 35 miles are under construction.

Exceptionally good weather throughout the year made possible unusual progress in construction of Alberta's roads. Over $58 million had been voted for highways, of which $36 million was for construction, $5½ million for bridges and $3½ million for main highway maintenance. Grants to municipalities and improvement districts for building roads other than highways added a further $7½ million, with another $3½ million for certain district highways. Another $2½ million was spent on bridge maintenance.

The year's construction program covered 305 miles of grading, 288 miles of base course, 324 miles of asphalt plant mix, 131 miles of seal coat and 318 miles of gravel surfacing. Twenty-seven bridges and two road-rail overpasses were completed.

The Trans-Canada highway across Alberta is now completed, except for final surfacing of a few miles, from Calgary to the Saskatchewan boundary. The last 65 miles west of Calgary to Banff Park will be completed in record time when details of the route have been worked out. Alberta's 1955 appropriation for the TCH was $6 million.

Saskatchewan's highway budget for 1955 at $19,600,000 exceeded that of 1954 by 5 per cent. Federal funds of $2,750,000 bring the total to $22,350,000. In spite of a considerable carryover from 1954 and poor weather conditions in the spring, 1955 objectives will be substantially attained. The maintenance allotment exceeded last year's substantially, due to serious road and bridge damage from high water levels, abnormal spring break up and heavy rains. Maintenance for 1955 will include 55 miles of bituminous surfacing, 1,400 miles of regravelling and 145 miles of seal coat operations.

The Trans-Canada highway paving is completed from the Manitoba boundary to Regina and seal coat operations are in progress, with prospects of com-

pletion of a paved road all across the province by freeze-up, excluding some sections between Moose Jaw and Swift Current now under reconstruction. Grading will be completed this year on a new road from Saskatoon to Lloydminster and 34 miles are oiled.

Manitoba's 1955 program on trunk highways includes 234 miles of grading, 296 miles of gravelling, 130 miles of base and bituminous mat, 300 miles of prime and double prime, and 18 miles of concrete. In spite of a considerable carryover and a wet spring, more work has been accomplished this

The Hon. Antonio Talbot

summer since July than in any former year.

Work on the Trans-Canada highway has been speeded up, and by freeze-up 260 miles of grading and 190 miles of surfacing out of a total of 303 miles, will be completed or under contract.

Expansion of the province's oil production, development of Lithium discoveries within the Precambrian Shield and a growing tourist trade, as well as greater help for designated truck routes within cities and towns, all result in increased demand for road-building.

Ontario's record $175,600,000 program for road work for 1955 includes a record $43.7 millions for assistance to municipalities in construction and maintenance, with the balance of $131.9 million set aside for the Queen's highways. A recent tabulation showed 176 new construction and reconstruction contracts advertised, 152 of which have been awarded for a value of $56 million, and that 34 resurfacing contracts have been let for a total value of $7 million.

The Queen's highway work in northern regions is concentrated on the Trans-Canada highway but a considerable amount is being done on all roads. Of the 267 capital projects planned for 1955, 176 or over two thirds have been called. The highlight of the year is the substructure for the Burlington Beach skyway, which will by-pass Hamilton on the Queen Elizabeth way. Total cost of the skyway will be $14,500,000. Design and supervision is being carried out by consulting engineers.

Construction on dual highways is an important part of this year's program, 223 miles of dual highway is now completed, with another 103 under construction. Dual highway contracts still to be awarded this year will add up to nearly 40 miles and 24 structures, at a value of $6,234,670.

The highlight of Quebec's 1955 program is the large appropriation for permanent pavements and for resurfacing old ones. Over 46 asphalt plants are in operation with the ultimate aim of laying 1,450,000 tons of bituminous material. This year's target is 650 miles of permanent pavement and 240 miles of resurfacing. It is expected highway expenditures, excluding bridges, will hit an all time high in 1955. This will benefit all parts of the province, providing the rural areas with adequate connecting roads.

One of the most important tasks undertaken in recent years has been improvements to Highway 15 from Quebec to Baie Comeau; including 120 miles of complete new road from Sept Isles to Baie Comeau. The western end to Malbaie is being finished this year, with steep grades being eliminated.

Ten miles are being added to the Talbot highway at the Stoneham end, and a cutoff at Hebertville that will save 8 miles. The 147 mile "Tour du Lac St. Jean" is now completed. In the Gaspé peninsula 561 miles of tourist belt-road and 100 miles of Trans-Gaspésian highway are now in service. Within two years the entire 394 miles from Montréal to Rouyn will be paved.

New Brunswick, with a total road mileage of some 13,000 miles, has allocated just over $6 million on capital account for roads and bridges in 1955. The province has a further $13 million available from revenue funds for construction, maintenance and snow removal, including federal contributions to the Trans-Canada highway.

Contracts have been let for grading and gravelling some 300 miles, in addition to completion of a few carryover contracts. It is hoped to complete 500 miles of surface treatment and seal coat this season. No new paving contracts were called in 1955. Last winter 11,000 miles were kept open full time and 964 miles part time. Concrete substructures for five steel bridges are under construction.

Results from tests during the past two winters on additives to prevent surface ice formation are now admitted to be a complete failure as far as the province is concerned.

Nova Scotia's expenditure on highways for 1955, including maintenance and construction, will be close to $20 million. On the trunk system and other roads the province expects to reconstruct 90 miles and to pave 160 miles. Besides this, contracts for 32 miles have been let for grading of the Trans-Canada highway this season and work is underway. No paving work has yet been dealt with.

It is estimated it will cost some $140 million to reconstruct all bridges within the province. This year 60 bridges will be rebuilt at a cost varying from $10,000 to $500,000 each.

In the past ten years Prince Edward Island has rebuilt more than half the province's highway mileage to modern standards. In all, 240 miles will be completed, bringing the program past the halfway mark. On the Trans-Canada highway 44 out of the province's 74 miles are now paved. Uncertainties respecting the Hillsboro bridge have retarded its completion.

Earth fills or causeways are finding favour in place of bridges or trestles over tidal estuaries, being cheap and easily built. It has been found no pavement stands up to the province's changeable winter climate except hot mix plant asphalt or concrete.

Newfoundland's highway expenditures continue to climb. This year the province's estimates are greater than ever before. The greatest increase is for the Trans-Canada highway, and this year an allocation of $8 million has been provided. Except for the

Trans-Canada, successful completion by freeze-up is expected of the whole 1955 program.

Trans-Canada construction in Newfoundland is done in three stages: (1) rough grading, (2) granular sub-base and base course, and (3) pavement. Stage 1 has now been completed for some 200 miles at an average cost of $70,000 per mile excluding bridges. With another 50 miles done it will be possible to drive some 600 miles from Port aux Basques to St. John's. Surveys are being made over 100 miles of rough graded road to find suitable materials for Stage 2. No work on Stage 3 is planned for this year.

Since 1945 there has been an average increase in motor registrations of 15 per cent annually. No longer is it possible with this tremendous traffic increase to satisfactorily maintain gravel roads. But large expenditures on reconstruction must be made on existing roads that were not built to a standard suitable for paving. This year an extensive bridge building program is under way, mostly on the Trans-Canada.

Trans-Canada Highway

Of the 4,580 miles of highway within 9 participating provinces including two national parks, 1,835 miles of grading are approved and 1,554 miles completed; 1,358 miles of base course and paving are approved and 1,168 completed; and 158 structures out of an estimated 700 required, are approved with 117 completed.

Funds committed since the passing of the Trans-Canada Highway Act in December, 1949, to mid August this year, total $202 million, out of the $300 million authorized under the act, to be shared equally between provinces and the federal government. When these $202 millions are spent, only some 35 per cent of the highway will be completed.

It is thus doubtful whether any province will complete its section before expiration of the present act in December, 1956. Saskatchewan and Prince Edward Island appear nearest completion with about two thirds done. Two major gaps remain, namely one in Newfoundland east of Gander, and one in Ontario in the Chapleau district. Emphasis is being placed on grading these uncompleted sections.

The possibility of relocating the highway between Golden and Revelstoke in British Columbia, by way of the Rogers Pass, rather than by way of the "Big Bend", thus saving 105 miles of its length, is being surveyed and studied.

General Sessions

There were general sessions featuring discussions on important subjects.

The third session was a panel discussion on civil defence, and an outline of plans for "Operation Lifesaver" by Paul Fox, chief transportation officer for Civil Defence. Mr. Fox gave figures to show there was ample land transportation available to carry out evacuation of our 18 largest cities without difficulty.

Following this, delegates heard K. B. Rykken of the AAA discuss toll roads in the United States. Mr. Rykken said only between one fifth and one eighth of the U.S. national system of interstate highways lends itself to the operation of toll roads. The toll road operators pick out the cream of the crop. Toll road technique could not be applied to metropolitan areas.

Albert J. Wedeking, executive director, Indiana Toll Road Commission, quoted statistics to show that in the U.S. there were 1,000 miles of toll roads in operation, 1,200 miles under construction and a further 6,000 miles authorized or proposed.

The fourth and fifth general sessions heard reports of sub-committees of the advisory committee on technical information; traffic planning and design, soils and materials, construction and maintenance; and economics, finance and administration. The economics committee report expressed the view that the obvious starting point must be the collection of more and better information about Canada's roads and their use.

Annual General Meeting

The final morning session was devoted to an address by the Hon. Brooke Claxton on steps being taken to organize the Canadian Highway Safety Conference, following the national conference held in Ottawa last May under CGRA sponsorship. This was followed by committee reports.

Reviewing the year's work of the association, Managing Director C. W. Gilchrist paid special tribute to the Hon. Brooke Claxton's guidance and direction of the Highway Safety Conference last May in Ottawa. Referring to the steady expansion of the Association's activities, he pointed out there was more to offer members than at any time in CGRA history, and called for the membership target to be set a little higher next year.

The annual dinner was addressed by the Hon. E. C. Manning, Premier of Alberta.

Thirty-five Years Ago

Comment on the *JOURNAL* of November 1920

In going through these old *Journals,* one occasionally comes across a paper which was the forerunner of many on the same subject. Usually such a paper is concerned with a method or process very new at the time it was written and hence of great interest to all engineers, a process which today has been so generally accepted that it has lost all novelty and not infrequently has become such big business as to have built up its own corps of specialists, to which the rest of us turn when in need.

Such a paper is "Electric Welding", by F. H. Williams, A.M.E.I.C., in the *Journal* for November, 1920. It would be pleasing to know something about Mr. Williams, but beyond the fact that he came from Moncton, he is a stranger to us. He wrote a good paper, interesting today because it gave a little of this history of electric welding, which was apparently started in 1874 by Wederman and developed by Zerener, Meriteus, Bernados, Olszewski and Slavianoff, among others. Dr. Elihu Thomson, that versatile electrical genius, had a hand in its development, too; his seems to have been about the only English name among the pioneers.

The 1914-18 war was responsible for rapid development in electric welding and at the end of that struggle, this kind of welding was well on the way to becoming the useful tool it is now. Mr. Williams was quite aware that many welding problems were metallurgical, for he illustrated his paper with a dozen or so photomicrographs of welds, good and bad, and of the metal near welds, before and after welding.

Dr. F. H. Sexton, of the Nova Scotia Technical College, put forth a strong plea in this *Journal* in support of "Secondary Technical Education". In thirty-five years the situation has not improved as much as he thought imperative. His argument was based on the necessity of having a few privates in the engineering army, not all officers: "Leadership is . . .(an) important factor . . . in any human organization, but it is only a factor. Any leader must have a . . . collection of individuals co-operating with him and subject to his will, if the desired results are to be attained." Dr. Sexton dismissed the apprenticeship system as outdated, but it seems to have staged something of a comeback since 1920, as witness the rather successful systems now functioning in many parts of Canada. Nevertheless, he was quite right in saying that we did not do enough for young people who would like to learn a trade and it is doubtful if we do enough now.

H. B. Muckleston, M.E.I.C., gave an excellent summary of the 1920 Alberta Irrigation District Act in this *Journal*. Perhaps the act's outstanding feature was that it was framed after "very careful consideration of . . . legislation in the various arid states of the Union . . . to avoid the pitfalls which . . . (have been) revealed (there) and to stick to the . . . trails which experience shows have led to success. . . . The act is very complete and if any contingency has not been foreseen and provided against, it is not for want of study and care. . . ."

Engineering Physics Course Established

A note on "Engineering and Physics" appeared on the editorial page. It referred especially to a new course in engineering physics just authorized at McGill University, the first at any university, so far as known. For once the educational people made a real step forward, for the course—modified over the years, as is natural—is still in existence and its graduates are in demand, especially in the communications and electronics fields, and before long we shall probably find a good many of them concerned with the utilization of atomic power for peaceful purposes.

Moncton Branch

The Moncton Branch was born on October 11, 1920 and this *Journal* carried a short account of its inauguration. Of its first executive of nine, only two are still on our books: H. J. Crudge, M.E.I.C., now a consulting engineer in Moncton, and S. B. Wass, M.E.I.C., now consultant to the National Capital Planning Committee in Ottawa. But others have taken the places of those who dropped out and the branch has flourished since its beginning.

Once in a while an engineer wanders off into a field far from his professional interests. Religion, morals and ethics seem to fascinate some of us, as is illustrated by the review of a new book by an Institute member in this *Journal*. Its title was "Righteousness vs. Religion". It is obvious that it contained matter of a highly controversial nature, the merits of which had best not be discussed in these columns.

This issue of the *Journal* carried a more or less verbatim account of the proceedings of the general professional meeting held in Halifax during the previous October. There were the usual papers, of course, but there was also a good deal of social activity, which impressed the editor of the *Engineering News-Record* so much that he wrote on "Livening Society Meetings" when he got back to New York. He concluded that the Halifax meeting was a "pleasant and profitable (one), which stands out among the many that it is the duty of a technical editor to attend . . . (If program makers would) provide opportunities for . . . men to get together between sessions, they would find that their members would go home better pleased and more inclined to come again."

Counselling students who thought they were fitted for an engineering career is mentioned for the first time in this *Journal*, which gives a list of seven books and pamphlets that such young men might well read. Perhaps these were a little expensive for the normal boy; today more and better advice is available gratis to most students.

The branches seem to have been sailing rather placidly, which must have been something of a relief to headquarters, under a heavy bombardment of requests for immediate action of one kind or another not long before. The Toronto Branch, as it had been for some time, was still concerned with Institute policy and was debating such questions as: How far should the Institute go in helping its members economically? Should the grades of membership be changed? Should all business and nominations originate in the branches? Should the fees be raised? Should members take more interest in social welfare? Up to the date of this *Journal*, no real opinion on these matters had crystallized in the Branch, but it was not for want of discussion.

Nova Scotia Association

The first regular general meeting of the Association of Professional Engineers of Nova Scotia was reported at length. The election resulted in the choice of C. E. W. Dodwell, M.E.I.C., as president, and W. P. Morrison, Prof. Faulkner, K. H. Smith, I. P. Macnab, J. W. Roland, A. F. Dyler and F. A. Bowman, all members of the Institute, plus Dr. F. H. Sexton, as councillors. To these were added J. L. Allan, T. J. Brown, W. G. Matthewson, D. W. Robb and L. H. Wheaton, also all members of the Institute and appointed by the lieutenant governor in council.

An associate member from Victoria wrote in to ask if a course in "structural engineering and other correspondence courses" offered by a concern in a small Massachusetts town, were any good. The editor did not reply—probably he could not—but he referred the enquiry to members.

This was an average issue of the *Journal*, not the best we have reviewed in the last two years or so, but containing a fair ration of distinctly useful material and showing evidence that the magazine was growing up.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Dominion Council

(Reprinted from *The Canadian Professional Engineer, July 1955*)

The Purpose of Dominion Council

For those not familiar with the present functions of Dominion Council of Professional Engineers, the following provides a brief outline:

When it was created as such in 1936, the constitution adopted defined the objectives and purposes in the following words—

"Having due regard for Provincial autonomy, the objectives and purposes of the Council shall be:

(a) To assist the Association by recommending ways, means and procedures for co-ordinating and standardizing their activities, primarily in matters pertaining to the Registration, Licensing and Transfer of Registration of Professional Engineers; and

(b) With the unanimous consent of the Associations to act in respect of other matters of a Dominion-wide nature concerning the Profession, either alone or in co-operation with other bodies".

Meetings of Dominion Council are held yearly and in the various Provinces. To these meetings each Association delegates an official representative, usually the president or vice-president to ensure close contact with the thinking of the Association Councils. These representatives elect a Dominion Council president, a vice-president and a member of the executive, who hold office for one year. Of recent years the duties of the secretary-treasurer, who is appointed by Dominion Council have been shared between the permanent staffs of the Quebec Corporation and the Ontario Association, alternating every two years.

As stated in the Constitution, action by Dominion Council can be taken only with the unanimous consent of its member associations. This may have the effect of slowing action but on the other hand the according of unanimous support to any proposal means a powerful backing by the profession as a whole.

The annual conferences have been invaluable in providing a means of discussing mutual or individual problems and in an informal manner. It has placed the profession on a personal basis and made very obvious the fact that what affects one Association, affects all.

The meeting's agenda is prepared in advance so each representative can come prepared to present his Association's experience or viewpoints. If agreement is reached on a proposed solution to a problem, Dominion Council will present this as a recommendation to each Association for acceptance or otherwise. If unanimous support is not forthcoming, the matter will be returned to Dominion Council for further consideration. Rarely, however, is unanimous support not forthcoming.

Some of the achievements of Dominion Council which may be named are: abolition of the transfer fee for members moving from one Province to another; adoption of a syllabus of examinations used by all Associations and thus promoting uniformity in treatment; the issuing of a recommended Schedule of Salaries for Professional Engineers endorsed by all Provincial Associations; a sharp narrowing of the gap in requirements for registration and the probable unanimity on same in the very near future; a profitable development of public relations programs which have done much to enhance the position of the professional engineer; and the preparation of the annual news-sheet, The Canadian Professional Engineer, which is sent to each registered professional engineer in Canada with the idea of bringing him more closely into the picture.

A very valuable feature of Dominion Council meetings has been the presence, as guests, of representatives of the various engineering and technical Institutes of Canada and of the U.S.A. sister organizations, the National Society of Professional Engineers and the National Council of State Boards of Engineering Examiners. Of particular help has been the presence of a representative of the Canadian Civil Service Commission in the person of G. A. Blackburn, of Ottawa, and himself a professional engineer. All are encouraged to enter into the discussions and experience has indicated that professional problems know no national boundaries.

An Earlier Record of the Engineering Profession

The accompanying is reproduced from the first bulletin of Dominion Council and published 19 years ago. At that time Dominion Council was made up of representatives of professional engineers in Alberta, British Columbia, New Brunswick, Nova Scotia, Ontario and Saskatchewan, whose members in 1936 totalled 2,636. In those same Provinces today the registration is close to 19,000 and of all Provinces about 25,000.

While the first get-together of representatives of Provincial bodies was a meeting in Montreal in 1926, it was not until ten years later that a constitution was adopted by the Associations of the six provinces named above. Later in the same year, 1936, Quebec decided to support Dominion Council and in 1938 Manitoba took similar action. In addition to the Associations named, Dominion Council today also includes the Association of Professional Engineers of Newfoundland, which was created in 1952, the Association of Professional Engineers of Prince Edward Island and the Association of Professional Engineers of Yukon Territory, both of which were authorized by legislation in 1955.

Editor's Note: Stated in very broad terms, one of the principal objectives of professional engineering confederation in Canada, which readers are aware is now under study, would be the creation of a single Council, to co-ordinate and assist the work of the Association *and* The Engineering Institute of Canada.

Ontario

News of the Members

W. A. McNair in May of this year took over the position of general manager of Kennatrack Corporation (Canada) Ltd., of 417A Birchmount Road, Toronto 13. The company, a subsidiary of Kennatrack Corp. of Elkhart, Ind., manufactures a complete line of sliding doors hardware in the Toronto plant and distributes to wholesale outlets in Canada and abroad.

Mr. McNair, a graduate of the University of Toronto, was previously a sales engineer with Empire Brass Manufacturing Co. Ltd.

E. Cattanes has joined the Solartron Electronic Group Ltd., Thames Ditton, Surrey, England, as a senior commercial executive. He will be responsible for developing the European market for Solartron electronic instruments and will, in particular, open up a new Paris office later in the year.

Mr. Cattanes, who attended the Universities of London, Grenoble and Turin, was French manager of A. C. Cosser Ltd. in Paris in 1932-36, and manager of the electronic instruments division until 1946. During the period 1946-48 he was manager of the electronic products division of Radiotel Corp. and until 1952 headed the industrial electronic division of English Electric Co. Ltd. When in Canada, Mr. Cattanes was with Industrial Electronics of Canada Ltd., Toronto.

J. S. L. Shales has joined with Lester W. Childs, formerly of Owen Sound, to form Cummins Diesel Michigan Inc., located at 3601 Gratiot Avenue, Detroit, Mich. Mr. Shales is vice-president of the company which succeeds Cummins Diesel Service and Sales of Michigan Inc., and its function is to sell and service Cummins diesel engines in the southern peninsula of the State of Michigan and the northwestern counties of Ohio.

R. F. Taylor of Packard Electric Co. Ltd., St. Catharines, Ont., has been appointed manager of the special products section of the company's sales department. The function of this new section will be to handle new business development and special projects.

Mr. Taylor, who is a graduate of the University of Toronto, has been a sales engineer for the company since early 1951 and has specialized in unit substation sales at the company's Toronto office.

Peter H. Aykroyd of the Federal District Commission, Ottawa, is giving an illustrated lecture on the National Capital Plan to delegates attending the 14th Short Course on Roadside Development at Columbus, Ohio.

Mr. Aykroyd will enjoy the distinction of being the first Canadian to be invited to address the annual meeting of Roadside Engineers who gather from all parts of the United States as well as from Central America.

Elsie Gregory MacGill consultant aeronautical engineer of Toronto, was elected president of the Business and Professional Women's Club of Ontario at the provincial conference held in London, Ontario, early in October. She will assume office in June, 1956.

Two years ago, Miss MacGill was awarded the citation of the Society of Women Engineers in the United States, as "woman engineer of the year". Late last month her biography of her mother, the late Judge Helen Gregory MacGill was published under the name "My Mother the Judge".

G. Franklin Dean of Toronto has been elected a director on the Council of the Illuminating Engineering Society whose 47th Annual Conference was held in Cleveland in September. Mr. Dean is in charge of lighting service of the Toronto Hydro-Electric System, and has specialized in illumination engineering since his graduation from the University of Toronto in 1924.

R. E. Hendershott of Canadian Westinghouse Co. Ltd. has been appointed manager of manufacturing services at the company's lamp division plant at Three Rivers, Que.

Mr. Hendershot joined the Westinghouse organization in 1935 following his graduation from the University of Toronto. He has enjoyed a wide experience in the lamp field in manufacturing, marketing and sales. Prior to his move to Three Rivers he was manager of the lamp sales department of the company and was located in Hamilton. During the Second World War he served with the Royal Canadian Engineers, retiring with the rank of lieutenant-colonel.

Prescott T. Duff of Toronto is now engaged in post-graduate study in industrial management at the Massachusetts Institute of Technology. His work at M.I.T., which will require approximately two years, is under a Teagle Foundation Scholarship awarded to Mr. Duff.

Mr. Duff has been with Imperial Oil Ltd., Toronto, since 1950 and graduated from the Nova Scotia Technical Institute in mining following graduation in science from Dalhousie University.

British Columbia

Engineers Most in Demand Among University Graduates

The demand for graduates in engineering tops the demand for graduates in any other branch of learning at Canadian universities.

In his latest "Bulletin on the Supply and Demand Situation in Regard to University Graduates" G. M. Morrison, supervisor of the Executive and Professional Division of the National Employment Service, says that his prediction three years ago that "Canadian employers will be looking for at least 2,000 graduates in engineering each year for some time to come" has proved conservative. Demand has been at least 2,500 and some officers of professional engineering societies say that it takes 3,000 graduates per year to keep up with the need for engineers in Canadian industry.

Mr. Morrison says further that the shortage of engineers is concentrated in the aircraft, electrical and oil industries, but that demand also exceeds supply of geological, mechanical and mining engineering graduates.

Improvement in the supply situation is indicated by figures obtained from the Schools of Engineering. In the autumn of 1950, the class scheduled to graduate in 1954 numbered 1,649. In the autumn of 1954, the class to graduate in 1958 numbered 3,282, an increase of nearly 100 per cent. There is, of course, a certain wastage to be anticipated, since not all first year engineering students eventually graduate.

Even with the increases in enrolment, there is no danger, Mr. Morrison says, of the profession becoming overcrowded. "In spite of the uncertainties which must qualify any judgment on the future, a long run view clearly points to a continuing high level of demand for scientific and professional manpower."

A table of the numbers of students in different faculties hired by the Civil Service of Canada shows that employment-opportunities for the scientifically trained are high even on the temporary, summer, level. In 1952-3 the Civil Service hired for the summer 120 students in agriculture, 64 students in Arts and Social Science and 661 in Applied and Pure Science. In 1953-4 the number of Applied and Pure Science students employed again topped the table with 694 Applied and Pure Science students given summer work by the Federal Civil Service, as compared with 147 agriculture students and 73 students in Arts and Social Science.

TRAFFIC—A Panel Discussion

(*Continued from page 1531*)

mild profanity: "My God! If we could get one mile per hour additional I'd thank God for it, I would really!"

When a city spreads out over a large area—metropolitan Toronto was stated to run 25 to 30 miles along the lake and 12 to 15 miles back from it—there is no possibility that its traffic can be handled even passably by any system of surface streets, with their numerous intersections, unlimited access and uncontrolled frontage development. Then expressways are indicated, always remembering that these are not an effort to decrease traffic, but merely to provide the best facilities economically possible for existing and for anticipated future traffic. But some of the traffic experts still look askance at them as over-expensive remedies.

Of course, a lot of the panel's time was spent in discussion of or arguments about parking. Only the real estate representative could find much good to say of street parking. He felt that prohibiting curb parking entirely would depreciate property values and, further, that asking owners to provide off-street parking was a little unfair, though he admitted that it had come to stay. And he was most decidedly of the opinion that civic bylaws asked for more off-street parking at the owner's expense than was necessary. Somebody has said, "Every square foot of a building devoted to parking is a square foot that produces no revenue." This isn't necessarily so; without adequate parking space, an owner might find it hard to fill his building, or might have to accept less than the going rental rate.

On the other hand, the example of a Montreal apartment building was cited. This had parking accommodations for about half its

tenants. To fill the other half, the owner had to rent outside parking space for these tenants; nobody was interested in an apartment without p a r k i n g. This outside space cost considerably more than it would have cost to have provided it in his own building.

The panel had a feeling that the provinces, perhaps even the federal government, would have to come to the financial aid of the cities before the latter could embark on any very extensive improvements aimed at the solution of traffic problems. No Canadian city could possibly raise the funds it ought to have for this purpose. One argument advanced for federal subsidization was that navigation, which lands goods on the city docks, is so subsidized, but that the further handling of these goods was by facilities partly furnished by the cities and provinces. Why shouldn't the federal government aid in this part of the trip, too?

One point on which the panel did agree unanimously was that Canada needed more traffic engineers and was doing little to produce them. The young man with an urge to go into this branch of engineering could get his undergraduate training at a Canadian university, but would have to go elsewhere for the necessary graduate work. It was suggested that the Institute might well call the attention of the universities to this situation.

There was considerable discussion from the floor, some of it much to the point. Altogether the panel session may be called a success. If it didn't produce any one-shot solution to the traffic problems—which would have been a miracle — it did give opposing points of view an opportunity to be heard. Listeners must have gone away with a conviction that traffic *is* a problem and that it will never be properly taken care of except through the mutual forbearance and concentrated efforts of everybody concerned.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Samuel J. Hungerford, HON.M.E.I.C., former president of Canadian National Railways, died on October 7, 1955, in Farnham, Que.

Mr. Hungerford was born in Bedford, Que., on July 16, 1872, and joined the South Eastern railway shops in Farnham, Que., as a machinist-apprentice when he was 14 years old. After a five-year apprenticeship he became journeyman machinist at various points in Quebec, Ontario and Vermont. From 1894 to 1897 he was chargeman at Canadian Pacific Railway's Windsor Station in Montreal, and remained with the C.P.R. until 1910, holding such positions as master mechanic of the western division, with headquarters in Calgary, Alta., and superintendent of the locomotive shops at Winnipeg, Man. In 1910 he joined Canadian Northern Railways as superintendent of rolling stock at Winnipeg, moving to Toronto in 1915. Following the organization of Canadian National Railways, he was appointed general manager of the eastern lines in November, 1917, and vice-president and general manager the following year.

He was appointed vice-president of operation and maintenance for the C.N.R. in 1920, and two years later, vice-president in charge of operation and construction in Montreal. In 1932 he was appointed acting president, and two years later was named president of the system. In 1936 he became chairman of the board of directors, and in 1937, upon the formation of Trans-Canada Airlines, he was named first president of that company, a position he held until 1941. He resigned as president and chairman of the board of the C.N.R. in 1941 and during the war was president and director of National Railway Munitions, a Crown corporation.

S. J. Hungerford, Hon.M.E.I.C.

Mr. Hungerford had been chairman of the committee which enacted the first shopmen's universal wage agreement in Canada. He also invented a number of railway appliances.

He became a Member of the Engineering Institute in 1919, and was awarded an Honorary Membership in 1937.

Arthur George Herr, M.E.I.C., a director of the Packard Electric Company in St. Catharines, Ont., died on September 27, 1955, at the Hotel Dieu Hospital in St. Catharines, following a brief illness.

Mr. Herr was born in Wartburg, Ont., on October 18, 1886, and attended public and high schools in Milverton, Ont. Then he followed architectural and engineering courses through International Correspondence Schools, working at that time in general construction work at Stratford and Welland, Ont. From 1911 to 1914, Mr. Herr was connected with the architectural offices of A. E. Nicholson.

A. G. Herr, M.E.I.C.

It was in 1915 that Mr. Herr began his long association with the Packard Electric Company. Joining the company as inspector of munitions, he was named chief draughtsman of the company in 1917 and was in charge of all mechanical engineering work. He was named a director of the company in 1935 and continued as chief draughtsman until his retirement at the end of 1954. He remained a director of the company until his death.

Mr. Herr was active in musical circles and was a director of the St. Catharines Community Concert. He was also a member of the Association of Professional Engineers of Ontario.

He became an Associate Member of the Engineering Institute in 1935 and transferred to Member in 1940.

Personals

News of the Personal Activities of Members of the Institute

John E. Bright, M.E.I.C., has been named district engineer with the harbours and rivers engineering branch of the Department of Public Works with headquarters in Halifax.

J. E. Bright, M.E.I.C.

Mr. Bright graduated in 1938 from Queen's University with a degree of bachelor of science in mechanical engineering. After a short time with the Bell Telephone Company and with the London Structural Steel Company he enlisted in the Royal Canadian Engineers in 1939 and served overseas. He was discharged in 1946 with the rank of major.

He was employed with the Richards and Wilcox Canadian Company at London, Ont. for a time prior to joining the Federal Department of Public Works as an engineer in the London, Ontario district office in 1946. In 1953 he was transferred to Ottawa where he was first in the bridge design section and then in the structures division of the engineering branch.

A.I.E.E. Awards Fellowships

Recently the American Institute of Electrical Engineers awarded fellowships to two prominent Canadian engineers. Recipients were **Dr. Rene Dupuis,** M.E.I.C., a member of the Quebec Hydro-Electric Commission in Montreal, and **D. W. Callander,** M.E.I.C., an engineering consultant in the Canadian Westinghouse Company's industrial products division at Hamilton, Ont.

In conferring the fellowship upon Dr. Dupuis the citation read "for contributions to the electric industry as engineer, author, administrator and educator."

Dr. Dupuis began his engineering education at McGill University and completed his course at Nancy, France, where he obtained his diplomas in mechanics and physics, and also studied political economy. Returning to Canada, he was employed for two years by the Canadian Westinghouse Company at Hamilton, Ont. From 1928 to 1930 he was with the Shawinigan Water and Power Company at Three Rivers, Que. In 1930 he became associated with the Quebec Power Company subsequently becoming assistant general superintendent of the company in 1939.

Dr. R. Dupuis, M.E.I.C.

In 1942 Dr. Dupuis founded the school of electrical engineering at Laval University and was its director until 1947 when the Quebec Hydro-Electric Power Commission named him superintending engineer of its Beauharnois operations. He retained that position when the Quebec government appointed him a commissioner in 1948. In 1952 he was asked to take charge at the executive level of the Commission's Bersimis River development. He is also a member of the Canadian section of the St. Lawrence River Board of Control.

In 1954 Laval University conferred an honorary degree of doctor of science on Dr. Dupuis.

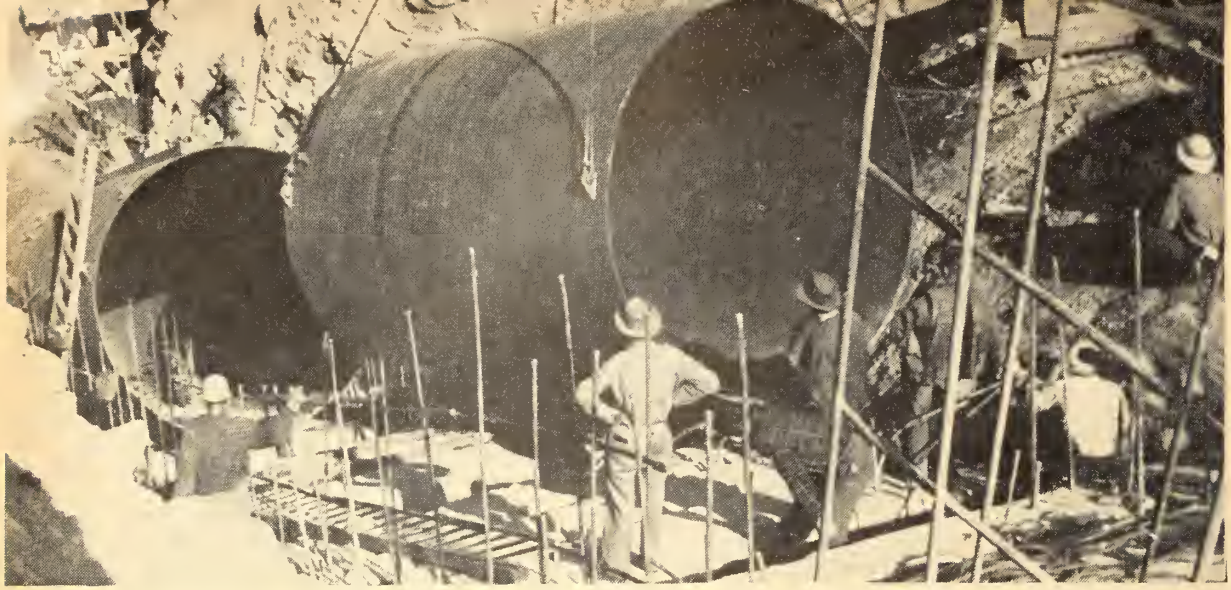
Dr. Dupuis is a past-chairman of the Quebec Branch of the Engineering Institute, having joined as an Associate Member in 1934, transferring to Member in 1940.

D. W. Callander, M.E.I.C., received his fellowship in recognition of his many achievements during his 46-year career in the electrical industry.

Mr. Callander joined Canadian Westinghouse in 1909 as an engineering apprentice and received his B.Sc. degree in electrical engineering from McGill University two years later. In 1912 he joined the motor and generator section of the firm's engineering department, spending two years on d.c. machine design. He spent the next seven years engaged in design and development work on polyphase motors and CAH fractional horsepower induction motors.

In 1921 Mr. Callander was transferred to the company's transformer division as a section engineer. In this position he worked on power transformers for projects by the Ontario and Quebec Hydros at Beauharnois, Shawinigan Falls and Gatineau Power. Under his supervision the CSP transformer was developed in Canada. In 1943 Mr. Callander was named division engineer in charge of power and distribution transformers at Westinghouse. He became consultant in industrial products engineering in 1947.

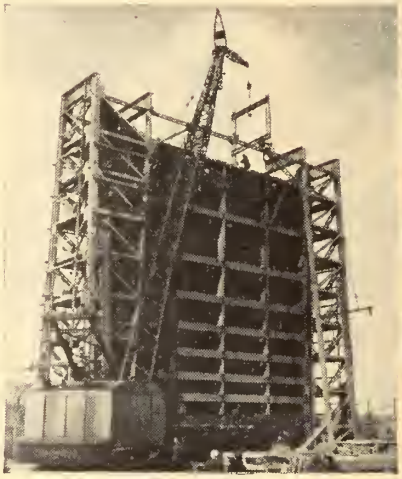
D. W. Callander, M.E.I.C.



PUNTLEDGE RIVER, B.C.: One of four major penstock installations by Dominion Bridge for the B C Power Commission 2½ miles of pipe totalling 5,775 tons of steel were used on this project. Penstock varies in size from 12 ft diameter with ⅜ ins plate to 9 ft. 10 ins diameter with 1⅛ ins plate.

ON THE JOB..

HALIFAX, N. S.: With its main span of 1447 ft and overall length of 4420 ft , the new Angus L Macdonald bridge is second largest of its type in the Commonwealth It is surpassed only by the Lions Gate Bridge, Vancouver, also built by Dominion Bridge

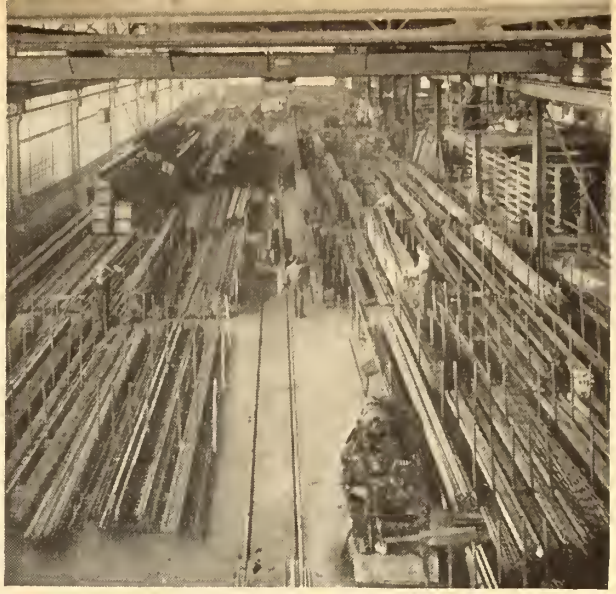


NIAGARA FALLS, ONT.: One of two hydraulic control gates — largest built in Canada — weighing 225 tons each and measuring 58′ high by 45′ wide For the new Sir Adam Beck generating station

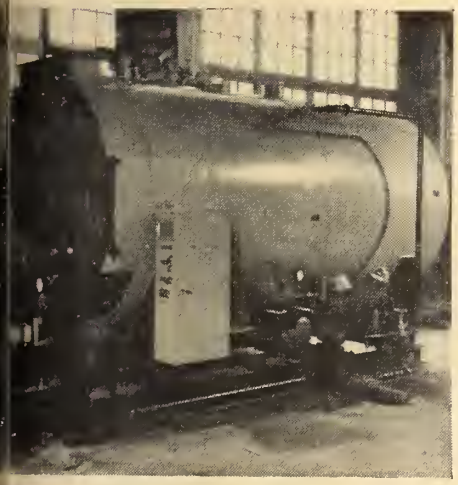
VANCOUVER, B.C.: One of v large oil refinery process ves cently fabricated at our Va plant — shown emerging fro relieving furnace

CALGARY, ALTA.: 12-foot radial type irrigation gate designed and fabricated by Riverside Iron & Engineering Works, Ltd This type of gate was formerly imported

NE, P.Q.: This new open-side plano-miller at our main believed to be the largest of its kind in the world. Used ing, drilling and milling large components, it weighs s — took two years to build.



TORONTO, ONT.: Warehouse steel of all types is immediately available from nine strategically located warehouses across Canada — like this one in Toronto.



RST, N.S.: We recently introduced a new type ch Dry Back boiler for use as a "packaged This one was built by our subsidiary. Robb ering Works Ltd.

HAMILTON, ONT.: First permanent "wavestack" television antenna in the world; designed by RCA Victor Co. Ltd. in conjunction with Dominion Bridge and built in our main plant. It was erected by our Ontario Division.

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• Personals

Mr. Callander became an Associate Member of the Engineering Institute in 1927, transferring to Member in 1940.

Geoffrey P. Webb, M.E.I.C., has become associated with Kennedy & Donkin, consulting engineers of London, England. He will be engaged on design and contract work in their hydro-electric division, later to be transferred to Caracas, Venezuela, as their representative for the Caroni hydro-electric scheme.

Mr. Webb, who is a B.Sc. engineering graduate of the University of London, class of 1952, served as a captain with the Royal Engineers in India and Burma from 1942 to 1946.

On coming to Canada three years ago Mr. Webb completed the Canadian General Electric's test course and then spent a year with that company in the power transformer and switchgear sales division in Toronto.

During the last year he has been with the Aluminum Company of Canada as an electrical engineer on the Saguenay hydro-electric system at Shipshaw, Que.

P. J. G. Carrothers, M.E.I.C., is now research engineer with the Fisheries Research Board of the Canadian Department of Fisheries. He is located at the Pacific Fisheries Experimental Station in Vancouver, B.C.

G. P. Webb, M.E.I.C.

A chemical engineering graduate of the University of British Columbia, class of 1944, Mr. Carrothers was previously chemical engineer in charge of research with Edward Lipsett Limited in Vancouver. He received a master's degree in textile engineering in 1952 from the Massachusetts Institute of Technology.

W. V. Morris, M.E.I.C.

W. Victor Morris, M.E.I.C., has joined the water resources division of the Department of Northern Affairs and National Resources as chief of the water development projects section in Ottawa.

Mr. Morris was previously on the staff of the civil engineering department at the University of Manitoba, since his graduation from that university in 1943. During the past several years he has been associated with the water resources branch of the Manitoba government, with the consulting firm of Main, Rensaa and Minsos in Edmonton, and in 1952-53 as hydraulic engineer with the Red River Basin Investigation. He also received the degree of master of science from the Colorado A. and M. College in 1954.

Mr. Morris is a member of the Association of Professional Engineers of Manitoba, and a member of the International Association for Hydraulic Research. He has served on the Branch Management Committee of the Winnipeg Branch of the Engineering Institute during the past year.

A. A. Goldes, M.E.I.C.

Noel William Smithson, M.E.I.C., has been named assistant to the chief civil engineer at Racey, MacCallum & Associates Ltd. in Montreal. He joined the company earlier this year as project manager in Toronto.

An electrical engineering graduate of London University, Mr. Smithson had previously been with the engineering construction department of Foundation Company of Canada Ltd. at Toronto.

Anton A. Goldes, M.E.I.C., has been appointed chief engineer of Hooper & Yolles, consulting engineers, in Toronto. Mr. Goldes became associated with the firm earlier this year.

Mr. Goldes was born in Johannesburg, South Africa, and graduated in civil engineering from Witwatersrand University in 1941. During the Second World War he served with the South African Army as technical officer and after the war was associated with Dr. Oscar Faber and Sir William Halcrow, consulting engineers in London, England.

He came to Canada in 1952 and was with the Dominion Bridge Company in Winnipeg, Man., as a senior designer. In 1954 he joined Shore & Moffat, architects of Toronto, as head of the structural engineering department.

Mr. Goldes is an associate member of the Institutions of Civil Engineers

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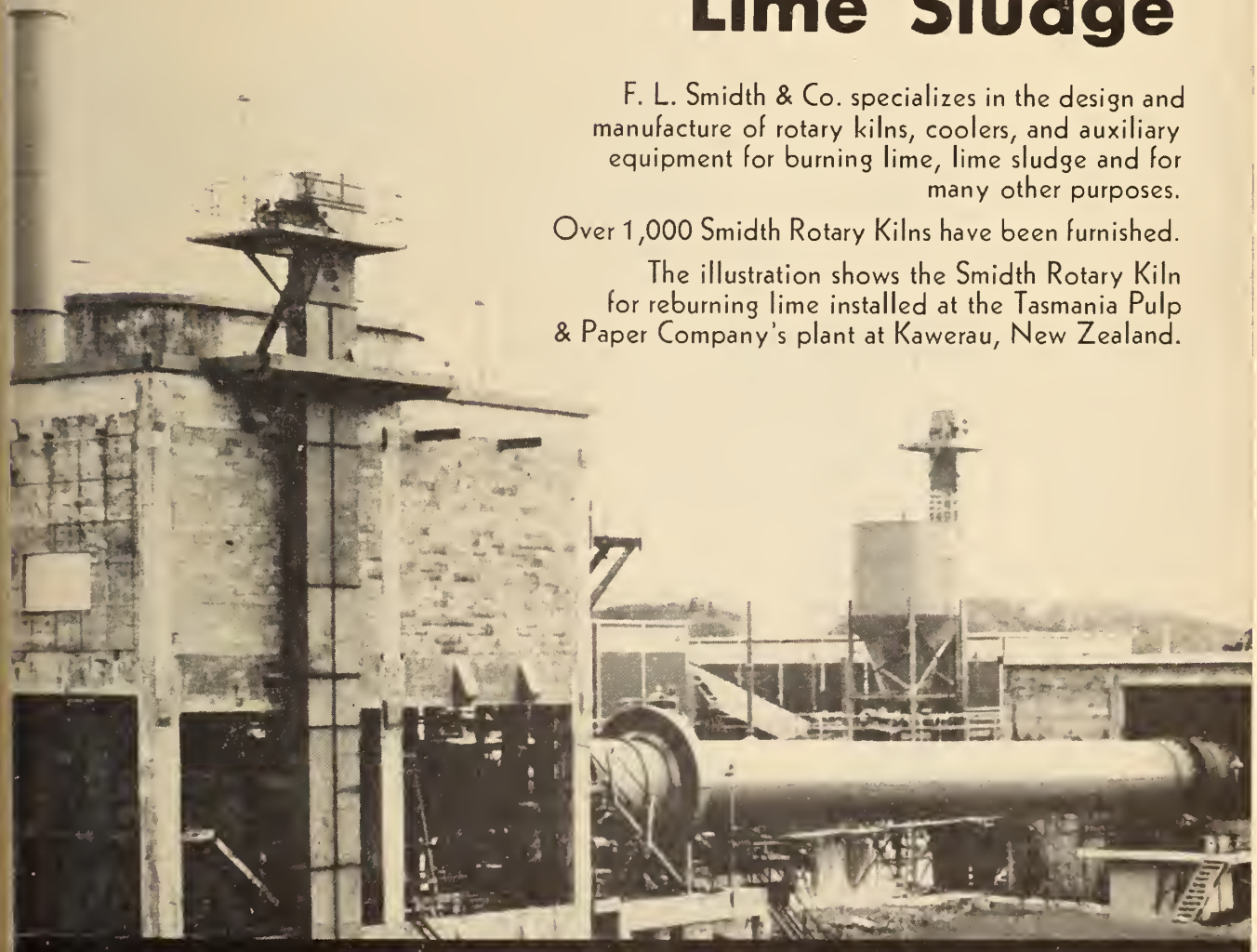
The illustration shows the Smidth Rotary Kiln for reburning lime installed at the Tasmania Pulp & Paper Company's plant at Kawerau, New Zealand.



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• Personals

and Structural Engineers of Great Britain.

C. W. Coote, M.E.I.C., has been transferred from Montreal to the Edmonton refinery as assistant manager by the British American Oil Company. He was assistant manager of the company in Montreal.

A chemical enginering graduate of the University of Alberta, class of 1939, he has also been refinery manager with the company in Calgary, Alta.

J. V. Daniliauskas, M.E.I.C., has joined the St. Lawrence River Joint Board of Engineers in Cornwall, Ont., as soils engineer. He was formerly hydraulic engineer with Power Corporation of Canada Ltd. in Montreal.

He has also been with the Canadian National Railways in Montreal as mechanical assistant in the chief architect's office in 1951.

Fenco Names New Vice-Presidents

Foundation of Canada Engineering Corporation Ltd. of Toronto and Montreal has announced the appointment of **N. D. Lea,** M.E.I.C., and **G. G. Leroux,** M.E.I.C., as vice-presidents.

Norman D. Lea became associated with the Foundation Company in Toronto in 1946 after graduating from the University of Toronto with a B.A.Sc. (honours) degree in civil engineering the year before. In 1949-50 he attended Harvard University and received his M.Sc. degree (honours) in a special course in soil mechanics.

G. G. Leroux, M.E.I.C.

Returning to Fenco in the Montreal office, he was named senior soils engineer in 1951. In 1953 he was also appointed vice-president of Gunite & Waterproofing Ltd., and the following year became assistant to the vice-president of Foundation of Canada Engineering Corporation Ltd., the position he held until his recent appointment as vice-president. Mr. Lea will be with the head office in Toronto.

N. D. Lea, M.E.I.C.

He is a member of the Manitoba Association of Professional Engineers, the Ontario Association of Professional Engineers, and of the Corporation of Professional Engineers of Quebec.

George G. Leroux graduated from McGill University in 1940 with a B.Eng. degree in civil engineering. After serving as a navigation officer in the R.C.A.F. he joined Fenco in 1945 as job engineer on the Metis Power Development.

In 1947 he was design engineer for the company and the following year was appointed superintendent of Duncan Wharf for the company in Port Alfred, Que. From 1949 to 1952 he was supervisor of engineering design in Montreal and then was named division engineer of construction, also in Montreal. In 1954 he was assistant general superintendent of heavy construction and also assistant to the vice-president. With his new appointment as vice-president Mr. Leroux will remain with the Montreal office of the company.

George Ross, M.E.I.C., has been named assistant to the executive vice-president of Inland Cement Company Ltd. in Edmonton, Alta.

Mr. Ross, a civil engineering graduate of the University of Alberta, was formerly sales engineer with Northwest Industries Limited, also in Edmonton.

J. R. Holmes, M.E.I.C., is now engaged in private practice as a professional sales engineer specializing in service for Canadian industry. He has his office in Montreal.

Mr. Holmes was previously district manager for Bush A.B.O.E. (Canada) Limited in Montreal, Que.

He is an electrical engineering graduate of McGill University, having received his B.Sc. degree in 1929.

E. T. Charnock, M.E.I.C., superintendent of technical services of the Great Lakes Paper Company, Fort William, Ont., has been elected chairman of the Lakehead Branch of the Engineering Institute.

Mr. Charnock was born in Fort William, Ont. and received his secondary education there. In 1938 he graduated from the University of Toronto with a B.A.Sc. degree in chemical engineering. Immediately after his graduation he joined the J R. Walkins Company in Winnipeg, Man., as a chemist.

MOBILE COMMUNICATION CENTERS

Radio Engineering Products has been continually in production of mobile communication centers for various NATO headquarters and for the U.S. Signal Corps Engineering Laboratories, over a period of several years. The centers produced have included type AN/MSC-1, type AN/MSC-5, and type AN/MSC-12, which have been or are being manufactured in full accordance with U.S. Signal Corps specifications. There have also been produced systems engineered by us to the specific requirements of a headquarters.

These systems have employed in some instances trailers and tractors of modified commercial types supplied by us, in some instances standard military-type vehicles supplied by us, and in some instances the using agency has supplied standard military-type tractors, trailers and trucks.

These centers have provided in mobile form, some or all of the following functions, in some cases in very complex and extensive form:

- Operations rooms for signal officers and commanders.
- Teletype conference viewer facilities.
- Teletype switchboards up to 120 lines.
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- Testing of military and civil wire facilities.
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- Multi-channel carrier-telephone and carrier-telegraph systems for superposing on wire and radio facilities.
- H-F frequency-shift radio transmitting facilities, and matching dual-diversity receiving positions.
- Teletype message-center, tape-relay, and cryptographic facilities.
- Mobile diesel power plants.

Radio Engineering Products has a broad and extensive knowledge of this subject, unparalleled plant facilities, and a team of engineers, production executives, and craftsmen which place us in a unique position in this field. We will gladly supply estimates on mobile com-centers to specific requirements on request.

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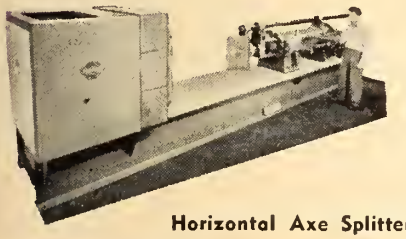
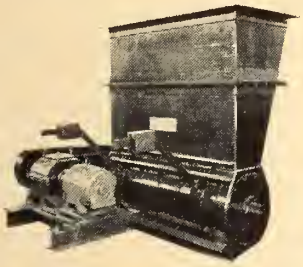
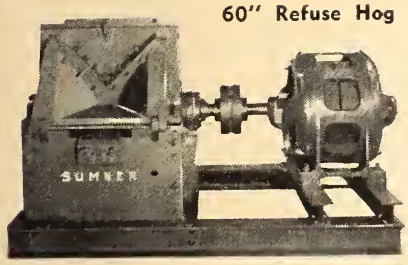


Horizontal Axe Splitter



Chip Feeder

60" Refuse Hog



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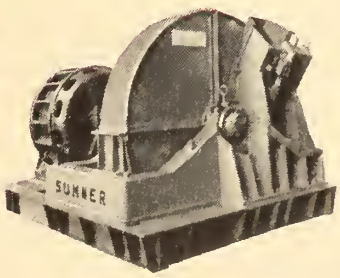
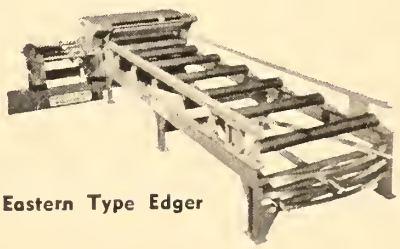
- 1 HORIZONTAL AXE SPLITTER
- 2 60" REFUSE HOGS





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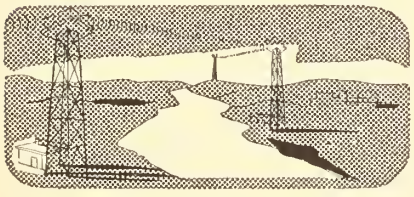

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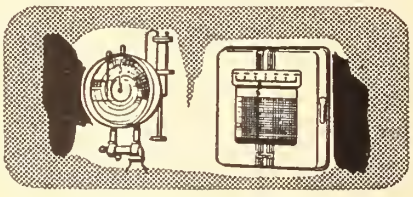

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SEVENTY-FIVE YEARS OF PROGRESS 1880–1955 75

• Personals

He began his association with Grea Lakes Paper Company in 1942 as sul phite engineer and was later name assistant sulphite superintendent. H assumed his present position in 1954.

Mr. Charnock joined the Engineerin

E. T. Charnock, M.E.I.C.

Institute as a Junior in 1944 and tran ferred to Member in 1948.

A. Reg. Underhill, M.E.I.C., has bee named city engineer for the City Brandon, Man. He was formerly offi engineer in the city engineering offi of the City of Regina.

Mr. Underhill is a civil engineerir graduate of the University of Albert class of 1949.

In 1952 he was technical officer at th Suffield Experimental Station in Ralsto Alta.

C. R. Stones, M.E.I.C., has been nam assistant to the manager of the enginee ing department of the Bowater Co poration of North America Ltd. Montreal.

Mr. Stones was previously associate with William Kennedy & Sons Limite and Had-Mil (Canada) Limited Owen Sound, Ont., as chief enginee having joined that company in 19 when he came to Canada from Englan He was first in Montreal as chief eng neer in the paper machinery divisio moving to Owen Sound later that ye for the company.

In England Mr. Stones was with th Bowater Paper Corporation in Londo from 1947 to 1952 as engineer in charg of various subsidiary companies inclu ing paper making, bag and multi-wa sack and corrugated box manufactu In 1945 he was with Bowater Mers Paper Mills Ltd. as assistant chief eng neer and from 1935 to 1945 he was wi Bowater Thames Paper Mills Ltd. chief draughtsman, and then wor manager.

W. H. D. Hanchet, M.E.I.C., has bc named contracts and service manager Doman Fleet Helicopters Limited Fort Erie, Ont.

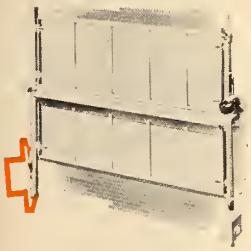
Mr. Hanchet, a mechanical enginee ing graduate of McGill University 1946, has previously been with th Canadian Pratt & Whitney Aircra Company in Longueuil, Que.

taking the extra stresses

Freight elevators need extra ruggedness of design to stand up under industrial power truck loading "punishment." The arrows in the diagrams at the left show how impact stresses vary when the elevator platform is level, below or above the landing. They also show the effects of a fast braking stop. These and the stresses of off-balance loading, and extra static loading are at work, not singly, but simultaneously and in endless combinations—as described in detail in Otis Heavy Duty Freight Elevators booklet B-705.

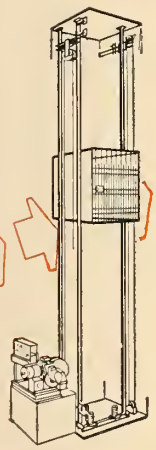
simplifying multi-floor handling

Freight elevators can easily be made to step up the efficiency of floor-to-floor production lines. The same electronic skill *that developed automatic operatorless AUTOTRONIC® elevators for busy office buildings* is ready to make completely automatic freight elevators an integral part of vertical production lines. This thinking can be applied to new buildings, to new elevators for existing buildings, and to modernizing outmoded light duty, general duty and heavy duty freight elevators.



time-saving hoistway doors

Otis power-operated biparting hoistway doors open while the car levels. This is a major time-saving feature. As compared with manual operation, automatic power operation is safer, quicker, smoother, and materially reduces round-trip time for busy freight elevators. The electric door operator does not depend on "coast" but drives the doors and car gates quietly to the fully opened and closed positions—as described in Otis Hoistway Doors booklet A-389 for new installations and modernization.



save costly building alterations

Otis Light Duty freight elevators have a semi self-supporting framework that permits installation in new and existing hoistways without reinforcing the building, or adding overhead supports, or building a penthouse. They can be used for any rise up to 35 feet at a speed of 25 feet per minute with lifting capacities of 1,500, 2,000 and 2,500 pounds. They're described in Otis booklet B-720.

value of a maker's pride

A perfectly performing installation is Otis' best salesman. That's why Otis maintenance is planned to keep elevators running like new—*year after year!* Preventive maintenance is *engineered service by the maker* that prevents slowdowns and breakdowns; extends elevator life by 50%; eliminates expensive, unexpected repair bills; keeps replacement parts readily available; and provides 24-hour-a-day service on a nationwide basis with factory-and-field trained men that have a knowledge of elevatoring that can't be matched.

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DUMBWAITERS

HOISTWAY DOORS

MODERNIZATION

MAINTENANCE

PASSENGER ELEVATORS

otis

• Personals

Jean H. Richer, M.E.I.C., has been appointed transportation executive to one of the operating companies of Brazilian Traction, Light and Power Company Ltd. He will be located in Rio de Janiero, Brazil.

A native of Montreal, he attended Brebeuf College and then obtained his B.Eng. degree in mechanical engineering from McGill University in 1943. During the summer of 1954 he took the management training course of the business administration school of Western University.

Mr. Richer served with the Royal Canadian Navy during World War II as engineering officer aboard frigates and destroyers.

In April 1946 he joined the Montreal Transportation Commission (then the Montreal Tramways Company) as assistant to the executive. In 1949 he was appointed director of time-tables and in February 1952, he was named assistant superintendent of transportation.

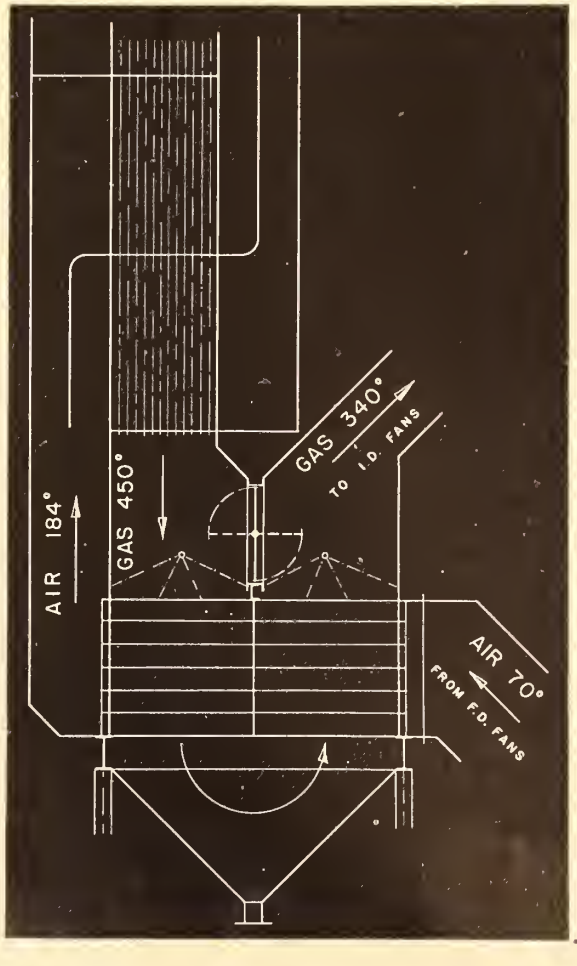
Dr. Charles A. Robb, M.E.I.C., has established a full time consulting practice in Montreal and will provide an analytical and advisory service to industry and to consulting engineering firms.

J. H. Richer, M.E.I.C.

Dr. Robb is a graduate of McGill, M.I.T. and Johns Hopkins University. He has taught engineering at M.I.T., the University of Alberta and at McGill University. He was professor of mechanical engineering and resident engineer at the University of Alberta for twenty years. As resident engineer he was responsible for the design, operation and maintenance of all power services, a steam power plant and a district heating system. Also during this period he served as consultant to utilities on thermal power problems.

Dr. C. A. Robb, M.E.I.C.

During the early years of the Second World War he was employed by the Canadian government as power consultant to the Department of Munitions and Supply. From 1942 until 1945 he was with the Aluminum Company of Canada as a power expert and was concerned with steam and hydro power costs and with power resources. Following the end of the war until entering private practice in 1953 Dr. Robb was chairman of the department of mechanical engineering at McGill University



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The typical arrangement shown is taken from a new booklet

"THE AIRHEATER PROBLEM"

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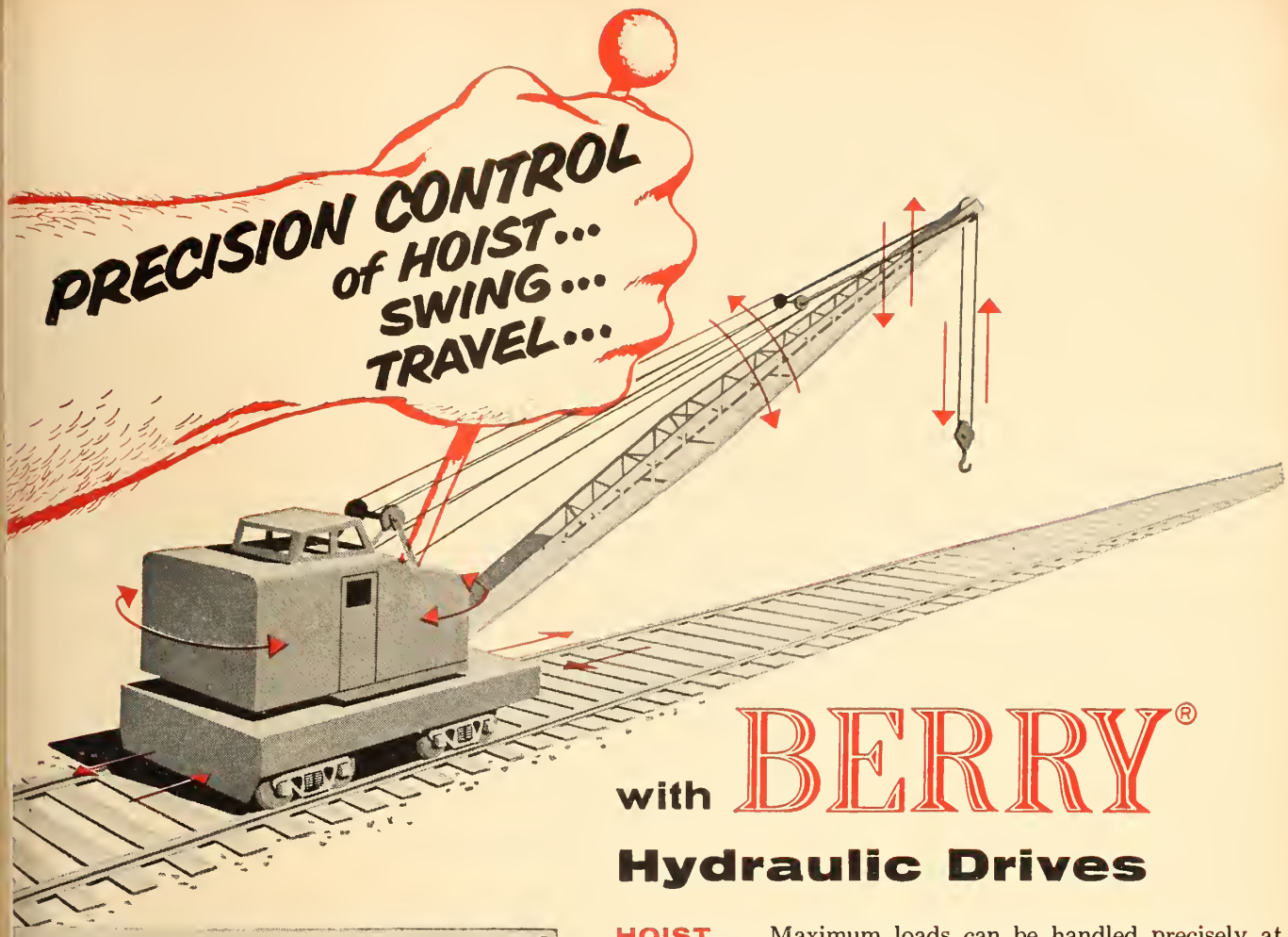

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for Canada's Industries

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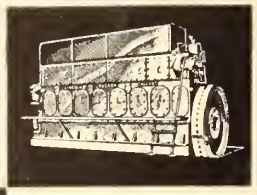
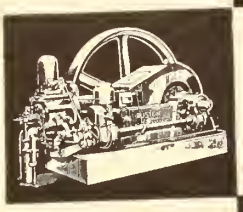
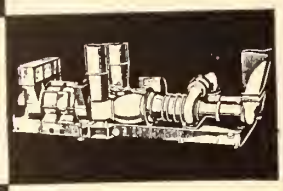


Diesel power in pocks, portoble generoting sets or seporote engines from 4 b.h.p.



Slow speed, extro long-life horizontol oil engines from 5½ to 295 b.h.p.



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Norrow gouge under-ground ond surfoce diesel locomotives from 3½ to 44 tons.

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Canadian Office & Spares Depot, 2, Paxman Road, Islington, Toronto 18, Ontario.

• *Personals*

where he taught thermal power plant design.

While at Alberta Dr. Robb carried out research programs on lubrication and operation of internal combustion engines at low temperatures and on the combustion of lignite coal. In 1938 he earned a doctorate under Dr. A. G. Christie of Baltimore for research and study on steam turbine design and turbine heat balance calculation techniques. Much of his teaching and consulting work since that time has been in these fields. Dr. Robb has been retained by more than thirty major firms as consultant.

Dr. Robb joined the Engineering Institute in 1908 as a Student, transferred to Associate Member in 1913 and to Member in 1923. He attained life membership in 1948.

V. G. Kosnar, M.E.I.C. has been transferred to the architectural section of the air services branch of the Department of Transport at Ottawa. He was formerly in the engineering and construction division of the department, also in Ottawa. He has also been with the Department of Mines and Resources in the surveys and engineering branch.

Mr. Kosnar is an electrical engineering graduate of McGill University, class of 1938.

N. J. Goode, M.E.I.C., is now associated with the Municipality of Burnaby, B.C. His position will involve operation of the water distribution system within the municipality.

Mr. Goode, a 1941 civil engineering graduate of the University of British Columbia, was previously public health engineer with the Department of Health in Victoria, B.C. He has also been in Regina, Sask. as senior sanitary engineer with the Department of National Health and Welfare.

G. H. MacDonald, M.E.I.C., has joined Hoyle Mining Company Ltd. in Toronto.

A mining engineering graduate of McGill University, he was formerly senior mining engineer and draughtsman with Canadian Johns Manville Company Ltd. in Asbestos, Que.

Edgar A. Thompson, M.E.I.C., has been named site superintendent at Site 40 on the DEW line project for the Foundation Company of Canada, Montreal.

Mr. Thompson has been associated with Ernest Harmon in Stephenville, Nfld. as construction and inspection engineer, and with Terminal Construction Company Ltd. in Montreal and in St. John's, Nfld. He has also been town engineer for Sackville, N.B. and for Bridgewater, N.S.

D. W. Blair, M.E.I.C., has been transferred from Toronto to Moncton, N.B. by the Canadian National Railways.

A civil engineering graduate of the University of New Brunswick, Mr. Blair became associated with the railway in 1946 as a junior assistant engineer in the department of research and development in Montreal. He was appointed assistant engineer at Levis, Que. in March 1947 and later that year, division engineer in the Laurentian division, Quebec. He was transferred in the same capacity to Montreal terminals and St. Jerome division in 1950. In 1953 he was named district engineer of the Southern Ontario district with headquarters in Toronto.

E. G. Ryley, M.E.I.C., has joined the firm of A. E. Rules Company Ltd., general contractors of Toronto. He was previously with the W. C. Brennan Contracting Company in Hamilton, Ont.

Mr. Ryley, a civil engineering graduate of McGill University, has also been associated with the Dinsmore-McIntire Company in Windsor, Ont. and with the A. W. Robertson Company at Long Branch, Ont. He has also been connected with Truscon Steel Company of Canada Ltd. in Walkerville, Ont., as general sales manager.

Maurice J. Kenn, M.E.I.C., has been appointed to the newly created position of lecturer in fluid mechanics on the faculty of engineering at the University of London King's College, London, England.

Mr. Kenn, who received his B.A.Sc. degree in 1947 from London University and his M.A.Sc. degree from the University of Toronto in 1952, was previously lecturer in civil engineering at the Imperial College of Science and Technology, City & Guilds College in London, Eng.

Donald E. Guard, M.E.I.C., is senior planner with the London and Suburban Planning Board at London, Ont.

A civil engineering graduate of the University of Manitoba, class of 1945, Mr. Guard has been associated with surveys branch of the Department of Mines and Natural Resources for the government of Manitoba.

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• Personals

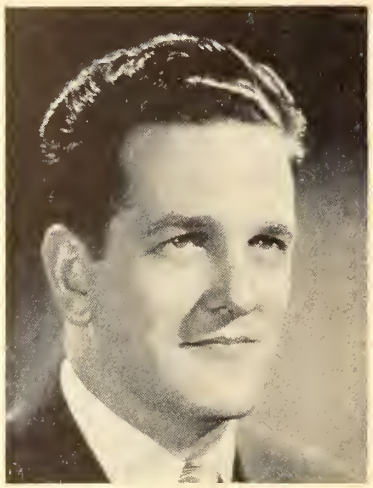
For the past two years Mr. Guard has been studying at the University of Manitoba in the field of community planning on a C.M.H.C. fellowship.

John J. Killin, JR.E.I.C., design engineer at the Great Lakes Paper Company in Fort William, Ont., has been elected secretary-treasurer of the Lakehead Branch of the Engineering Institute.

Born in Ocean Falls, B.C., Mr. Killin moved to Quebec City and received his secondary education in that city. He graduated from the University of New Brunswick in 1950 with a B.Sc. degree in civil engineering after serving four years in the Royal Canadian Air Force.

Mr. Killin has also been employed in the control department and in the paper mill and research and development department of the Anglo Canadian Pulp and Paper Mills. He began his association with the Great Lakes Paper Company in 1950.

He joined the Engineering Institute in 1948 as a Student and transferred to Junior in 1952.



J. J. Killin, Jr.E.I.C.

P. J. Tansey, Jr.E.I.C.

P. J. Tansey, JR.E.I.C., has been appointed St. Lawrence Seaway representative of Shell Oil Company of Canada Ltd. Mr. Tansey assumes an entirely new position in the company's organization and will be responsible for all sales and services to firms engaged in seaway contracts.

Mr. Tansey graduated in 1948 from McGill University with a mechanical engineering degree. He has held various positions with Shell Oil in the commercial and industrial field since 1950.

David L. Townsend, JR.E.I.C., after completing an Athlone fellowship in England studying soil mechanics, has joined the civil engineering department of Queen's University as lecturer.

Mr. Townsend graduated from McGill University in 1948 with a bachelor's degree in civil engineering and in 1953 received his master's degree. He received a diploma from Imperial College, London, in 1954. While in London he was associated with Soil Mechanics Ltd. and with John Mowlem and Company.

E. B. Bowes, JR.E.I.C., is now design engineer with International Harvester Company of Canada Ltd. in Hamilton, Ont. He was previously in Chatham, Ont., with the company as development test engineer.

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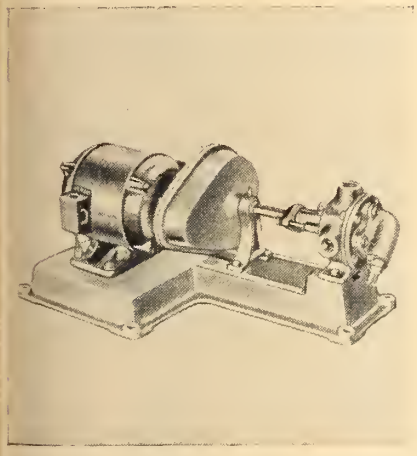

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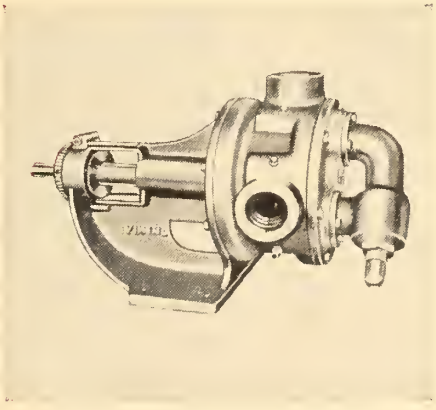
Specifically designed pumps for handling liquid petroleum gas or anhydrous ammonia in Bulk Stations or gas fueling units.



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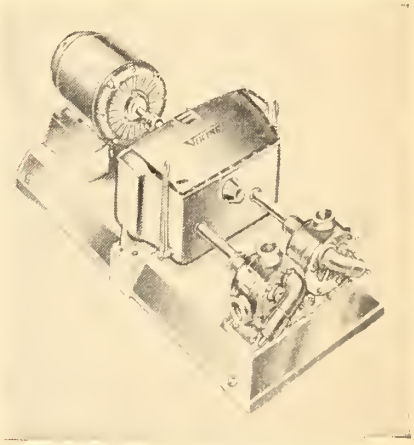

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• Personals

Mr. Bowes graduated in 1948 from Queen's University with a B.Sc. degree in mechanical engineering. He has also been with Truck Engineering Limited in Woodstock, Ont.

R. G. Redman, JR.E.I.C., has joined Atlas Steels Limited in Welland, Ont.

Mr. Redman had been with E. B. Magee Limited in Port Colborne, Ont., as office engineer since 1952.

After his graduation in 1949 from the University of Toronto he was product design engineer for R. D. Werber Company Ltd. in Oshawa, Ont.

William G. Cole, JR.E.I.C., is assistant methods analyst in the methods department of the Hydro Electric Power Commission of Ontario in Toronto. He has been with the H.E.P.C. since his graduation in 1949 from the University of Toronto with a B.A.Sc. degree in electrical engineering, and was previously assistant to the area engineer at Port Credit and also has been assistant meter and relay engineer at Belleville for the company.

Kenneth J. Irwin, JR.E.I.C., who received his master's degree this year from Ohio State University, is now employed as development engineer with the E. I. Dupont de Nemours & Company in Wilmington, Delaware.

Mr. Irwin graduated in 1949 with a bachelor's degree in mechanical engineering from the University of Toronto. Then he became associated with Horton Steel Works Limited in Fort Erie, Ont., prior to taking his post graduate course last year.

Sheldon Cherry, JR.E.I.C., has joined the civil engineering department of the University of Manitoba. He was formerly in England with the engineering laboratories at the University of Bristol.

Mr. Cherry graduated in 1949 from the University of Manitoba with a B.Sc. degree in civil engineering. He was a gold medallist of the university and then went to the University of Illinois as a graduate research student.

E. C. Walton, JR.E.I.C., is now employed by the Township of Scarborough, Ont., as road maintenance engineer. He was formerly with Timber Structures of Canada Ltd. in Peterborough, Ont.

Mr. Walton graduated in civil engineering from the University of London in 1949 and has also been associated with Stone & Webster Engineering Corporation in Toronto.

J. Arthur Reid, JR.E.I.C., has been named manager of induction motor sales at Canadian Westinghouse Company Ltd. in Hamilton. He was formerly a section engineer in the application engineering department at Westinghouse.

Mr. Reid graduated in 1949 from the University of Manitoba in electrical engineering and joined Westinghouse as a student engineer. After three years in the company's frequency conversion division he entered the application engineering department in 1953 and was named section engineer last June.

Mr. Reid has served as secretary-treasurer of the Hamilton Branch of the Engineering Institute.

R. R. Spence, JR.E.I.C., has been named manager of co-ordinated machine and control sales for Canadian Westinghouse Company Ltd. in Hamilton, Ont. He was previously supervisor of industrial machine sales for the company, also in Hamilton.

Mr. Spence graduated in 1949 with a B.Sc. degree in electrical engineering from Queen's University and immediately joined Canadian Westinghouse as an engineering apprentice.

L. E. Fownes, JR.E.I.C., is now plant engineer with the Canada Creosoting Company at Trenton, Ont.

An electrical engineering graduate of Nova Scotia Technical College in 1950, Mr. Fownes was previously an electrical supervisor in the plant engineering department of A. V. Roe Canada Ltd. at Malton, Ont.

Eric O. Stenerson, JR.E.I.C., has joined Canadian Vickers Limited in Montreal and is with the machinery division.

Mr. Stenerson graduated in 1950 with a M.Sc. degree in mechanical engineering from the Technical University in Denmark.

Before his new position he was with

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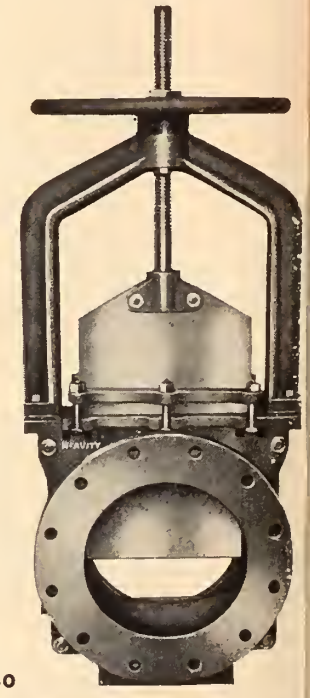

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• Personals

Falconbridge Nickel Mines Limited in Falconbridge, Ont.

John P. Beauregard, Jr.E.I.C., is now gas turbine performance engineer with Orenda Engines Limited at Malton, Ont. He has been with the gas dynamics section of the mechanical engineering division of the National Research Council in Ottawa.

Mr. Beauregard received his B.Eng. and his M.Eng. degrees in mechanical engineering from McGill University in 1950 and 1952 respectively. He then went to England and engaged in a two year course at Rolls-Royce Limited, Derby, returning to Canada in 1954 when he joined the N.R.C. in Ottawa.

Stuart F. Smith, Jr.E.I.C., is now with the engineering department of Canadian Oil Refineries Ltd. in Corunna, Ont.

A chemical engineering graduate of the University of Toronto, class of 1950, Mr. Smith has been with the Nichols Chemical Company in Valleyfield, Que., as plant supervisor.

W. J. De Coursey, Jr.E.I.C., has joined the chemical metalurgical division of Sherritt Gordon Mines Ltd. at Fort Saskatchewan, Alta. His position is that of chemical process engineer.

Mr. De Coursey received his Ph.D. degree from London University this year. He graduated in 1951 from the University of Alberta with a B.Sc. (Honours) degree in chemical engineering. He was then awarded an Athlone fellowship and joined the chemical engineering department of the Imperial College in London, England.

J. M. Raspberry, Jr.E.I.C., is now associated with the firm of Jas. F. MacLaren Associates, consulting engineers of Toronto.

Mr. Raspberry has been with the city engineer's department of the City of Hamilton, Ont. since his graduation in 1951 from the University of Toronto with a B.A.Sc. degree in civil engineering.

Eugene Dontigny, Jr.E.I.C., is now associated with George Demers, consulting engineer in Quebec City.

Mr. Dontigny graduated in 1952 from McGill University in civil engineering. He has been with H. G. Acres and Company in Lac Cassé, Que. and with the Hydro Quebec in Labrieville, Que.

John F. Frisch, Jr.E.I.C., is now employed as mechanical engineer in the pulp division of British Columbia Forest Products Ltd. in Vancouver, B.C. Previously Mr. Frisch held the same position in Montreal with the technical section of the Canadian Pulp and Paper Association.

He graduated in 1952 with a degree in mechanical engineering from McGill University.

Harold H. Hinton, Jr.E.I.C., is now project officer for Site 36 for the Foundation Company of Canada Ltd. in Montreal. He was previously with the track department of the Canadian Pacific Railways in Montreal.

Mr. Hinton graduated in 1952 with a B.Eng. degree in civil engineering from McGill University and has spent some time in Newfoundland with the U.S. Corps of Engineers at Stephenville.

Gordon Gracie, Jr.E.I.C., is spending a year in Holland where he will be engaged in studying photogrammetry at the International Training Centre for Aerial Survey at Delft.

Mr. Gracie graduated from the University of Toronto in 1952 with a B.A.Sc degree (honours) in civil engineering. He has been associated with Photographic

John P. Beauregard, Jr.E.I.C.

Survey Corporation Ltd. in Toronto as project engineer since his graduation.

John A. Stewart, Jr.E.I.C., is maintenance engineer at the Hull Lower Mill of the E. B. Eddy Company at Hull, Que.

Mr. Stewart graduated from Nova Scotia Technical College in 1952 with a bachelor's degree in mechanical engineering. Upon graduation he joined Canadian Industries Limited at Maitland, Ont., as maintenance foreman.

R. M. Wilde, Jr.E.I.C., is presently in Toronto with the Bell Telephone Company of Canada as equipment engineer.

Mr. Wilde has a bachelors degree in electrical engineering from the University of Manitoba, class of 1952, and has previously been with English Electric Company of Canada Ltd. in St. Catharines, Ont.

Ralph E. Donkin, Jr.E.I.C., is now employed as assistant construction engineer in the planning and works department of the roadways branch of the City of Ottawa.

Mr. Donkin graduated from the University of New Brunswick with a B.Sc. degree in civil engineering, class of 1953.

He had been with Dominion Bridge Company Ltd. in Montreal as junior engineer.

J. H. Drinnan, Jr.E.I.C., is now a graduate assistant in the electrical engineering department of the Illinois Institute of Technology. He was previously in Hamilton, Ont. as a trainee with Canadian Westinghouse Company Ltd.

Mr. Drinnan graduated in 1953 with a B.A.Sc. degree in electrical engineering from the University of British Columbia.

C. I. Cameron, Jr.E.I.C., has joined the engineering department of the Mersey Paper Company in Liverpool, N.S., as structural engineer.

Mr. Cameron graduated from the University of New Brunswick in 1953 with a degree in civil engineering. Before assuming his present position he was employed as structural engineer with the Nova Scotia Department of Highways. He has also been with the City of Saint John, N.B. as structural engineer.

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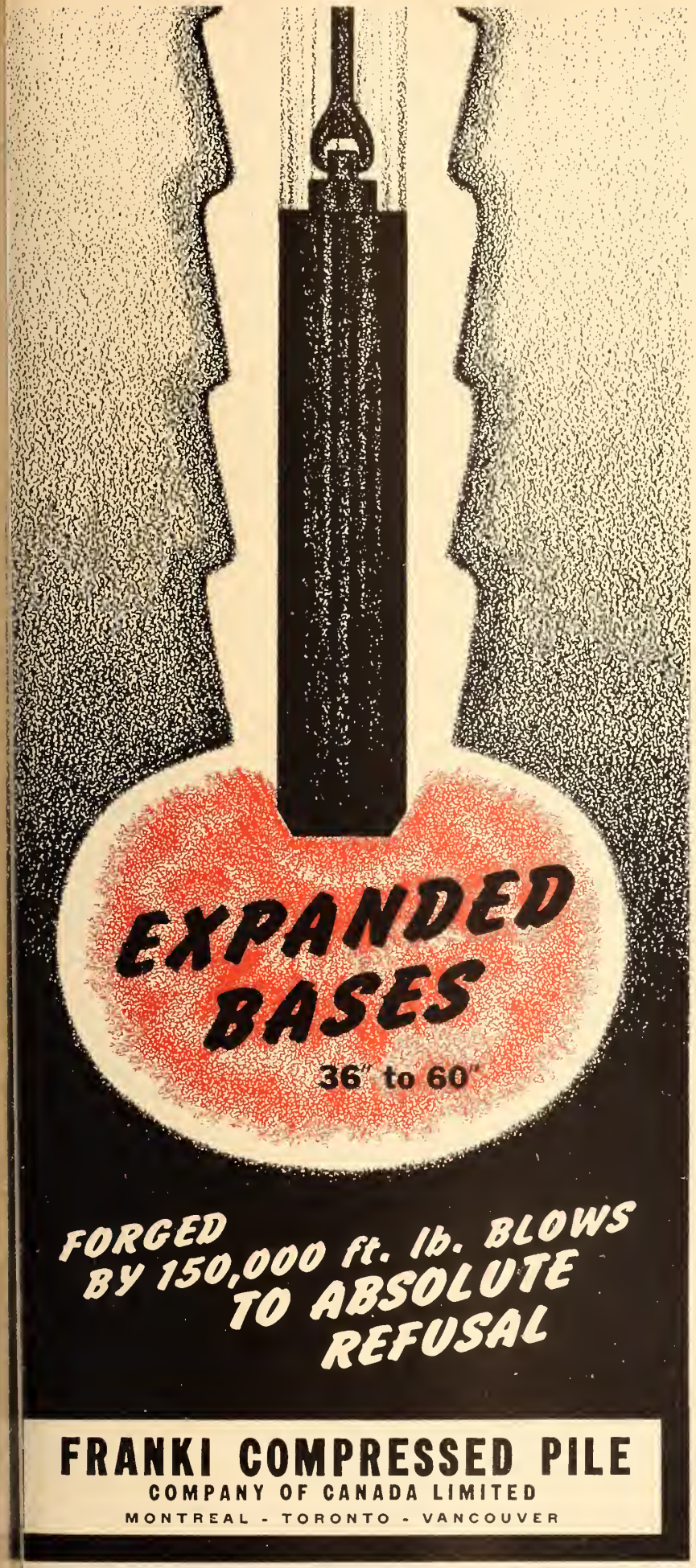

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Soil investigations by Franki found the subsoil to be as follows:

0″ to 1′ 0″ Top soil
1′ 0″ to 4′ 0″ Brown sandy clay containing a few rock pebbles
4′ 0″ to 9′ 0″ Grey sandy and silty clay
9′ 0″ to 24′ 0″ Mixture of clay and gravel with numerous silt lenses
24′ 0″ Bedrock

The water table October 8th, 1953, was found 10′ below surface with numerous puddles on the surface caused by improper drainage. Due to lack of homogeneity in the nature and resistance of the subsoil, the design on spread footings would have entailed special engineering difficulties with possibility of settlement. Franki caisson-piles were therefore chosen to alleviate subsoil conditions.

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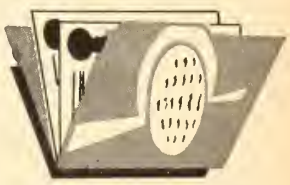

• Personals

Graeme M. Tuttle, JR.E.I.C., has been transferred by the Canadian Gulf Oil Company from Calgary to Stettler, Alta.

Mr. Tuttle graduated in 1953 from McGill University with a degree in civil engineering and immediately became associated with Canadian Gulf Oil as an engineering trainee in Calgary, Alta.

Pierre Y. Dionne, S.E.I.C., is with the traffic department of the Quebec Telephone Company at Rimouski, Que.

Mr. Dionne graduated last April from Laval University with a B.A.Sc. degree in civil engineering.

George A. Flett, S.E.I.C., is now a junior engineer on the staff of the Spruce Falls Power and Paper Company at Kapuskasing, Ont.

He graduated this spring from Queen's University with a B.Sc. degree in mechanical engineering.

Keith E. VanVliet, S.E.I.C., who graduated in 1954 from Nova Scotia Technical College with a B.Eng. degree in mechanical engineering, is now with Lytle Engineering Specialities Ltd. in Toronto.

Mr. VanVliet has also been with the Department of Citizenship and Immigration at Lacolle, Que.

Kenneth W. Walker, S.E.I.C., is with the engineering division of Imperial Oil Limited at Sarnia, Ont., and is presently employed in the draughting room of the company.

Mr. Walker graduated this spring from the University of New Brunswick with a B.Sc. degree in civil engineering.

Peter Geiger, S.E.I.C., who has been with the canal services branch of the Department of Transport in Cornwall, has joined Iroquois Constructors, also in Cornwall.

Mr. Geiger graduated last spring from the University of Toronto with a B.A.Sc. degree in civil engineering.

John P. Mooney, S.E.I.C., an electrical engineering graduate of Nova Scotia Technical College, class of 1955, is with New Brunswick Telephone Company Ltd. He is with the equipment engineering section of the company at Saint John, N.B.

R. L. M. Lord, S.E.I.C., is presently employed as an electrical engineer by the City of Montreal, Que.

Mr. Lord, a 1954 graduate of Michigan State College in chemical engineering, was previously a process engineer with the Dominion Tar and Chemical Company in Montreal.

Leslie H. Tough, S.E.I.C., has accepted a position as mechanical engineer with British American Oil Company Ltd. at their Edmonton, Alta., refinery.

He graduated in 1954 from the University of Manitoba with a degree in mechanical engineering.

Harvey W. Thompson, S.E.I.C., is also with British American Oil Company Ltd., employed as assistant chemist at the Moose Jaw, Sask., refinery.

He is a chemical engineering graduate of Queen's University, class of 1954.

Kenneth O. Bartlett, S.E.I.C., has joined Canadian Gypsum Company Ltd. as a trainee engineer at Windsor, N.S.

Mr. Bartlett graduated from the University of New Brunswick this year with a degree in civil engineering.

Gordon H. Good, S.E.I.C., is employed by the Canadian Westinghouse Company in Hamilton, Ont., and is engaged on their graduate training course.

Mr. Good graduated last spring from Nova Scotia Technical College with a B.Eng. degree in mechanical engineering.

B. B. Hereus, S.E.I.C., has recently completed the graduate engineers training program at the Clarkson, Ont., refinery of the British American Oil Company and has been posted as technical assistant to the planning engineer of the manufacturing department of the company's head office in Toronto.

He graduated in 1954 from Queen's University with a B.Sc. degree in mechanical engineering.

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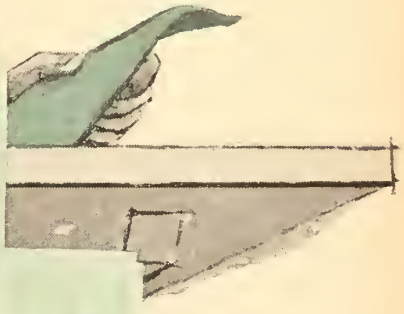

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CHEMICAL ENGINEER, M.E.I.C., age 35, married. Ten years experience in research, development, control and production in the pulp and paper industry. Seeks senior supervisory or administrative position. Complete resume upon request. File No. 660-W.

PRODUCTION ENGINEER, M.E.I.C., P.Eng. (Que.) McGill, diversified experience includes business administration, plant operation, Sales, purchasing, product control. Project engineering, labor negotiations. Manufacturing cost estimates and analyses. Plant layout, methods studies. Production planning and scheduling, material handling. Age 45. Married. Desires challenging and demanding position. Available on reasonable notice. Full resume on request. File No. 1186-W.

GRADUATE ENGINEER B.Sc. (C.E.) cum laude, 10 years experience selling heavy machinery, gears, speed reducers, steel and bronze castings to heavy industry, including shipyards, machinery builders, cement industry, steel fabricators and paper mills. Prior to this, wide experience in the production, inspection, maintenance engineering and time and methods study, phases of industry. The position desired would be in top level sales work, in sales management, or in management. It would offer ability and initiative, scope for advancement. File No. 2500-W.

GRADUATE ENGINEER, 1945, age 33, bilingual, diversified industrial experience combined with sales engineering in various fields such as process control instruments, coals and petroleum fuels. Excellent knowledge of fuel marketing and extensive experience in many aspects of fuel utilization: heating, combustion, smoke abatement, steam plant engineering and related equipment. Seeks technical position of senior responsibility in sales, service, purchasing, management. Montreal area preferred. File No. 2554-W.

CIVIL ENGINEER, Jr.E.I.C., McGill 1949, P.Eng., (Ont.) age 27. Experience as follows: design in reinforced concrete and structural steel, layout of building sites including roads, grading and drainage. Design of storm and sanitary sewers. Estimating and specification writing. Seeks job where knowledge will lead to position of increased responsibility. File No. 3134-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.) N.S.T.C. graduate 1950, 27 years old, single. Two years pulp and paper mill design and layout, one year diesel locomotive maintenance, 18 months railway car building and heavy repair. Desires responsible position where qualifications and experience can be utilized. Available on reasonable notice to present employer. File No. 3271-W.

ELECTRICAL ENGINEER, Jr.E.I.C., P.Eng., 1949, graduate. Married, 2 children. Experience as follows: 1 year electronics, 2 years on inspection of electrical equipment, 2 years on construction, operation and maintenance of power houses, transmission lines, substations, 1½ years with consulting engineers on design of power and lighting systems for industrial and commercial buildings. Desires position with heavy industrial power or consulting company. File No. 4124-W.

SALES ENGINEER, P.Eng., Alberta 1950, age 31, desires employment as sales representative working out of Hamilton. Willing to sell any industrial or construction product. Five years experience in sales and engineering with industrial electrical manufacturing firm. Have both factory and district experience (2 years Montreal). 3 years with Navy petty officer in radio and radar, married, family, resident of Hamilton. File No. 4213-W.

MECHANICAL ENGINEER, P.Eng., Jr.E.I.C., B.Eng., McGill '51. Single, 30. Completed graduate student training course with large electrical equipment manufacturer. Presently engaged as industrial engineer responsible for productivity of a power products line. Post graduate courses. Interested in position with greater responsibility, challenge and opportunity to demonstrate ability. File No. 4217-W.

INDUSTRIAL MANAGER M.E.I.C. Mechanical engineer wtih twenty years' experience all phases of engineering, production and management at both factory and general management level. Background covers sheet-metal manufacturing in both aircraft and commercial products. Successful record in organizing, leadership, and labor relations. Seeking career appointment, preferably in moderate sized company with opportunity for participation. File No. 4219-W.

CIVIL ENGINEER, Jr.E.I.C., Sask. 1949, married, age 27. Desirous of employment in Alberta. Experience chiefly in the field of heavy industrial equipment. Would like sales, plant engineering, application engineering. Presently located in Montreal. File No. 4517-W.

MECHANICAL AND INDUSTRIAL ENGINEER, McGill graduate, age 46, M.E.I.C., P.E.Q. and P.E.O., married. 21 years news print and fine paper experience, in repairs, maintenance and all phases of plant engineering. Desires change outside of Quebec. Available short notice. File No. 4540-W.

CIVIL ENGINEER GRADUATE McGill University, wishes to find employment with a medium sized construction company or smaller consulting firm. Over five years experience in all phases of the building field: Engineering studies, sight and soil investigation, design, construction, maintenance, inspection, and costing. Have worked for some of the best construction firms and engineers. File No. 4588-W.

EXECUTIVE-ENGINEER M.E.I.C., comprehensive experience background in construction and allied industries, with excellent profit results. Thoroughly familiar with industrial and commercial buildings. Seeks opportunity where mature financial judgment, organizing and administrative ability required. Well acquainted with estimating, tendering, costing and project supervision; accustomed to deal with top executives. Age 45, professional engineer (civil), post graduate in business administration. File No. 4640-W.

ELECTRICAL JR. E.I.C., McGill 52, presently employed, experience includes utility and power project work, switchgear and control design, and contracts, Industrial rectifier sales, and control work on D.C. drives. Interested in consulting or manufacturing in or around Montreal and would be available on one month's notice. File No. 4694-W.

CIVIL ENGINEER, M.E.I.C., P.Eng. (Ont.) A.M.I.C.E. (Britain), age 35, married. Desires responsible position with well established engineering firm or municipal authority, preferably in British Columbia or Ontario. Experience includes approximately 10 years with highways and bridges autborities in U.K., 3 years as executive engineer in the Public Works Dept. East Africa, and 2 years in government engineering and construction service in Canada. Good administrative ability with considerable experience in design specification writing, and supervision of construction of highway projects, reinforced concrete bridges, domestic and public building works, airfields, water supply, sewage disposal, and drainage schemes. File No. 4707-W.

ELECTRICAL ENGINEER, B.A.Sc. 1945, P.Eng., M.E.I.C., age 31, married with family. C.G E. test course, presently employed. Excellent technical and practical background combined with administrative experience including 7 years complete charge of electrical engineering, design, construction, operation and maintenance of large papermill and hydro electric stations including water control, transmission, relaying, and distribution. Other experience includes substation, illumination design and sales. Desires position In Canada or elsewhere with heavy industrial, power or consulting company where experience will be an asset. File No. 4725-W.

CIVIL ENGINEER, National University of Ireland, with eight years good general construction experience, including tunnels, roads and piling. Seeks position with good construction company. Free to travel. File No. 4770-W.

AGRICULTURAL ENGINEER, P.Eng., Jr.E.I.C., B.E. (Sask. 1951). Canadian citizen, 26, married, farm background, Canadian experience: 2½ years design drawing office. Britisb experience under Athlone Fellowship: one year machine shop training, one year divided between process planning, time and motion study, and design drawing departments. Desires position in design or development field, preferably connected with the farm equipment industry. Available Nov. 1st. Location open. Resume sent on request. File No. 4772-W.

FIRMS OR INDIVIDUALS IN CANADA or the U.S. desiring consultations or representation in Mexico, or other parts of Latin America may contact a professional engineer (Member Corp of Professional Engineers of Quebec) with broad and lengthy experience and

travel, knowledge of Spanish, permanent resident status in Mexico, and numerous important contacts in Canada, the U.S., Mexico, Venezuela, and the West Indies. Correspondence invited. File No. 4773-W.

MECHANICAL, ELECTRICAL ENGINEER, P.Eng., Jr.E.I.C., high standing graduate from Polytechnique, 1953, bilingual, single. Two years experience in administrative work with large municipality. Actually in charge of two engineers, one technician and two foremen. Two years evening studies in general electricity at McGill University. Seeks challenging position with advancement and incentive for consulting engineers or contractors located in Montreal area, not necessarily in electricity or mechanics. File No. 4774-W.

MECHANICAL ENGINEER, Jr.E.I.C., B.Sc., P.Eng. Six years varied experience in estimating, incentive systems, plant layout and product inspection. Supervisory and administrative experience as a departmental head responsible for high daily productive output of forged and machined products. Seeking responsible position with greater opportunity for advancement. File No. 4775-W.

METALLURGICAL ENGINEER, P.Eng., M.E.I.C., M.C.I.M.M., Canadian born. Married, age 37. Graduate McGill University. Course in management administration. Twelve years diversified experience in ferrous metallurgy. Development and supervision of chemical and metallurgical laboratories, inspection, specification and technical service divisions in steel finishing mill. Presently employed but seeks more responsible position. File No. 4782-W.

MECHANICAL ENGINEER, S.E.I.C., N.S.T.C. 1952, age 26, married, 2 children. Experienced in newsprint mill process and development. Excellent knowledge of process instrumentation. Desires permanent responsible position in development, production or instrumentation. Has done considerable supervising. Detailed resume on request. File No. 4783-W.

MECHANICAL ENGINEER, P.Eng. (Ont.), Jr. E.I.C., B.Eng. 1954, McGill University, age 24, married. Experience in sales, manufacturing methods and maintenance. Desires work of definite mechanical nature, either sales or/and engineering. Hamilton area preferred with moderate travel acceptable. File No. 4785-W.

YOUNG MANUFACTURING EXECUTIVE electrical engineer, M.S., P.Eng., M.E.I.C., A.M. I.E.E., A.M.A.I.E.E., early thirties, experienced manufacture switchgear and control gear, successively development engineer, chief engineer, manager. Seeks executive position (not necessarily electrical) with scope and good future prospects. Location open. File No. 4786-W.

MINING ENGINEER, specialized also in soil mechanics, wide experience drilling, prospecting, development, production; in coal, salt, quarries, oil and formerly full professor Mining Engineering, Technical Assistance Administration (U.N.) expert. Fluent English and French, Spanish, Portuguese. Married, age 45 years. Desires position where any former experience may be best utilized. Available immediately. File No. 4791-W.

MECHANICAL AND INDUSTRIAL ENGINEER, P.Eng. (Que.), Jr.E.I.C., graduate B.Eng., McGill 1951. 27 years old, married with two children. 4 years experience in fields of plant engineering, plant layout, process engineering, production control in various junior administrative positions with a medium-sized company in the manufacture of light precision machine parts. Extensive extra-curricular study in the fields of business administration accounting and auditing. Desire responsible position as deputy to general manager or in industrial engineering and production control where initiative and top performance will lead to increases in responsibility and incentive. Willing to travel and will locate anywhere in Canada or northeastern United States. Canadian citizen available upon three months notice. Substantiating data available on request. File No. 4792-W.

ELECTRICAL ENGINEER, B.Sc., E.E., 1953, age 24, single. Jr.E.I.C., 2 years in England on Athlone Fellowship, experience with large manufacturer of power equipment, several months experience in switchgear and relay applications departments, desires employment with future leading to position of responsibility in Canada or abroad. Please reply to File No. 4794-W.

CHEMICAL ENGINEER, M.E.I.C., married, age 47. 16 years experience in oil industry, 3 years experience in Canada as chemist analyst for ferrous and non-ferrous alloys. Economic studies, business and sales experience. Speaking fluently French and Italian. Interested in a position where capabilities will be fully utilized. Location and size of company is not important. Available on 15 days notice to present employer. File No. 4797-W.

MECHANICAL ENGINEER, Jr.E.I.C., age 30, five years practical experience in power plant, chemical plant, and refinery design and construction. Desires position in P.Q., preferably Montreal area. File No. 4798-W.

ELECTRICAL ENGINEER, B.A., B.A.Sc., Laval University 1954. Presently on a two year training course in England with a world wide company, specializing in hydro-electric. Undergraduate experience in the power field, experienced traveller. Married, 24, bilingual. Seeking interesting position with consultant firm or power company. Location open. File No. 4799-W.

GRADUATE ENGINEER, M.E.I.C., U. of T. 1922, chemical, civil, mechanical. Available Oct. 15, now resident Toronto. Immediate employment is desired anywhere, where there is prospect of permanence and some future ahead. Experience: tool designer, mechanical and architectural draftsman, structural steel and reinforced concrete detailer, pressure vessel detailer (over 10 years). Hold high school teaching certificate, have technical school and university teaching experience (12 years). Particular interest includes: chemical plant, oil refinery, steam plant, structural steel fabrication plant, associate or partner in consulting practice. Transportation expense advance is requested where interview is required prior to engagement. File No. 4800-W.

POWER ENGINEER, born U.K., B.Sc. (Eng.) 1947, P.Eng. Works trained—2 years experience electrical distribution—3 years transmission, design and construction—3 years power house design and construction. Last two years spent in Canada with consulting engineers as, resident electrical engineer on 80,000 H.P. hydro electric project and as a design engineer. Seeks responsible post with management prospects or as senior development engineer. Preferred location Montreal. File No. 4803-W.

MECHANICAL ENGINEER, member A.S.M.E., 43, married, 3 children. Registered State of Minnesota. B.Eng., McGill, Canadian citizen now resident in U.S. desires to return to Canada. 5 years service in R.C.A.F. as aeronautical engineer officer. 10 years experience design and development. Past 5 years as a senior engineer in engineering research and development department of large U.S. firm engaged in development and construction of special machines for civil military and atomic installations. Capable of handling projects from conception through prototype testing. Reason for change U.S. security clearance being withdrawn from aliens. File No. 4808-W.

GRADUATE MECHANICAL ENGINEER (McGill), age 34, 7 years of design and draughting experience in hydraulic turbine design, process and steam piping, plant layout, sheet metal work and materials handling seeks draughting or design work nights and/or on weekends. Also translation of German scientific papers into English. File No. 4809-W

MECHANICAL ENGINEER, Jr.E.I.C., age 31, McGill 1948. Past experience includes 2½ years plant engineer of substantial manufacturing and relocation operation involving multiple projects. 4½ years country wide sales of power plant and paper equipment of diversive nature. Affiliation in either plant engineering or sales desired. Canada or U.S. references and details available. File No. 4810-W.

MECHANICAL ENGINEER, M.E.I.C., age 39, married. Fifteen years valuable experience in designing estimating, selling and project engineering in the machinery and plate industry. Desires position in the Montreal area with reliable firm and good future. Presently employed, but available upon reasonable notice. File No. 4814-W.

MECHANICAL ENGINEER, P.Eng., M.E.I.C., A.M.I.Mech.E., First Class B.O.T. Steam & Diesel Certificate. 32 years old, married, no children. Desires responsible position in mechanical or marine engineering fields. Experience consists of five year workshop apprenticeship, seven years as marine engineer officer and one year surveyor to international classification society in United Kingdom. Canadian experience includes one year experimental thermodynamics, two years in charge engineering department large insurance company. Available on reasonable notice to present employer. File No. 4815-W.

CIVIL ENGINEER, Jr.E.I.C. (U.N.B. 1950), married. Age 29. Experience construction and maintenance. 5 years experience with large transportation company. Familiar sewage and drainage problems. Interested in municipal engineering or contracting. Fluently bilingual. Available on two weeks notice, for work in Quebec or Ontario. Expected salary open for discussion. File No. 4818-W.

SITUATIONS VACANT

CHEMICAL

CHEMICAL ENGINEERS required by chemical works within 40 miles of Montreal. Successful applicants will be trained for production supervision. Two years experience preferred. File No. 5352-V.

YOUNG CHEMICAL ENGINEER recent graduate or one with 1 to 4 years experience required by long established chemical manufacturer located 18 miles from centre of Montreal. Duties include part office and part plant. File No. 5371-V.

CHEMICAL ENGINEERS (3 years or less experience) required for research and development work in large chemical company situated in Niagara Falls, Ontario. File No. 5380-V.

ENGINEER REQUIRED FOR PROJECT engineering work by petroleum contractors in the Toronto area. Applicants should have minimum 3 to 5 years experience in petroleum or chemical industry with knowledge of equipment selection and coordination of engineering purchasing and construction. Salary open. File No. 5407-V.

CHEMICAL ENGINEER required by large Montreal manufacturer, recent graduate to be trained for work involving a wide variety of plant processes including organic finishes. Preference will be given to a recent University graduate, but consideration will also be given applicants with chemical finishing experience in the mass production field. File No. 5425-V.

TWO YOUNG CHEMICAL ENGINEERS to initially be assigned process evaluation and/or development problems and trouble shooting in the process plants. This-on-the-job training will lead to production supervision, technical sales or service or technical administration. Location Sarnia. File No. 5445-V.

CIVIL

SENIOR PROJECT ENGINEER required by young municipal engineering firm to supervise both design and construction of complete water supply and sewage disposal systems. Qualifications thirty to forty years with applicable experience in Canada. Please reply giving full details of academic training, professional experience, references and salary requirements. File No. 5332-V.

STRUCTURAL ENGINEER for technical promotion work in connection with a major type of building construction. Applicant must be a Canadian citizen experienced in structural design and capable of meeting and assisting engineers, architects and public officials with structural problems. Office in Toronto, considerable travel in Ontario. Salary $6,000. Car allowance. Reply stating personal data, qualifications and references. File No. 5360-V.

SOILS ENGINEER, required by rapidly expanding consulting firm located in Western Canada. Must have a post graduate degree majoring in soils and a minimum of five years experience in related work. State full particulars as to age, experience and salary expected in first letter. File No. 5365-V.

YOUNG ENGINEER or architect required for young construction firm, specializing more in sewer work and excavation but also doing building construction. Salary to start $400.00 per month. Must have at least two years experience and not over 35 years of age. Apply stating age, graduation, experience, and references to File No. 5373-V.

RECENT GRADUATE CIVIL ENGINEER required in the track section of the office of the chief engineer of a major railway company in Montreal. File No. 5377-V.

CIVIL ENGINEER preferably not over 35 years of age required by structural steel firm in Montreal, to act as salesman for roof deck and wall panel construction. Salary open. Please reply File No. 5393-V.

SOIL ENGINEERS, required by well-known Engineering and Construction Company. Must be graduate Civil Engineers, preferably with post graduate studies in Soil mechanics and foundation engineering. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

GRADUATE CIVIL ENGINEERS, required by well-known engineering and construction company for special work in the field of soil mechanics and foundation engineering. Post graduate studies in soil mechanics and structures desirable but not essential. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

SENIOR STRUCTURAL ENGINEER required for mining and concentrating plant design and layout. Please state full details of qualifica-

CAREER OPPORTUNITIES

Stimulating and challenging positions with a future are opening up in our new and expanding Research and Development Department in Montreal. At this time we have several responsible positions open (and others will be available during the coming months) for graduate engineers, chemists and physicists with experience in one or more of the following fields:

PRESSURE SENSITIVE ADHESIVES
RUBBER AND/OR PLASTICS
RESINS AND COATINGS • TEXTILES
COTTON PURIFICATION AND PROCESSING
SYNTHETIC FIBRES
FINE AND SPECIALTY PAPERS
PAPER CONTAINERS • INSTRUMENTATION

Modern well-equipped laboratories in our new Research Centre will provide excellent facilities and working conditions. Liberal benefits. Salaries commensurate with education and experience.

Replies will be given all applicants submitting a complete résumé of personal data, educational background, work experience, references and a recent photograph of themselves to:

Director of Research

Johnson & Johnson
LIMITED MONTREAL

7101 Notre Dame East • Montreal, Quebec

tions, experience and age in first letter to File No. 5398-V.

LECTURER CIVIL ENGINEERING for immediate appointment: to give undergraduate instruction in design of steel and timber structures and allied subjects to carry cut investigations and research. Salary range $3,440. to $4,100. with superannuation, hospital insurance and other benefits. Applicant should be university graduate with some years practical or teaching experience in structural design. Location Halifax, Nova Scotia. File No. 5410-V.

A PRESIDENT IS REQUIRED immediately by a Montreal firm, thoroughly experienced in the contracting industry, especially in the management and public relations industry. Successful candidate should be a man of ability and vision. Preferred age 35-45; must be a civil engineering graduate. Salary in five figures plus bonus. File No. 5417-V.

PROJECT ENGINEER excellent opening for the right man, with a well established engineering firm in Montreal specializing in the hydro electric field, this is a senior position. Applicant should be a graduate with 15-20 years experience in the design, preparation of plans and specifications, reports and estimates for the civil engineering aspects of hydro electric power developments He will be required to take charge of a designing group as project engineer. The position is of a permanent nature and entails the usual pension, groups insurance and other benefits. The salary will be commensurate with the capabilities, educational background and experience of the applicant. The applicant should be prepared to furnish references as to his qualifications and experience. All applications will be acknowledged. File No. 5431-V.

CIVIL ENGINEER with good knowledge of building construction and costing by general contractor in the Kingston, Ontario, area. Salary open. File No. 5434-V.

STRUCTURAL ENGINEER with some experience in steel or reinforced concrete. Age to 35. Applicants must be willing to headquarter in Minniapolis, Minnesota, with some travel in both the U.S. and Canada. Position offers permanence and opportunity for advancement. Reply giving complete information regarding personal history, education and experience. File No. 5436-V.

CONSTRUCTION ENGINEER for company located in Western Canada. Age range 40-50. Must be well experienced in asphalt paving, soils, road work, concrete structures, gravel plants. Must be able to operate as general superintendent. Excellent salary and possibility of participating in company profits. File No. 5437-V.

STRUCTURAL STEEL DESIGN and detail engineers required by a progressive pulp, paper and converting company. The location is in Eastern Canada. Excellent residential, educational and recreational facilities are available. Applications will be treated with strictest confidence. Send complete resume and salary expected to File No. 5439-V.

SANITARY ENGINEER wanted for department of Health, Newfoundland. Applicant must have a degree in civil engineering and/either a certificate in Public Health Engineering or be willing to take a year's training in public health on a bursary supplied by the Department. Enquiries re salary and conditions of employment to be directed to File No. 5442-V.

ASSISTANT CIVIL ENGINEER required by an established public utility supervisory consulting organization, age 30-45, minimum 5 years experience on structural steel, reinforced concrete and foundation design of steam electric power plants. Location N.Y. Some travel field future. Reply stating age, education, experience, personal particulars, minimum salary expected. File No. 5449-V.

FOUR REGIONAL HIGHWAY ENGINEERS located Kamloops, Nelson, Prince George and Victoria, British Columbia. Salary $556.00 to $644.00 per month depending on experience and qualifications. Duties: responsible for the administration and co-ordination of activities in the region. Directs a staff consisting of a construction engineer, maintenance engineer, district engineers and their engineering staffs. Maintains liaison between his regional staff and headquarters in the operations, construction and maintenance of highways, bridges and ferries. General direction of approved policies and regulations, accounting records, traffic controls and general discipline. Present recommendations to headquarters regarding planning, priorities, for major construction projects. Qualifications: university graduation with degree in Engineering; membership in a Provincial Engineering Association and if other than B.C., eligible for registration in this Province; must have proven experience in construction and maintenance of highways; considerable experience in administration and organization methods; a high degree of tact in dealing with other government officials and the general public. Applicants other than B.C. Department of Highway officials are requested to supply references. Apply Chairman, Civil Service Commission, 544 Michigan Street, Victoria, not later than November 30, 1955. File No. 5458-V.

ELECTRICAL

GRADUATE ELECTRICAL ENGINEER, required as assistant engineer rural department of power company in Alberta. Location in Edmonton. Duties involve design and estimation of single phase farm power lines with related engineering. Salary commensurate with qualifications. Excellent employee benefits provide pension, group life, sickness and accident coverage. File No. 5359-V.

TWO JUNIOR ELECTRICAL or engineering physicists for work in our research and development departments. The work involves research and development work in various special antennae and related components. Location Ontario. File No. 5374-V.

ELECTRICAL ENGINEER university graduate required for electrical service of power and industrial equipment of a Canadian manufacturer. Applicant will be located in Montreal with possibility of limited amount of travel in Province of Quebec. Please state education, experience and starting salary expected. File No. 5384-V.

ELECTRICAL SALES ENGINEERING AND APPLICATION ENGINEERING positions in new and growing company making electrical, industrial control apparatus in S.W. Ontario. Prefer electrical, mechanical or engineering and business. File No. 5388-V.

ELECTRICAL MANUFACTURING ENGINEER, with experience in the design and manufacture of Air Break Switchgear required for Chief Engineers position with Western Manufacturer. Should be capable of leading a development program in a newly equipped laboratory on low voltage air break switchgear and circuit breakers up to 15 kv. Salary open. Replies from applicants with all or part of the required experience will be treated in strict confidence, and should contain full details of experience, age, and educational background. File No. 5395-V.

COMMUNICATIONS DEPARTMENT OF LARGE transportation company in Montreal has immediate openings for electrical engineering graduates specializing in or with experience in communications as assistant engineers in the transmission and equipment groups. Work involves application and special engineering of all types of carrier telephone telegraph program network transmission, television and broadband microwave systems. Offers wide range of experience in communications field. Headquarters Montreal, with field engineering throughout system. All replies will be held in strict confidence and will be acknowledged. File No. 5403-V.

ELECTRICAL ENGINEER WITH experience in design of electrical installation including communications for industrial and commercial buildings. Minimum five years experience since graduation. Firm of consulting engineers in Toronto. File No. 5411-V.

ELECTRONIC ENGINEER required with several years experience in design and construction of experimental equipment. Knowledge of magnetic amplifiers essential. Capable of

DU PONT OF CANADA

MONTREAL ENGINEERING DEPARTMENT

CHEMICAL ENGINEERS

2 — with at least three years' experience in the selection of chemical plant equipment and piping layouts.

and

2 — recent graduates with some experience in chemical manufacturing design or operation.

MECHANICAL ENGINEERS

2 — with at least three years' experience in the selection of equipment and the layout of manufacturing plants.

and

2 — recent graduates with some experience in process equipment design or operations.

Applicants should be between the ages of 23 and 35 and application may be made in writing, giving a brief summary of training and experience to:

PERSONNEL DIVISION
DU PONT COMPANY
OF CANADA LIMITED
P. O. BOX 660, MONTREAL.

UNIVERSITY TEACHER WANTED

The University of Saskatchewan wishes to receive applications from engineering graduates, Civil, Electrical, or Mechanical, under thirty-five years of age, to teach applied mechanics and allied subjects. Duties are to commence January 1, 1956, the salary offered is $4000.00 per year, and permanent appointment is a possibility. Apply to the Dean of Engineering, University of Saskatchewan, Saskatoon, Sask., giving age, qualifications, experience, and references. File No. 5443-V.

independent work on servo-mechanisms for aircraft application. Manufacturer of aircraft engine fuel systems located in Toronto. Apply with full details as to age, date of graduation, experience and approximate salary required. File No. 5412-V.

LARGE ELECTRICAL MANUFACTURING industry in Niagara Peninsula, has vacancies for graduate electrical engineers in switchgear sales department. Duties include the preparation of specifications and settlement of technical details for all classes of switchgear from 600 volts to 330 KV. Previous switchgear engineering experience with a manufacturer or utility desirable but not essential. File No. 5415-V.

ELECTRICAL ENGINEER required as assistant in rotating machinery department handling special induction motors, alternators and generators. Should be capable of handling quotations, orders and general correspondence. Location Montreal. File No. 5432-V.

ELECTRICAL ENGINEER required as assistant in motor department handling standard induction motors. Should be capable of handling quotations, orders and general correspondence. Location Montreal. File No. 5432-V.

ELECTRICAL ENGINEER as assistant in transformer department. Should be capable of handling quotations, orders and general correspondence. Location, Montreal. File No. 5432-V.

ELECTRICAL ENGINEER a recent graduate, now in a narrow field but who wants broad experience in the design, installation and operation of heavy power distributing equipment. File No. 5445-V.

APPLICATIONS ARE INVITED FROM electronic development Engineers with experience in the intermediate frequency field, for advanced development work associated with I.F. circuits and systems for new techniques in pulse and doppler radar. The position, which is permanent and pensionable is at the company's main plant at Rugby, England. Qualifications: University degree and at least two years experience in I.F. or related circuit developments. Applications, stating age and giving details of qualifications, should be made in the first instance to file No. 5446-V.

MICROWAVE DEVELOPMENT ENGINEER. Applications are invited for the position of development engineer at the company's main plant, Rugby, England. The position is permanent and pensionable, and concerns long-term development of the latest techniques in microwave systems of unusual complexity. Ample opportunities are afforded for original work. Qualifications: University degree in electrical engineering or physics, and at least two years practical experience in microwave systems and/or components development. Applications stating age and giving details of qualifications should be made in the first instance to File No. 5446-V.

OPPORTUNITIES FOR ELECTRICAL ENGINEERS and engineering physicists with the Defence Research Board at Valcartier, Quebec; Ottawa, Ontario; Dartmouth, Nova Scotia. The challenging program, which offers excellent chance for advancement, includes research on missile control systems, servo-mechanisms, temperature and vibration problems, fire control systems, instrumentation, low frequency and high frequency propagation, radio communication circuits, radar, microwave techniques, and underwater acoustics. Applications are invited from University graduates (or the equivalent) who are Canadian citizens or British subjects. Initial salaries range from $3,750.00 to $6,000.00 depending on qualifications and experience. Modern laboratory facilities and generous employment benefits available. File No. 5447-V.

ELECTRICAL ENGINEER required by Potash Company in Saskatchewan. Must be qualified to lay out and supervise installation and maintenance of power distribution system for an industrial plant and mine. A knowledge of control systems, switchgear, relaying and heavy motors is desired. Position involves supervision of electrical and mechanical installation and offers a varied and interesting position in an expanding company. File No. 5448-V.

ELECTRICAL ENGINEER, graduate two to five years experience, protective relay work with

ALUMINUM COMPANY OF CANADA LIMITED

Has openings for GRADUATE ENGINEERS PARTICULARLY IN THE FIELDS OF CHEMICAL ENGINEERING and EXTRACTIVE METALLURGY

•

For production or development work in their plants in the Saguenay District, Quebec and Kitimat, British Columbia.
Please write giving details to:

Employment Department, 1700 Sun Life Building, Montreal, Quebec.

electric utility. Permanent position long-established supervisory consulting organization Headquarters New York. Some travel Latin America. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5450-V.

YOUNG ELECTRICAL ENGINEER, power option, recent graduate or man with one or two years experience. Good opportunity. Permanent position with long-established electric utility in Costa Rica. Knowledge Spanish necessary. Reply stating age, education, experience, personal particulars, and minimum salary expected. File No. 5451-V.

GRADUATE ELECTRICAL ENGINEER, required to assist in preparation of plans, specifications and estimates of electrical systems for offices, shops and buildings designed in chief architect's department Trans-Canada Air Lines, Montreal. Preference given to applicants having two or more years general experience in the electrical branch of construction work and interested in being closely associated with architectural work. Permanent position with full employee benefits. File No. 5452-V.

SENIOR POWER TRANSFORMER design engineer. Good opening for aggressive man unafraid of responsibility and with existing or potential ability to handle up to the largest ratings. Well established firm with excellent technical facilities. Salary open and commensurate with experience and ability. Our employees know of this advertisement. All replies will be treated as confidential. File No. 5461-V.

MECHANICAL

GRADUATE MECHANICAL ENGINEER required by a heavy industry with extensive mining and milling operations in the Eastern Townships (Quebec). Duties will include machine design, plant layout, work scheduling etc. Preference will be given to applicant with one year's experience or recent graduates. Good opportunity, interesting and permanent position with attractive salary. Numerous employee benefits. Replies should include complete record of education, also salary expectation should be mentioned. File No. 5338-V.

SENIOR ESTIMATING ENGINEER required in a large manufacturing plant located in Montreal. Applicant must have general experience in heavy mechanical equipment, a broad knowledge of product costs, be energetic and have administrative abilities. Give details of age, education, experience, salary requirements and other relevant information to File No. 5357-V.

GRADUATE MECHANICAL ENGINEER required by large manufacturing plant located in Montreal. A minimum of five years experience in heavy mechanical equipment essential. Some shop experience desirable. Applicant will be required to study analyse and report on new product lines and develop specifications for cost estimating. Give details of age, education, experience, salary requirements and other relevant information to File No. 5357-V.

THE PLANT ENGINEERING SERVICES of the National Research Council, requires at Ottawa a graduate mechanical engineer preferably with some experience in plant work to design, prepare plans and specifications for heating, ventilating and air conditioning systems. Familiarity with various manufacturers equipment and control systems is essential. Initial salary up to $4,500 per annum depending on qualifications. Apply by letter giving full details of education and experience to The Employment Office, National Research Council, Sussex Drive, Ottawa, Ontario. Please quote file PE-236. File No. 5358-V.

MECHANICAL ENGINEER required for work in refinery at Sarnia as area maintenance engineer. Must have 3 to 5 years experience in oil refinery or related industry. Duties include general engineering and estimating. Permanent position, full employee benefits. Write giving full particulars of age, qualifications, experience, present salary. File No. 5364-V.

DU PONT OF CANADA INVITES APPLICATIONS FROM ENGINEERS

with mining experience to act as technical representatives in the sale of explosives to the mining and other industries. These positions will provide good opportunities for advancement in a new expanding organization. A knowledge of mining practices, particularly development and production, is necessary but previous sales experience is not essential. Applicants should be in their twenties or thirties. Please reply in writing giving details of education and experience to:

PERSONNEL DIVISION, DU PONT COMPANY OF CANADA LIMITED, P.O. Box 660, Montreal, Quebec.

SALES ENGINEERS

Internationally known manufacturer of combustion control and industrial instruments has openings for recent Canadian mechanical graduates interested in sales work in Ontario and Quebec.

Extensive factory and field service training will be provided. Good starting salaries and excellent prospects for advancement.

Write: File No. 5404 V.

MECHANICAL ENGINEER required for product design by manufacturer of mining machinery in Southern Ontario. Registered or qualified professional engineer. Reply in detail stating personal history, education and experience. File No. 5368-V.

MECHANICAL ENGINEER for sales office required by manufacturer of hydraulic fittings and hoses, etc., located in Ontario. Salary open with excellent future prospects. Age group approximately 23 to 30 years. File No. 5370-V.

LARGE MONTREAL MANUFACTURER requires specialist in welding and brazing techniques for mass produced apparatus. Applicant should be mechanical engineering graduate or equivalent with minimum of five years experience in welding processes. Salary open. Your confidence will be respected. File No. 5376-V.

EASTERN TOWNSHIPS OF QUEBEC firm requires graduate and/or practical engineer to take over responsibility for all plant mechanical, electrical, heating and construction problems. This is basically a planning and coordinative job with appointment as mechanical superintendent as its aim. File No. 5379-V.

MECHANICAL ENGINEER required by pulp and paper company with all or some of the following qualifications. Experience in maintenance work, knowledge of the fundamentals of time and motion study. Ability to supervise a group of approximately ten persons. Some knowledge of production cost systems. Duties include work with consultants on the installation of a system of maintenance standards. Develop standard time values, supervise a crew of maintenance standard accessors. File No. 5382-V.

PLANT ENGINEER required for a plant located in Sherbrooke, P.Q. Should be capable of taking full charge of all maintenance and construction work. Salary dependent upon qualifications. File No. 5387-V.

MECHANICAL SALES ENGINEERING and application engineering positions in new and growing company making electrical, industrial control apparatus in S.W. Ontario. Prefer electrical, mechanical or engineering and business 1955 graduates. File No. 5388-V.

A WELL KNOWN MACHINERY manufacturer requires a mechanical sales engineer to contact large industries in the Province of Quebec. Established clientele assuring substantial income for qualified man. Some knowledge of French desirable. This is in addition to the existing staff who are aware of this vacancy. If you believe you are the man for this position, please send complete details of qualifications and past experience which will be held in strict confidence. File No. 5389-V.

GRADUATE MECHANICAL ENGINEER for large industrial concern near Montreal required for development work and general project engineering. Permanent staff position and good prospects of promotion for young engineer with initiative and ability for original design work. Previous experience preferred but not necessary. We will pay travelling expenses for interview. Write stating personal information, experience in detail, salary required and date available. File No. 5390-V.

MECHANICAL DESIGN ENGINEER. We require an experienced professional mechanical engineer with 10 to 15 years experience in design mechanical equipment particularly cranes or materials handling machinery. Experience in design of radioactive material handling valuable. Will be required to design layout of fuel rod handling system and equipment. Please reply by letter stating experience, qualifications, etc. Location Ontario. File No. 5401-V.

PLATE AND VESSEL DESIGNER. We require an experienced professional mechanical engineer with 5 to 10 years design experience in vessels, heat exchangers or allied equipment. Will be required to work on pressure vessels and heat exchanger for the reactor, as well as plate and tube components for the reactor core. Please reply by letter stating experience, qualifications, etc. Location Ontario. File No. 5401-V.

RECENT MECHANICAL GRADUATES of Canadian Universities have exceptional opportunities to train for sales of combustion control and industrial instruments. Prominent American manufacturer has organized Canadian company with general offices and assembly plant in Toronto. Canadian born engineers required. Extensive factory and field service training will be provided. File No. 5404-V.

MECHANICAL ENGINEER required by sheet metal fabricating company in Montreal, to take charge of small engineering department. Duties will include supervision of drafting and estimating standard and custom products and development of new products. Applicant should have 4 or more years applicable experience and be preferably bilingual. Starting salary minimum $5,000.00 per year. Company name Eastern Steel Products but please submit full details as to past experience, age, etc., to File No. 5416-V.

ASSISTANT CHIEF INSPECTION ENGINEER, graduate mechanical engineer, age 30 to 40, minimum five years practical shop experience. Ability to get along well with others essential. Duties cover all phases of mechanical inspection, working directly under the chief inspection engineer. Apply in writing stating place of birth to File No. 5422-V.

TWO GRADUATE MECHANICAL ENGINEERS wanted by manufacturer of heavy industrial machinery in Western Montreal for application engineering and sales. 1950-1955 graduates considered. Training provided. Benefits include generous life insurance, sickness and accident and pension plans. Five day week. Applicants should outline training, experience, and salary expected. File No. 5423-V.

CANADA'S MOST MODERN transformer plant requires mechanical engineer with five years experience on pressure vessel design, medium to heavy structural steel or plate design, for work on large tanks and components. Work is interesting and varied; transformer experience not necessary. Full employee benefits, pleasant working conditions in attractive Southern Ontario community. File No. 5426-V.

DESIGN ENGINEERS required for commercial vehicle design. Good opportunity with a sound future for a graduate mechanical engineer, who has had practical experience in structural design. Location Ontario. File No. 5429-V.

MANAGER ENGINEERING DEPARTMENT required by large and long established manufacturing company in Montreal. A man with the following qualifications to fill the senior position. Graduate engineer preferably mechanical with post-graduate training in business administration and industrial organization. Over 5 years experience as plant engineer or as assistant plant engineer in a large company with administrative responsibilities. Thorough knowledge of modern maintenance control and material handling methods. Age 30 to 40 years. Salary is open. File No. 5435-V.

MECHANICAL ENGINEER either recent college graduate or with some experience. Age to thirty-five; must be willing to locate in Minneapolis, Minnesota, and to travel as required by duties. Interests and/or back ground should be in air handling, plant layout or design. Position offers good salary, opportunity and permanence. Reply giving complete information regarding personal history, education and experience. File No. 5436-V.

WANTED MACHINE DESIGN ENGINEERS. A progressive pulp, paper and converting company has opportunities for experienced pulp and paper mill machinery designers. The location is in eastern Canada. Excellent residential, educational and recreational facilities are available. Applications will be treated with strictest confidence. Send complete resume and salary expected to File No. 5439-V.

LARGE CHEMICAL PLANT in Edmonton area has staff openings for two mechanical engineers. (1) Required qualifications and duties as follows: qualifications B.Sc. in mechanical engineering from recognized university. Up to 5 years experience in design on field work. Ability to supervise drafting work. Duties: general engineering in chemical plant including design and layout of alterations and new installations. Supervision of drafting work. (2) Qualifications: B.Sc. in mechanical engineering from recognized university. Up to 7 years' experience in design or field work. Experience in plant maintenance work an asset. Ability to supervise clerical and drafting work. Duties: maintenance engineering, including trouble shooting of mechanical problems, responsibility for spare parts program. Assist in setting up preventive program. Mechanical design work. Please supply references, age, marital status, academic standing, experience, salary expected and data available. File No. 5440-V.

SALES ENGINEER age 25 to 30, mechanical engineer or equivalent required by well-known Canadian heavy machinery manufacturer to handle pulp and paper mining and process industry accounts; to work out of Montreal; reply in writing stating age, education, experience etc. File No. 5441-V.

PROJECT ENGINEER with 2 to 5 years mechanical design experience in a process industry. This position would provide the opportunities to handle major prospects in all aspects and to see the project actually built in the field. Location is Sarnia. File No. 5445-V.

ENGINEER PREFERABLY with 5 to 6 years experience in industry required by pencil manufacturer in Province of Quebec, to act as assistant factory manager in plant employing 100 persons. Applicant should be preferably bilingual. Salary negotiable. File No. 5457-V.

INDUSTRIAL ENGINEER. An attractive position for an ambitious man about 35 years of age has developed in our industrial engineering department. This post will involve the management of one or more of the functions of direct labour control, the development of standards and estimates, scheduling, forecasting and methods improvement. A graduate mechanical engineer with five to ten years' manufacturing experience of some responsibility would be preferred, but persons with equivalent experience will be considered. This position will provide sufficient interest, authority, and salary to attract an exceptional man. File No. 5463-V.

LARGE TRANSPORTATION COMPANY in Montreal requires mechanical engineer to work on the staff of the electrical section of the mechanical department. The duties involve steam power plant layout, including piping, and other mechanical assignments. This is an opportunity for a recent graduate to obtain experience in this line of work. File No. 5464-V.

MISCELLANEOUS

CHIEF OPERATOR required for hydro electric power plant. Must have experience, ability to direct and be responsible for operation and maintenance of power plants, dams and equipment. Location Northern Quebec. Full company benefit plan. In reply state age, education, experience, marital status, date available and salary expected to File No. 5353-V.

RESEARCH HYDRAULIC ENGINEER required for research team studying the forces involved in pulpwood holding grounds, at both model and full scale. Requirements: master's degree in hydraulics engineering, good academic record and ability to work with woods personnel in the field. Apply by resume to File No. 5361-V.

PULP AND PAPER ENGINEER required. Graduate engineer capable of planning and

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SANITARY ENGINEER WANTED FOR DEPARTMENT OF HEALTH, NEWFOUNDLAND

Applicant must have a degree in Civil Engineering and/either a certificate in Public Health Engineering or be willing to take a year's training in Public Health an a bursary supplied by the department.

Enquiries re salary and conditions of employment to be directed to:

Leonard Miller, M.D.,
Deputy Minister of Health,
St. John's, Newfoundland.

developing complete pulp and paper projects. Must have not less than five years experience in newsprint manufacturing. Summarize experience. Location about 100 miles from Montreal. File No. 5363-V.

MINING OR CHEMICAL ENGINEER having design and detail experience in ore handling or chemical plant equipment is required by a large Kingston manufacturing company. Reply giving complete information on personal history, education and experience. File No. 5372-V.

PHYSICAL METALLURGIST to undertake both fundamental and applied research on non-ferrous metals primarily lead and zinc and their alloys. Salary dependent upon qualifications and experience. Location Southern British Columbia. File No. 5391-V.

INSTRUMENTATION ENGINEER to design measuring and control systems for chemical and metallurgical process. Work includes preparation of flowsheets, wiring and piping diagrams, layout and detail drawings, detailed instrument specifications and cost estimates. Location Western Canada. Salary open. File No. 5391-V.

CIVIL, MECHANICAL or CHEMICAL engineers with about 5 years experience on construction of industrial plants and process equipment required as field engineers by company planning to build new plant. Location Ontario. File No. 5392-V.

PROJECT AND CONSTRUCTION ENGINEER. Graduate in civil or mechanical engineering with three to five years experience in building structure, material handling equipment, structural and machine design. Supervisory ability in draughting. Experience in smelting operation or construction would be an asset. Fluent English is essential. File No. 5378-V.

ENGINEERING OPPORTUNITIES IN Victoria, B.C., for senior and intermediate civil engineers in hydraulic design, both office and field and senior electrical station designers. Excellent welfare provisions. File No. 5385-V.

APPLICATIONS ARE INVITED for engineers and architects with good academic records and preferably with a few years of experience for positions as research officers in the division of building research, National Research Council, for work in the following fields: **Housing**, To undertake studies leading to the assessment of materials and the evaluation of the performance of components for application in housing. **Construction**: the dissemination of technical information to the construction industry. Study in the performance of new materials and techniques used in construction. **Building Code** to undertake studies relating to the preparation of building regulations, particularly in the field of public health engineering, in relation to the National Building Code of Canada. **Building Design**: A civil engineer for the investigation of the structural performance of building components and completed structures. The work in view includes the testing of full scale structural elements in the laboratory and in the field. **Soil Mechanics**: A civil engineer to work in the laboratory and in the field on urgent projects already under way in this section. **Fire Research**: A chemical engineer or chemist for laboratory research into the combustion properties of materials especially those used in buildings, and into the application of chemical agents for the suppression of fire. File No. 5386-V.

MECHANICAL, MINING OR CIVIL ENGINEER, required for sales work in the Province of Quebec. Requirements: earthmoving and/or heavy equipment experience, bilingual preferred, free to travel. Age up to 40. Good appearance and background. Excellent remuneration, insurance and pension benefits guaranteed by advertisers who are Quebec distributors for world renown make of heavy equipment in the earthmoving field. File No. 5397-V.

ATTRACTIVE OPPORTUNITIES for senior architects and engineers with the Federal Government in Ottawa. Salaries up to $7,900. Requirements include: an assistant chief penitentiaries engineer with training in engineering or architecture; a telecommunications engineer, a communications engineer, an architect (building) an electrical engineer (power), a structural engineer and a construction engineer (runways). Opportunities for advancement. Generous fringe benefits. File No. 5400-V.

REFINERY ENGINEERING AND SAFETY administration opportunities. Modern catalytic oil refineries require a plant engineer. Responsibilties involve structural design, supervision of contract work and engineering programing. Salary commensurate with qualifications. Safety engineer also required to conduct equipment inspection and plant safety programmes. Professional qualifications preferred but not necessary. Responsibilities and salary commensurate with qualifications. Location W. Canada. File No. 5402-V.

SALES ENGINEER for the Province of N.S. to represent national manufacturer of fabricated steel products, for the construction industry. Preference will be given to applicants from Nova Scotia or graduates of N.S. universities, between the ages of 23-36 years. The successful candidate for this opening will be associated with a staff of engineers and will have the opportunity of advancing to the exccutive level. Initial letter should outline complete background and availability for interview. File No. 5405-V.

DESIGN ENGINEER young graduate with several years product engineering experience and writing ability, for editorial work on new magazine. Good working conditions and remuneration in keeping with ability. With first letter give education and experience also starting salary requirements. File No. 5406-V.

YOUNG ENGINEER required for work in heating and ventilating company located in Ontario. Will be trained in the engineering, research and sales departments of the company with a view to eventual branch office work. File No. 5408-V.

A VACANCY OCCURS FOR a general works manager, at a plant located approximately 100 miles north of Toronto. Medium and heavy engineering products are manufactured by between 600 and 700 employees. The works include a steel foundry: grey iron foundry: bronze and non-ferrous metal foundry (including centrifugal castings); with pattern, machine and erecting shops. The position is such that only first class applicants will be considered who must have the qualifications of being a trained engineer, a good organizer, a pleasing personality and ability to fulfil a position of trust. The ultimate prospects for the right man are of the highest. Also salary will be commensurate to the candidates' ability and experience. File No. 5413-V.

OPPORTUNITIES FOR ENGINEERS. Mechanical, are required with at least five years' experience in designing heavy machinery and plant equipment. Mechanical, metallurgical, electrical and chemical, interested in training for production supervisory positions are wanted. Mechanical, Engineering Business, Electrical and Chemical, interested in industrial engineering are also needed. Our expanding development on the most advanced specialty steel mill equipment assures you of an excellent salary and good opportunities for promotion with Canada's foremost specialty steel mill. Contributing to your security are extra benefits such as a generous pension, hospitalization and group life insurance schemes. File No. 5414-V.

YOUNG MINING OR CIVIL ENGINEER, preferably bilingual required by mining industrial plant near Montreal. Must be also good draughtsman and be responsible for plant equipment and plant expansion. Salary in accordance with experience. Write stating age, marital status and experience. File No. 5419-V.

A NATIONAL ORGANIZATION in Ottawa requires 2 engineers; a junior with 2 to 3 years experience in electrical or civil fields, and the other — a senior engineer with 5 to 10 years experience in electrical field. Permanent employment complete with pension plan. File No. 5420-V.

SALES ENGINEER required for leading manufacturer of automatic controls. Duties involve application of limit switches and clutch controls to industrial equipment and the organizing and training of distributors. The applicant selected will undergo a training program in the U.S.A. after which he will be located in Montreal. All replies should state personal particulars, background and salary required. File No. 5424-V.

GRADUATE ENGINEERS FOR JUNIOR positions in the industrial engineering department of a large asbestos mine in the Eastern Townships. Applicants should be between 21 and 30 years of age, and have an engineering background. Experience in industrial engineering in heavy industry or large manufacturing enterprises preferable but not essential. Successful candidates will be given training in wage incentives and job methods. Excellent working conditions, extensive employee benefits. File No. 5427-V.

MECHANICAL OR CHEMICAL ENGINEER required by pulp and paper company located in Province of Quebec. This engineer is required for our design engineering department and should have a minimum of 5 years experience with at least 2 years in pulp mill engineering. The salary is open for discussion. File No. 5421-V.

TECHNICAL PERSONNEL NEEDED FOR integrated petrochemical and synthetic fibre plant located Western Canada. 1) Senior mechanical engineer with extensive experience in materials handling equipment, both application and design. 2) Senior process engineer with extensive experience in oil refinery, chemical or allied engineering. 3) Junior mechanical engineer. Recent graduate. Experience in oil refinery, chemical plant or allied industries preferred but not essential. 4) Junior corrosion engineer mechanical, chemical or metallurgical graduate with experience or interest required for work on plant scale corrosion problems and materials specifications, 5) Textile engineer, recent graduate in textile engineering or engineering degree with equivalent training preferably with experience in synthetic yarn plant. 6) Maintenance engineer mechanical, electrical or chemical engineer, 2-5 years' experience in maintenance department of large chemical or synthetic yarn plant or equivalent operation in large chemical or allied industry. 7) Senior piping draftsman. Experienced piping designer including specification, layout and detailing, or graduate engineer interested in piping design. Applications will be treated confidentially. Write immediately stating personal details, experience in full. Salary required and date available. File No. 5428-V.

MECHANICAL OR STRUCTURAL ENGINEER, with steel fabrication experience required to take charge of detailing office, consisting of four draughtsmen and one estimator and to consult with architects and contractors to obtain suitable fabricating contracts. A thorough knowledge of welding, welding procedures and jig design required. This is an excellent opportunity in a well established Vancouver firm, employing approximately 50 men. Maximum salary and employment benefits to right man. Reply stating age, experience and salary required. File No. 5433-V.

AGRICULTURAL SALES ENGINEER required for metropolitan Montreal and Maritime provinces. Applicant should have university degree or equivalent in agriculture. Knowledge of French and chemistry desirable. Field of sales covers a line of agricultural chemicals to distributors in the Maritime Provinces supported by detailed sales and service work with dealers and growers; and sanitary and surfactant chemicals to industrial concerns in metropolitan Montreal. Applicant must be willing to headquarter in Montreal and be prepared to travel frequently into the Maritimes, taking up temporary residence there at a central location with his family during the active summer season. This latter provision subject to discussion. Apply by confidential letter giving details of education, experience and general background to File No. 5438-V.

AGRICULTURAL AND/OR INDUSTRIAL chemical sales engineer required for Alberta and British Columbia territory. Applicant should have University degree or equivalent in agriculture or chemistry, have had three to five years sales experience in agricultural or in-

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ASSISTANT CHIEF INSPECTION ENGINEER

Graduate mechanical engineer, age 30 to 40, minimum five years practical shop experience. Ability to get along well with others essential. Duties cover all phases of mechanical inspection, working directly under the chief inspection engineer.

Apply in writing, stating place of birth, to: Personnel Supervisor, Dominion Engineering Works Limited, 1st Avenue, Lachine.

dustrial chemicals, possess strong administration interests and aptitudes and be willing to locate in Vancouver, B.C., area. File No. 5438-V.

UNIVERSITY TEACHER WANTED. The University of Saskatchewan wishes to receive applications from engineering graduates, Civil, Electrical, or Mechanical, under 35 years of age, to teach applied mechanics and allied subjects. Duties to commence January 1, 1956, the salary offered is $4,000.00 per year, and permanent appointment is a possibility. Apply to the Dean of Engineering, University of Saskatchewan, Saskatoon, Sask., giving age, qualifications, experience and references. File No. 5443-V.

THE GOVERNMENT OF British Columbia requires engineers and technicians for a multi-million dollar highway programme. Engineers: should have experience in highway location, design or construction. Professional registration desirable but not essential. Salaries range from $327.00-$464.00 per month depending on qualifications and experience. Benefits include compensation coverage, sick and vacation leave after one year; pension plan, statutory holidays. Opportunities for experience and advancement with a progressive programme in a fast growing province. File No. 5444-V.

SALES TRAINEE. After extensive training in Canada and U.S. these two trainees will be given permanent assignments as field representatives. Large chemical manufacturer located in Toronto. File No. 5445-V.

ONE YOUNG METALLURGICAL, mechanical or chemical engineer with the aggressiveness to develop a national market in the light metal industry. Location is Toronto. File No. 5445-V.

SALES ENGINEERS with a flair for selling and with some sales experience in a process industry will be given the opportunity to combine technical training with interesting customer contact. Initially located in Toronto or Montreal. File No. 5445-V.

RECENT UNIVERSITY GRADUATE required for inspection engineering miniature electronic components and assemblies. Location Montreal. Salary up to $4,620.00 depending on qualifications. Generous employee benefits. Good opportunity for advancement. File No. 5454-V.

REGISTERED PROFESSIONAL ENGINEER required for organizing and supervising inspection of materials, components and assemblies for weapons including auxiliary and ancillary equipment. Location Sorel, P.Q. Opportunity for continuing employment with advancement in due course. Salary commensurate with education and practical experience. File No. 5455-V.

LARGE CANADIAN ORGANIZATION handling quality precision instruments requires junior inspection engineer at Toronto. Only registered or graduate engineers with some experience in design production or inspection of instruments need apply. Starting salary up to $400.00 per month depending on experience. Opportunity for advancement. File No. 5456-V.

PROMINENT WEST COAST CONSULTING engineering firm requires graduate engineers with experience in the following categories: Mechanical, for design and lay-out of process plants, materials handling systems, process piping. Civil: structural design, field work, hydraulic systems. Electrical: Industrial plant power systems. Please reply stating experience, salary expected and availability to File No. 5459-V.

EXCELLENT OPPORTUNITY FOR a recent Canadian university graduate 1952-1955, from either engineering physics or electrical engineering, for a sales position in the X-ray field. This position offers intensive training on x-ray equipment from six months to one year's duration and a sales engineer's position at the end of the training period. The possibility for advancement into a management position is excellent. This opportunity is located in Toronto. File No. 5460-V.

INDUSTRIAL ANALYSTS. Graduates in engineering or science wanted for large asbestos mine in Eastern Townships of Quebec. Applicants preferred who have training and/or interest in business administration or finance. Selected individuals would be trained to appraise and report upon the financial desirability of making capital and operating expenditures. Salary depends upon qualifications. Age 20-35 years preferred. Excellent living accommodations with good educational, social and recreational facilities available. Near large cities. Apply in writing, giving details of education, experience, marital status and salary desired. File No. 5462-V.

CIVIL ENGINEER

Recent graduate required as assistant to City Engineer. Experience in asphalt paving desirable but not essential. Salary dependent on experience. Applications close January 15, 1956. Additional information will be supplied upon request. Apply to:

City Engineer's Office,
City Hall,
SWIFT CURRENT,
SASWATCHEWAN

WANTED FIELD ENGINEERS

with

2 to 8 years experience in major civil engineering and structural work to work on varied projects in Eastern Canada from Montreal office. Must be accurate instrument men and for senior positions capable of supervising contractors' work. Some knowledge of piling and dock work a decided advantage. Minimum of several years work for right man.

Apply to:

Mr. T. A. Hughes
C. D. HOWE COMPANY LIMITED
1433 Atwater Avenue,
Montreal

Attention, Members

Please telephone in advance and make an appointment if you propose using the Institute's Employment Department.

This will result in a better service to everyone concerned.

TELEPHONE PLATEAU 5078

Except in special cases all interviews will be arranged between the hours of 9 and 12.

FROM THE BETHLEHEM PLANTS . . .

A Steady Flow of Steel for World Markets

Every day of the year, Bethlehem plants are busy turning out huge tonnages of steel for users all over the world. A constant flow is assured through Bethlehem's centrally controlled operations, which include every step in the making of steel, from the mining of the ore to the shipping of the finished product.

This means that Bethlehem is a thoroughly dependable supplier — willing and able at all times to serve your needs. And it is easy to do business with Bethlehem, for our large network of friendly offices and representatives is spread to all corners of the globe. Bethlehem Steel Export Corporation, 25 Broadway, New York 4, U. S. A.

Canadian Representatives

Bethlehem Steel Export Company of Canada, Limited
Dominion Square Building, Montreal; Royal Bank Building, Toronto
A. L. Murray, Marine Building, Vancouver; James G. Crawford, St. John's, Newfoundland

★ BETHLEHEM STEEL ★

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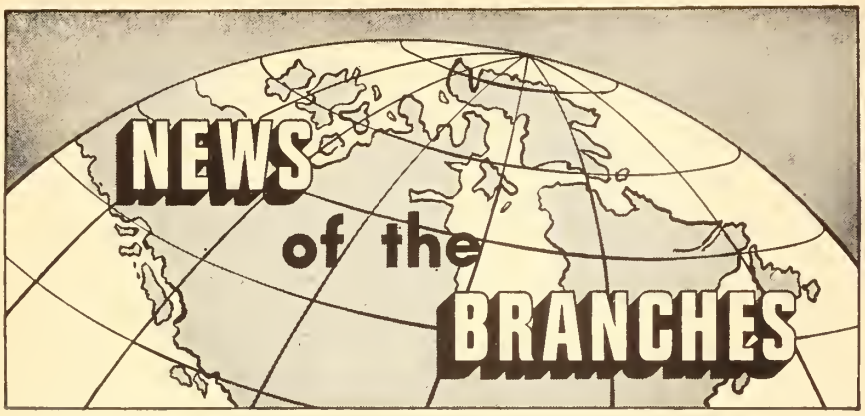


Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Brockville

K. R. Bullock, Jr.E.I.C.,
Secretary-Treasurer
G. M. Woods, M.E.I.C.,
Branch News Editor

Car of Tomorrow

Automotive trends for the future were graphically described to 45 members of the Brockville Branch on September 27, 1955, in the assembly room of the Du Pont of Canada, Maitland Works. The speaker was Ian McNab of the General Motors of Canada whose theme was "The Car of Tomorrow".

While the car of the earlier part of the century was the product of the inventive genius of individuals, the car of the future will be the outcome of well-organized scientific and technological genius. Research and industry have become an intimate team, the speaker stressed.

"The engineer has become a leader among the professions," Mr. McNab stated. "The engineers needed in the future of our mechanical age will most likely outnumber all the lawyers and physicians many times. This increase is directly related to the progress we have made and expect to make within the automotive industry," he said.

Principle Unchanged

Mr. McNab said the present engine has really not changed very much since it replaced the steam engine. All trends towards its betterment are more or less conventional, but the real threat to the motor of today will come from the gas turbine.

Outlining some of the trends in the industry, Mr. McNab said that one movement was toward higher compression ratios, to improve fuel economy by 30 per cent, equivalent to a saving of three billions annually to car drivers in North America.

Another trend was towards an improved carburetor to reduce loss of hydrocarbon gases and other fuel wastages. These hydrocarbons, the speaker pointed out, form a part of the organic pollution that is estimated to reach 1,000 tons in a city of 100,000 people.

With reference to atomic power he said "We can take for granted that the splitting atom, as well as fusing atoms, holds as much or more promise to revolutionized life as the development of the automotive industry has done up to now."

18-Month Job

The General Motors official said the design and development of a new body starts at least 18 months ahead of the birth of a new model car.

Some of the annual conditions laid down for the new body are that it must be the latest in styling and streamlining and, above all, it should cost less than the old model.

The speaker was introduced by Chairman Fred Walsh and thanked on behalf of the members by Tom Reade of Cardinal.

Central British Columbia

H. D. DeBeck, Jr.E.I.C.,
Secretary-Treasurer

General Dinner Meeting

A general meeting of the Branch was held at the Golf Club in Kamloops on September 9, 1955 with 22 in attendance.

Vice-chairman A. F. Joplin was in the chair. Following the refreshments and dinner, the meeting was called to order and the minutes of the previous meeting held in Vernon on February 11, 1955, were read.

A. E. Stewart Speaker

The chairman then called on Mr. Hatfield to introduce the guest speaker, A. E. Stewart, M.E.I.C., divisional engineer for the Canadian Pacific Railway at Revelstoke, who gave a very interesting talk on "Railroading in the Mountains".

Kamloops Executive Meeting

A meeting of the Executive was held at the Golf Club, Kamloops, on September 9, 1955.

The meeting convened at 9.30 p.m. with Mr. Joplin in the chair. The members present were Messrs. Dimock, Harris, Zirul and DeBeck.

The minutes of the last executive meeting held in Kelowna on April 15, 1955, were read.

A letter from Branch Councillor M. L. Wade concerning the expense advance for the annual general meeting was read; authorization was given to the secretary-treasurer to pay the Kamloops Golf Club for the rental of the premises; and approval was given to an application for membership in the Institute.

The meeting adjourned at 10 p.m.

Hamilton

A. F. Barnard, Jr.E.I.C.,
Secretary-Treasurer
Ross R. Parker, Jr.E.I.C.,
Branch News Editor

Plant Tours

The first meeting of the Hamilton Branch was a plant tour of the continuous galvanizing process and the oxygen process for steel making at Dominion Foundries and Steel Limited.

After visiting the two plants during the afternoon of September 15, 1955, we were served light refreshments at Dofasco Veterans' Club. To describe the many interesting things we saw, D. O. Davis, vice-president and chief engineer gave an illustrated talk.

Oxygen Method

The vessels for making steel by the oxygen method were described as pear-shaped vessels mounted on two trunions.

One of the greatest advantages of the process is the reduction in time of producing steel. The total time is 45 to 55 minutes per heat. Usually oxygen is used for 28 minutes and quantity of eight to ten tons used per ton of steel. The oxygen lance is water cooled.

Only one vessel is used at a time as the other one is being lined. The refractory lasts about eight days.

Advantages

Some of the advantages of this process over open hearth or the electric furnace is that it has 50 per cent of the material cost and less operations cost. The maintenance cost is less, due to less refractory, in fact 50 per cent less than the open hearth. In most cases the quality of the steel equals or surpasses steel from electric furnaces.

To begin the operation, molten iron from the blast furnace is delivered in 150 ton Treadwell cars. After being poured into ladles, the iron is used to change the vessel. The vessel is 14 ft. in diameter and 25 ft. high. With 100 tons of dolomite refractory brick they have a capacity of 1,150 cu. ft.

The additives such as silicon, limestone, flux and manganese are added through a spout into the top of the vessel. Cars carrying the additives are moved on a monorail system operated by one man.

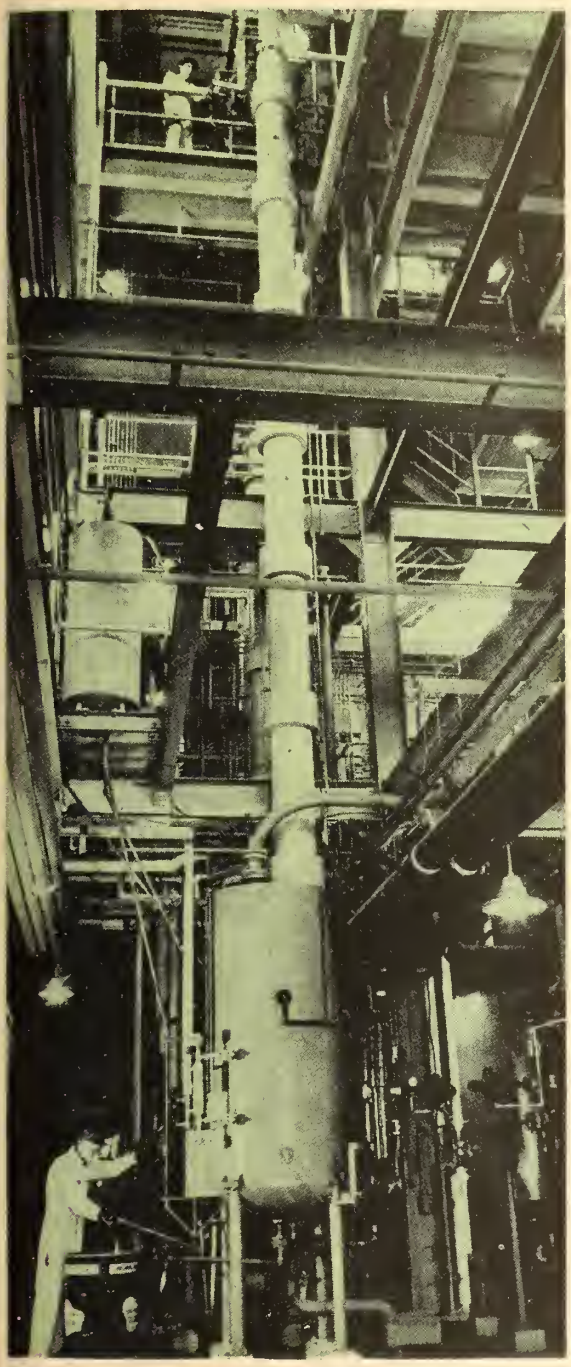
After being charged with molten iron, scrap is added. The scrap makes up 30 per cent of charge. Fifty to sixty tons of steel are made per heat and eight or nine heats poured per shift.

The slag is poured from the vessel on the side opposite to the side on which the steel is poured. The slag pots are put on trucks with special dumping hoists.

The steel is poured into a ladle which is transported to moulds by one of the four cranes. Six ingots are poured from one station, after which the beds are stripped and the gates and feeders removed and the moulds rebricked. The

DOW CORNING

increases column throughput without impairing overhead purity



Heat input to the still of this vacuum packed fractionating column in Dow Corning pilot plant is under precise Foxboro Control. Based on pressure drop across column, Foxboro Control maintains optimum conditions at all times See diagram

...with Foxboro Control of pressure drop

Maximum column loading with minimum priming or carry-over is one outstanding efficiency feature of Dow Corning Corporation's pilot plant production of chlorosilanes and silicones at Midland, Mich. To achieve this optimum throughput, completely unaffected by variations in product concentration, Dow chemists employed the Foxboro Pressure Drop Method of Control.

In this automatic Foxboro System, a d/p Cell Transmitter continuously measures column pressure loss caused by plate or packing resistance plus liquid and vapor mass velocities. This *true* measure of vapor product movement is relayed by the transmitter to a Foxboro M/40 Controller. The Controller precisely regulates heat input to the column . . . maintains steady boil-up for any given feed stock, without overloading.

Foxboro Pressure Drop Control will perform with the same high-efficiency on *your* column . . . whether it's packed, bubble cap, or sieve-plate type . . . on continuous or batch runs. For complete details, write for Engineering Data Sheet 282-14.

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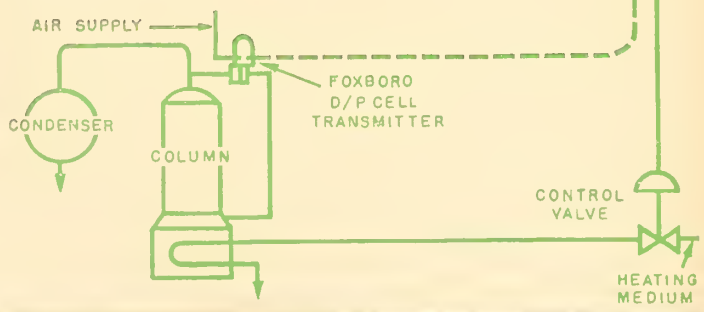

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• Branch News

14 to 17 inch ingots are taken to the hot rolling mills in semi-trailers which have insulated sides and top of refractory brick. These insulated trucks reduce hot pit time 50 per cent.

Much time was spent in developing the dust collectors which, at 90 ft. above the floor, collect dust by passing the waste gases through a water spray. Next the gases go through a venturi. At the throat, water is admitted. Fans pull the gases through the separators.

The brickmaking equipment is in the same building. The bricks are tar bonded dolomite.

In the question period it was brought out that the fountain pouring of ingots is not special to the oxygen process. Better ingots are made due to less turbulence so that the end of the ingots need not be cut in the blooming mill.

Much of the reaction in vessel is caused by the difference in densities of steel and iron and not due to the action of the oxygen. There are only about a dozen oxygen steel making plants in the world and this was the first one in North America.

Continuous Galvanizing Mill

Mr. Davis also described the continuous galvanizing mill which was also visited during the afternoon.

There are two payoff reels of sheet steel which is rolled first hot, then cold before being placed in this mill. The ends of the strips are welded together. To enable the strip to operate continuously, a large loop is placed next, which is used when a new strip is being welded to the older one. A constant tension is maintained on the loop car by cable from a drum which is connected through a worm gear reduction unit to a hydraulic coupling driven by an electric motor.

The strip then passes through a flame clearing furnace and undergoes mechanical scrapping. To obtain a clean surface and ensure a good bond, the strip is annealed in a hydrogen, nitrogen atmosphere which is reducing. At 800 deg. F, the strip passes through the zinc bath. The thickness of zinc is governed by rollers. Finally it is cooled and either rolled or cut into sheets.

As the heated melt never passes through the atmosphere, no flux is needed. This also ensures better adhesion between the zinc and steel. It is corrosive resistant.

Professional Development

At the initial meeting of the professional development group, 110 men were present to form the four groups.

The chairman, W. Filer, called on two former directors, T. Hill and G. Schneider who described some of the activities of the past and suggestions for the future. The chairman of the Hamilton Branch, F. E. Milne, gave a history of Engineering Institute in Canada and Hamilton and listed the advantages of being a member.

The executive director of the A.P.E.O., Col. T. M. Medland, spoke of some of the problems of professional recognition from industry and from within the profession itself.

We were given a brief history of the recent meetings of the European-American Engineering conferences in London and Zurich by the General Field Secretary, Col. Grant. The progress of the professional development programs in Canada has been very satisfying, while in the U.S.A., Col. Grant reports only one group in Cleveland is active.

The evening closed by having registration in the four groups, after which refreshments were available.

Lethbridge

R. D. Hall, Jr.E.I.C.,
Secretary-Treasurer
R. B. Godwin, Jr.E.I.C.,
Branch News Editor

Calgary Field Trip

On Saturday, September 17, some 50 members, wives, and guests enjoyed a field trip to Calgary. Hosts for the occasion were Calgary Power Ltd. who conducted the tour of Bearspaw Dam, and the Imperial Oil Company (manufacturing department) who conducted the tour of their Calgary refinery.

Bearspaw Dam

The party gathered at the Bearspaw Dam site, a few miles west of Calgary at 11 a.m. Tom Stanley gave a brief resume of the features of the project and operations carried on at Bearspaw. Bearspaw Dam was constructed both to provide more effective flood control on the Bow River, and hydro-electric power for the rapidly increasing loads Calgary Power is supplying. The dam is of both earth fill and concrete construction.

To the north is the earth fill section of the dam. It is 900 ft. long, 20 ft. wide at the top, and 350 ft. wide at the base. The maximum height in the river is 64 ft.

The concrete transition section located directly south of the earth fill portion of the dam is 175 ft. long and consists of four separate piers. During the construction of the Power House, sluice gauge and spillways, the river flowed between these piers. The space between these piers is now permanently closed with concrete. At the north end of the transition section, wings extend at an outward angle to provide a cup-like abutment which permits a good seal between the concrete and earth fill section.

Concrete Sluice Dam

To the south of the powerhouse in the main section of the river is the concrete sluice dam, which is approximately 250 ft. long. This dam contains a small regulating gate capable of passing four to five hundred cubic feet per second, and three large sluice gates. These sluice gates are 50 ft. wide and 31.5 ft. high and are capable of passing up to thirty thousand cubic feet per second each.

Turbine

The powerhouse houses a single Kaplan turbine of 22,000 horsepower. A feature of the turbine is that the pitch of the blades varies automatically with the depth of water in the forebay, the water gate opening and electrical load.

The powerhouse also serves as a main communications centre for the utility. Direct and relayed radio links are maintained with points throughout southern Alberta, and communication to and from these points can be relayed directly via telephone lines to the Calgary Power head office in Calgary.

Another feature of the station is the repair shop for large power transformers, etc., which utilizes the powerhouse crane. At the time of the field trip a large transformer was dismantled for repairs, and the visitors were able to inspect the construction details of this unit.

Following the tour of the dam and powerhouse, the party enjoyed lunch at Eamons Inn, on the Banff Trail, courtesy of Calgary Power Ltd. Mr. Stanley introduced Mr. Monkman, chairman of the Calgary Branch; Jeff Hann, superintendent of the Imperial Oil Company's manufacturing department; and Bert Howard, general manager, Calgary Power Ltd.

Jack Haberman, chairman of the Lethbridge Branch expressed the thanks of the Branch to Calgary Power Ltd. for their well conducted tour and hospitality.

ATTENTION PLEASE!
E.I.C. BRANCH EXECUTIVES

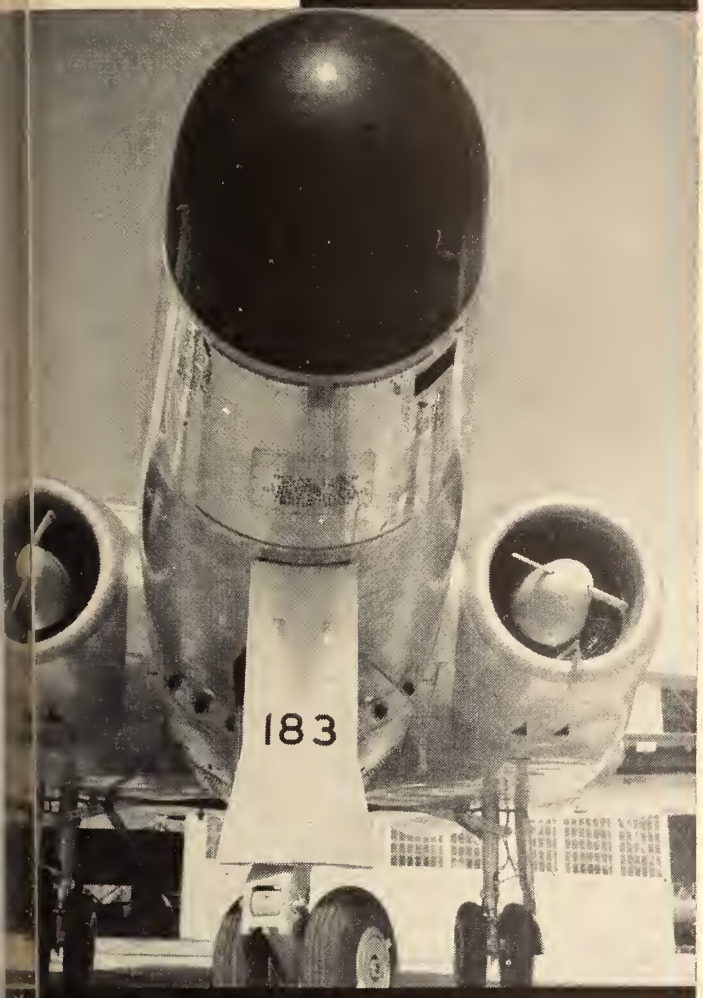
Several months ago you were written to by headquarters' staff on the subject of new developments in your area of Canada, and the desirability—almost the necessity—of getting Journal papers to describe them. There is so much going on now, in so many places, that ordinary methods of keeping abreast of the engineering news may fail us. We hope not, but you can help us to be sure. Please organize your branch this year so as to cover these two things:—

1. When you hear about a new development in your vicinity, in engineering or technology, get a few facts together, plus the names of some of the principals, and send this information to the editor. We will take it up from there, if you wish.
2. When you have a paper delivered before your branch, if it is a reasonably worthwhile effort TRY to get a manuscript of it and send it to the editor. Some of our finest technical presentations are lost forever because of this lack, and no record exists beyond the memories of the comparative few who heard the speaker.

HELP THE EDITORS TO KEEP IMPROVING OUR JOURNAL

CANADIAN INDUSTRY SAVES WITH

NICKEL ALLOY STEELS



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Nickel Alloy Steels often contribute to lower unit-labour costs due to their excellent performance response to usual fabrication methods. They are easily formed and welded, features which are especially suited for fabricating heavy-duty equipment requiring maximum ruggedness and stamina with minimum weight.

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Lower maintenance and replacement costs complete the savings picture with Nickel Alloy Steels. Their high resistance to conditions of corrosion, abrasion and impact mean longer service life . . . more profitable operation.

Nickel Alloy Steels are available from Canadian steel mills in a wide range of varieties to meet specific applications.

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The electrolytic corrosion resulting from a junction of copper tubing with a steel header is entirely absent where "Steeline" is used . . . the liners being arc-welded to the headers to form an all-ferrous construction.

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• Branch News

Refinery Tour

The group drove to the Imperial Oil Company's refinery, just east of Calgary, assembling at 3 p.m. where Jim Scott outlined the operation and construction details of the refinery. The party then broke up into small sections and was conducted on a tour of the various portions of the plant, during which the particular operations and equipment were described in more detail.

The plant refines about 10,000 bbl., of crude per day, and is one of the company's smaller refineries. Crude oil is brought in by pipelines from the Turner Valley field, and by tank car and truck from the other numerous fields in Southern Alberta.

Refinery Process

The process is similar in all refineries. Crude oil is initially heated and then pumped into "fractioning" towers, where the various components are condensed out of the vapour at their own particular condensing temperature. Components with lower boiling points condense near the top of the towers while those with the higher boiling points are condensed out nearer the bottom. In the fractioning tower, gases, naphthas, light distillates, light fuel oils, gas oil and distillate oil are taken off from top to bottom. After further treatment the naphthas become natural gasolines or solvents, the light distillates become kerosene, and stove oil, light fuel oils are made into furnace or diesel fuel. Residual oils which are too heavy to boil in the fractioning tower are made into lubricants, heavy fuel oil, waxes, asphalt and even coke.

Cracking

The commonly heard term "cracking" refers to the method of turning heavier oils into lighter products such as gasoline. Gas oil is used in the cracking process, the most modern technique of which utilizes a catalyst to produce gasoline. The gasoline and fuel oils produced by the cracking process are blended after purification with the natural products produced in the fractioning tower to form a wide variety of products suited to different jobs. The various chemicals added to gasoline to give it storage, lubricating, and other properties include tetraethyl lead which gives the fuel more power and anti-knock properties. Tetraethyl lead is presently imported from U.S.A. but a new Canadian plant will soon be supplying this essential component of modern gasoline.

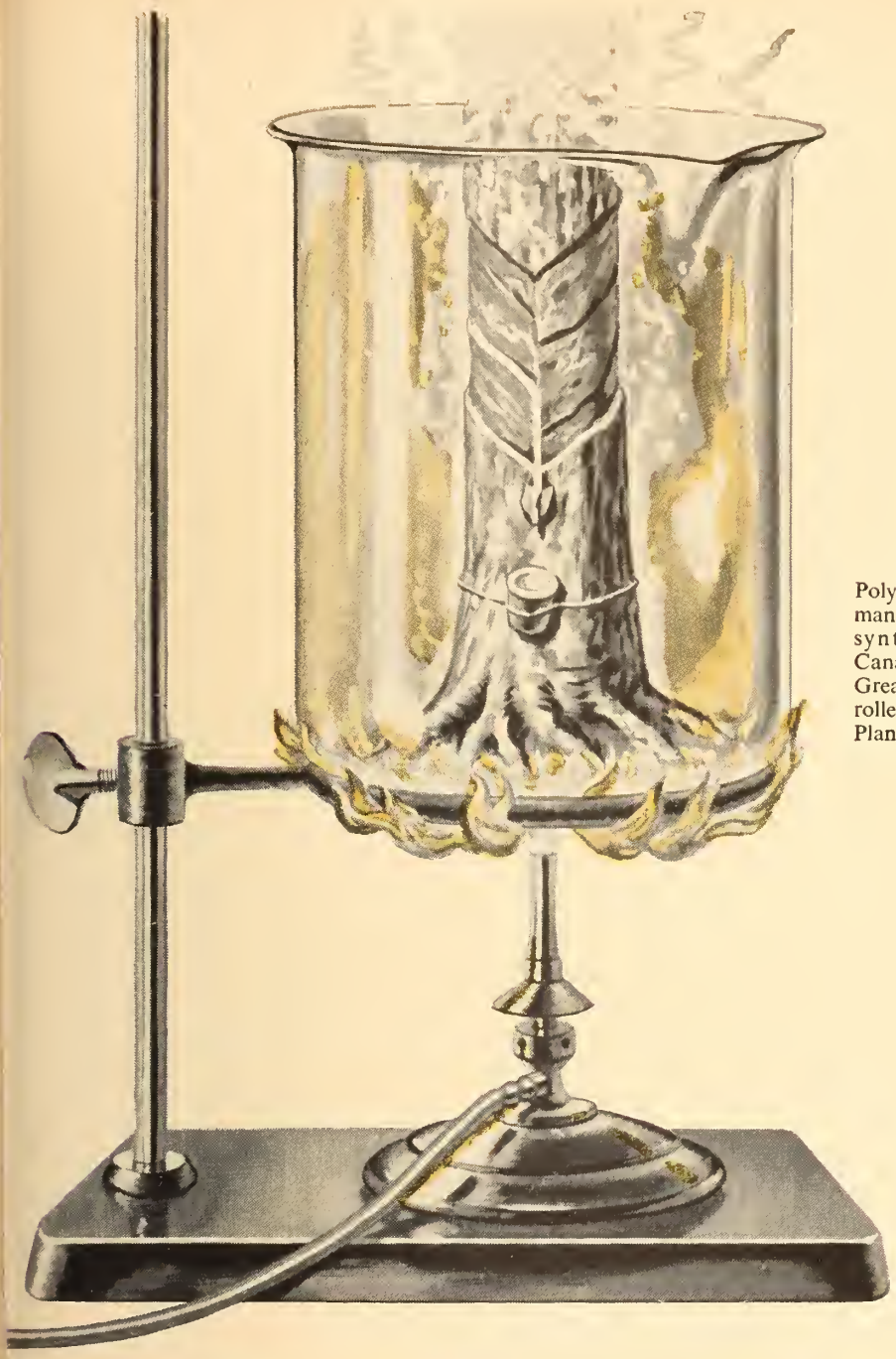
Following the tour, the party was treated to refreshments by Imperial Oil Ltd., and the guests were able to ask further questions concerning the refinery and the processing of its products.

Jack Haberman, thanked Mr. Hanna and the Imperial Oil manufacturing department for the informative tour and courtesies extended to the visitors.

Year's First Dinner Meeting

The Lethbridge Branch held its first monthly meeting of the 1955-56 season at the Lethbridge Flying club on October 15. Some 50 members in attendance

(*Continued on page 1604*)



Polymer Corporation Limited, manufacturers of 90% of the synthetic rubber used in Canada, use Shell Alvania Grease on grease lubricated roller bearings at their Sarnia Plant.

HEVEA BRASILIENSIS CANADIANA

HEVEA Brasiliensis — or in plain English, rubber tree, common or jungle variety — has a Canadian, man-made version. Of all the rubber used in Canadian products, almost half is chemically produced — manufactured at Sarnia by Polymer. And for most purposes it is *better* than natural rubber!

With its steadily rising output, Polymer needs to combine both chemical and industrial know-how. Significant is its choice of Shell Alvania Grease for lubricating pumps, driers, conveyors and electric motors. Results have confirmed the wisdom of the choice. Because Alvania does a job previously needing several different greases, Polymer has been able to cut its lubricant inventory, save both on employee training and labour, and so reduce general maintenance costs.

Helping Canadian manufacturers to improve the products you use is the continuing aim of Shell Research.

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The Field Secretary on Tour

Colonel L. F. Grant, E.I.C. field secretary, on a recent trip from the Toronto office, spoke at braneh meetings at Sault Ste. Marie and the Lakehead. He also visited with groups of engineers at Marathon, Red Roek and Terrace Bay, Ont. where there are no E.I.C. branches.

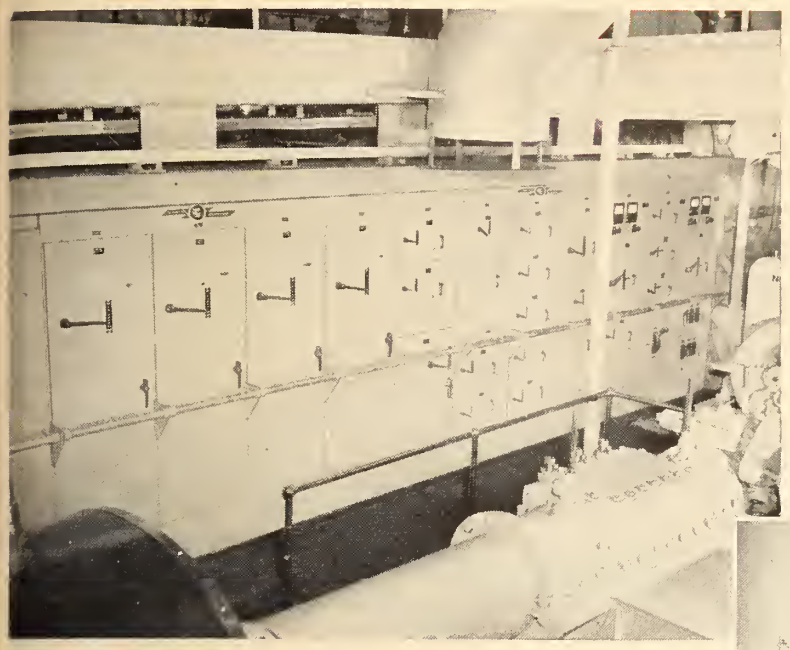
Red Rock - Baek row, l. to r: L. R. Ecman, E. S. Rice, J. H. Hargrave, L. F. Grant, W. G. Baker and F. Rudzicz. Front row, l. to r: H. Penner, P. R. McDowell, A. S. Kadziebwa, J. H. Bardsky, F. Katzmayr.

Marathon - Back row, l. to r.: J. H. Ross, L. G. Williams, A. K. Campbell, J. Corbould. Front row, l. to r: I. H. Birch, L. F. Grant, M. F. Frombach.

Terraee Bay - left to right: C. E. Paget, J. C. Wig, G. Heron, T. Smith, A. Harrison, T. Williscroft, L. F. Grant, and H. B. Crisson.

Where dependability is the first consideration ... it's

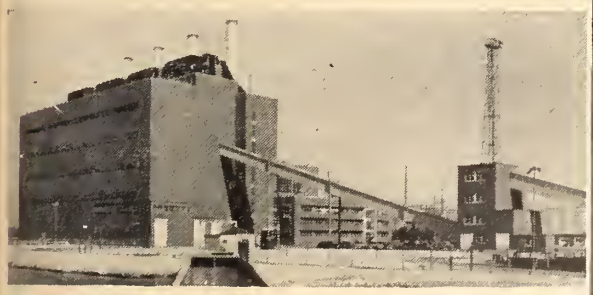
MOTOR CONTROL CENTRES

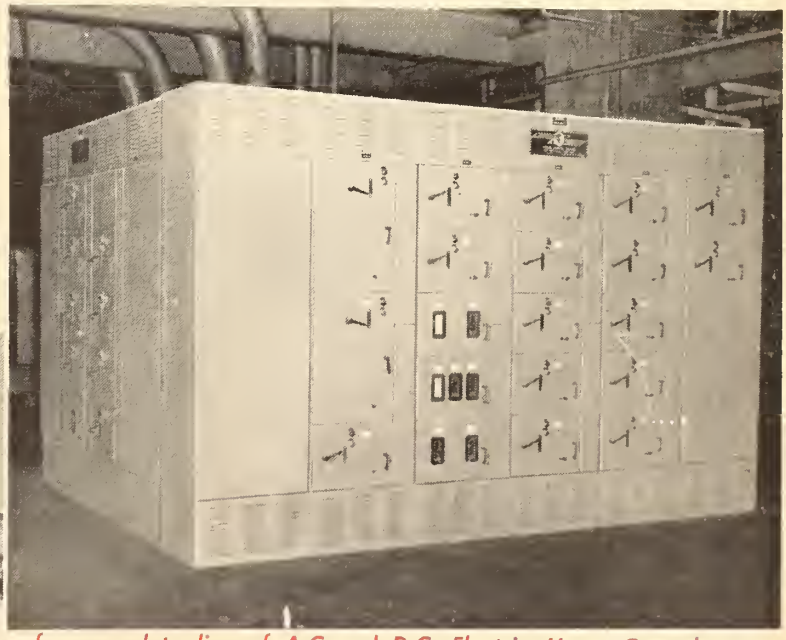


Showing C.C.L. Motor Control Centre, installed by Canada Steamship Lines aboard the "T.R. McLagan" the longest freighter on the Great Lakes.

The specification of motor controls is never a casual incident. Responsibilities of selection increase where dependability is the first consideration. Those shown on this page . . . for example . . . are of vital importance to life and property.

At the Hydro-Electric Power Commission's J. Clark Keith Generating Station . . . the Motor Control Centre is another important installation by Canadian Controllers Limited.





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• Branch News

were entertained at dinner by piano and violin selections played by Mr. and Mrs. Brown. This marked the thirtieth year that the Browns have played for the Lethbridge Branch meetings.

Following dinner the new executive was introduced by J. Haberman. George Brown then led the meeting in community singing.

Jack Strath Is Speaker

After a short intermission the speaker for the evening, Jack Strath, was introduced by D. Cramer. Mr. Strath spoke on "Photogrametric Methods for Highway and Irrigation Ditch Location". He stressed that, while aerial photography could not replace the surveyor for final construction quantities, it could do a much faster and more adequate job of the preliminary surveying almost always required for any location work.

Photogrametric Methods

By taking aerial photographs in a set sequence and finding ground control point by normal surveying methods, the areas involved could be contoured to an accuracy of one foot in elevation. This contouring, Mr. Strath stated is done with a special photogrametric machine which mechanically "reads" the photographs and interprets them.

Several examples of the work done by this method were shown by Mr. Strath. They included detailed town plans, contour maps, highway and water course locations, and other similar examples.

Much use of this method of surveying has been made in recent years in northern Canada. Such recent projects as forestry inventory, town surveys, highway relocations, and the now famous "Dew" line, have been surveyed by the use of aerial photogrametry. In closing Mr. Strath again stressed that the use of aerial photography is a new field and that many things which now seem improbable or impossible may be accomplished by it in the future years.

Mr. Strath was sincerely thanked for his interesting and informative talk by E. Lawrence and the meeting was adjourned with the singing of "God Save the Queen".

Nipissing and Upper Ottawa

J. Kartzmark, Jr.E.I.C.,
Secretary-Treasurer

F. R. Marshall, Jr.E.I.C.,
Branch News Editor

Branch Hears J. E. Koyle

On Wednesday evening, September 21, at the Manor Hotel, North Bay, members of the Nipissing and Upper Ottawa Branch of the Engineering Institute of Canada heard J. E. Koyle deliver an address on "Boiler Feed Water Treatment".

Mr. Koyle graduated from the University of Saskatchewan in chemical engineering and later specialized in chemistry at the University of Western Ontario. During the war years he spent considerable time in the Royal Canadian Navy as a lieutenant commander. He was awarded the D.S.C. and was also mentioned in despatches. At the end of hostilities Mr. Koyle joined the Bird Archer Company as manager of the railway service department.

Boiler Feed Water Treatment

Mr. Koyle's address dealt in detail with the various modern methods of treating boiler feed water externally and internally to reduce troublesome conditions such as the formation of sludge, scale and foam to an acceptable degree. It was pointed out that in certain areas of Northern Ontario water is contaminated with the saps from trees. This is capable of producing a microscopic layer of scale on boiler surfaces which has eighty times the insulating value of asbestos. This type of scale is difficult to detect and due to its high insulating qualities causes overheating and warping of the boiler plates.

Mr. Koyle was introduced by T. McNabb and thanked on behalf of the Branch by R. Booey.

Following the dinner L. Hood, Branch councillor, discussed the more important items dealt with at the Institute council meetings which he attended in Toronto.

Vancouver Island

Cmdr. P. F. Fairfull, M.E.I.C.,
Secretary-Treasurer

The Vancouver Island Branch at its last annual meeting, agreed to award annually a scholarship of one hundred dollars to an outstanding student, proceeding into engineering at an approved university. The award is to be made by the Committee on Prizes and Scholarship at Victoria College.

Winnipeg

Electrical Section

G. L. MacDonald, M.E.I.C.,
News Editor

Silicones

The Electrical Section of the Winnipeg Branch held its first meeting for the 1955-56 season on October 6. H. D. Hamilton, electrical sales division, Dow Corning Silicones Limited, presented a talk entitled, "Silicones as Applied to the Electrical Industry." Mr. Hamilton's talk was illustrated by slides and two main pictures, "What Is a Silicone?", and "Silastic", the latter dealing with silicone rubber.

Silicones are used in some 500 products in the form of fluids, resins, varnishes, moulding compounds and rubber. The products are very diversified ranging from adhesives to release agents, and from defoamers to foamed structures. This wide usage stems from several properties of silicones, or combinations of these properties. They have high thermal stability, for example, low temperature silastic is serviceable at minus 100 deg. F. and remains flexible at 480 deg. F. They are water repellent. They have high resistance to oxidation and weathering. Other properties are of special interest to the electrical industry and the following apply particularly to silicone rubber: high dielectric strength over a wide range of temperature and frequency; high thermal conductivity; high resistance to corona and ozone; and resistance to lubricating oils and some chemicals.

Wide Range of Materials

The A.I.E.E. hot spot temperature rating of class 'H' insulation is 180 deg. C. as compared to 105 deg. C for class 'A' insulation. High temperature or high overload applications frequently provide a good case for the use of class 'H' insulation. The use of silicones in class 'H' insulation, therefore, results in very considerable application in the electrical industry. A wide range of material is available in the form of varnished glass cloth and tapes, silicone bonded mica and mica glass combinations, silicone asbestos glass, glass laminates, silicone moulded parts, silicone dielectric fluids, impregnating varnishes and wire enamels.

Uses of Silicone Products

Silicone rubber is used for coated cloth and tapes for class 'H' insulation. It is also used for tubing, wire and cable insulation, and a variety of other uses. One interesting application mentioned by Mr. Hamilton was the use of silicone rubber insulated cable on Navy ships because it does not carbonize and form a conductor in case of fire, and because of a space saving of about 30 per cent. Silicone rubber tapes are available fully cured or semi-cured. The latter may be vulcanized by heat in position on the coil forming a resilient void-free insulating material which is also water repellent.

Silicone products are used on aircraft because of temperature stability and because of saving in space and weight. They are used for such things as insulation on actuator motors, control cable insulation, ignition system insulation and for sealing ignition and control systems. There are several interesting applications of silicones in the electrical industry other than in insulation. One of these is the use of silicone fluids as a damping medium in relays and instruments, and also as a lubricant for instruments. These fluids have a very flat viscosity temperature curve giving uniform performance over a wide temperature range. Also of interest are the various oils and greases which provide temperature stable lubricants for motors.

The relatively high cost of class 'H' insulation as compared to class 'A' insulation places some economic limitations on its use. It seems reasonable to assume that the increasing use of silicones in a wide variety of products may bring about some reduction in cost which would, therefore, increase their scope in the electrical industry. Demands for space and material saving and wider temperature requirements also point to an increasing use of silicone products.

Mr. Hamilton's talk was followed by a discussion period and the members had an opportunity to examine samples of silicone products including various types of insulation, moulded products, fluids and laminates.

As Good As They Look

These new refining facilities make a beautiful picture. Their performance is equally attractive. They are the main units* of a program that has greatly increased the output of Imperial's Montreal East Refinery and stepped up its production of high quality gasoline.

Now more people are enjoying more fine Esso products from this new plant,

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* *45,000 bpd two-stage crude distillation unit with desalting facilities*
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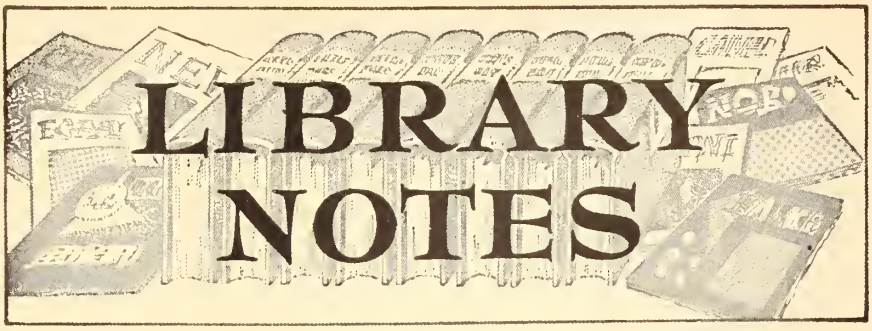

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Motion and time study; principles and practice, 2nd ed. M. E. Mundel. New York, Prentice-Hall, 1955. 575pp., illus., $9.35 (U.S.).

The author's aim in the first edition of this book, published in 1950, was to present the basic principles behind modern motion and time study in an organized form so that they might be readily understood. This second edition has been revised in the light of new developments, and incorporates ideas given the author by many practising industrial engineers and teachers. Professor Mundel also spent some time in England where he lectured at the University of Birmingham, and toured many industrial plants, so that many British ideas are also included. Experience gained in organizing a management engineering training programme for the United States Army Ordnance Corps is also reflected in this new edition.

The text falls into two sections, motion study and time study, the first and final chapters serving to tie the whole together, as they consider what motion and time study can accomplish, and how their standards can be applied.

All the steps in conducting a motion study are outlined, as are the various techniques. The author explains and gives examples of process charts, work activity analysis, multiple-activity analysis, micromotion study and therbligs, memomotion study, and cyclegraphic and chronocyclegraphic analysis.

In the section on time study, or work measurement, the various methods of direct time study are described, as are synthesized time standards.

The illustrations are taken from a wide variety of industries, and the author acknowledges that in many instances, he has drawn on the work of others, notably the Gilbreths. There is quite a large bibliography of general books and periodical articles referring to specific topics. There is also a collection of some hundred problems.

This should prove a useful text for students, for practising engineers new to the field, indeed, for anyone interested in applying the standards of motion and time study to his own business.

S. C.

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• Library Notes

BOOK NOTES*

Prepared by the Library
The Engineering Institute of Canada

*Review provided through the courtesy of the Engineering Societies Library in New York.

Aviation English: méthode d'anglais à l'usage des personnels de l'aéronautiques militaire et civile et des exploitants des transmissions. S. Humbert. Paris, Dunod, Montreal, Fomac, 1955. 2 vols., $2.65 a vol.

As the sub-title indicates, this is a text for teaching English to French-speaking personnel concerned with both military and civil air operations, although the emphasis in the vocabulary is rather on the former.

In the early chapters the vocabulary is kept simple, each lesson bringing in a new verb. More colloquial words are gradually introduced, and it should be possible to get a good working knowledge of English from a careful study of the books.

Basic synchros and servomechanisms. Van Valkenburgh, Nooger and Neville, Inc. New York, Rider, 1955. 2 vols., illus., $2.75 (U.S.) each.

Another in the series of "picture book" courses prepared for the U.S. Navy, these two volumes cover synchros and servomechanisms as used in automatic process control. The material is reduced to the simplest terms, and there are many diagrammatic illustrations.

***Centrifugal and other rotodynamic pumps.** 2nd ed. Herbert Addison. Toronto, British Book Service, 1955. 530pp., illus., $8.50.

The entire range of centrifugal, screw, and propeller pumps is covered in four sections dealing with principles, design and construction, performance, and installation. In the revision, minor changes have been made in accordance with advances in practice, and the bibliography has been brought up to date. Forty-eight worked examples of pump and pumping-plant problems are appended.

Chambers' technical dictionary, rev. ed. with supplement. C. F. Tweeney and L. E. C. Hughes, eds. Toronto, Macmillan, 1955. 980pp., $7.50.

Chambers' technical dictionary needs no introduction to the majority of our readers. It is a mine of information on a great variety of technical subjects, and the reference shelf of any library is incomplete without it.

In this edition some of the definitions included in the body of the work have been brought up-to-date, there is an addition to the supplement which was included in the 1943 edition, and the whole work has been re-set.

Civil engineering design. T. W. Barber, 4th ed. rev. by Rolt Hammond. London, Technical Press, 1955. 273pp., 25/-.

The sub-title of this book is "Notes and sketches for the use of civil engineers, draughtsmen, students, builders and contractors" and its object is to present sketches of machines, materials and methods used in civil engineering. Both sketches and definitions are re-

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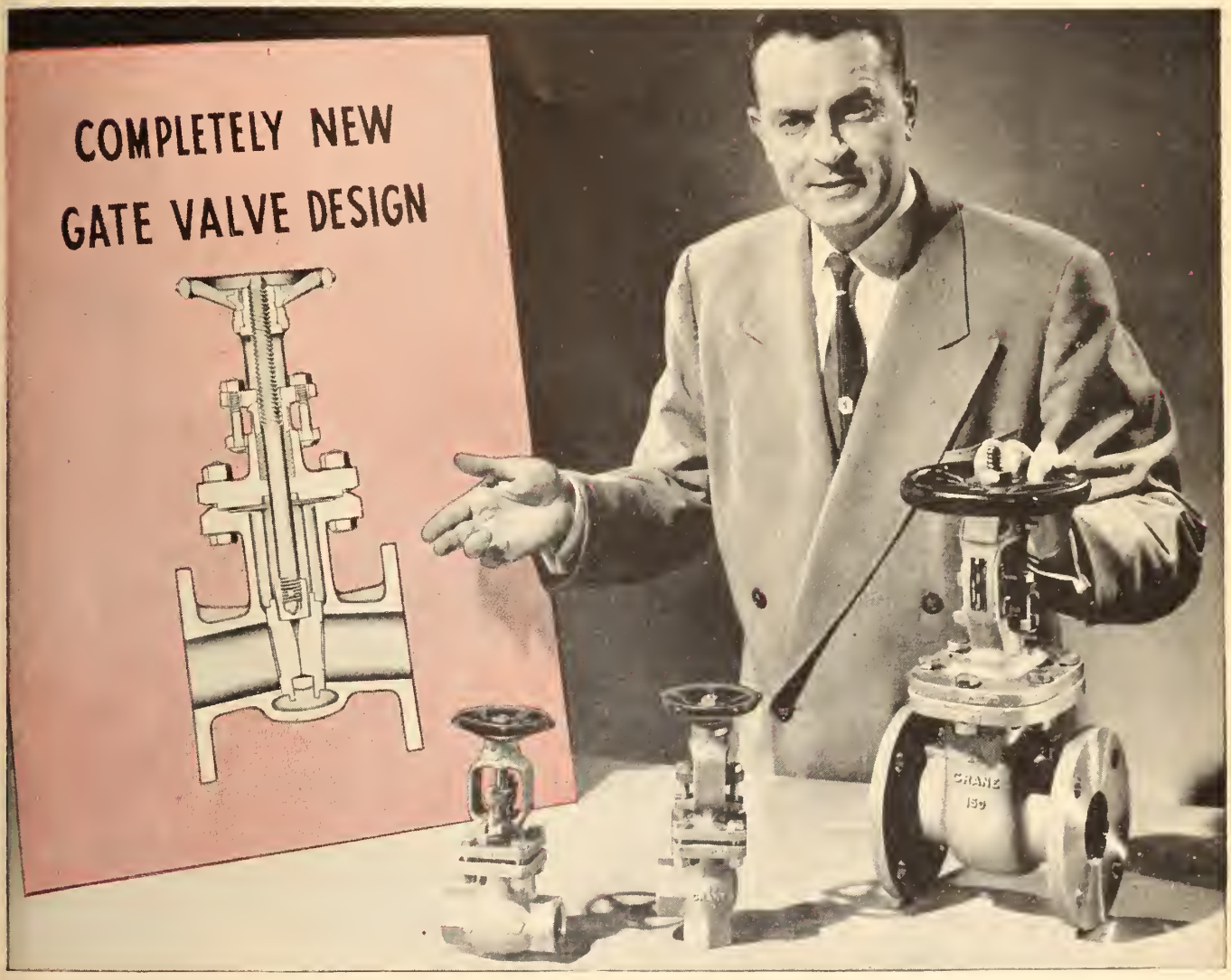

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duced to their barest outlines, and are classified. There is a bibliography of works on civil engineering published in the last ten years, arranged according to the Universal Decimal Classification, the system which is in use in the E.I.C. library.

***Cycles and performance estimation. (Gas turbine series, vol. 1)** James Hodge. Toronto, Butterworth, 1955. 329pp., 50/-.

This first volume in a new series on current gas turbine theory and practice sets out the basic principles for assessing gas turbine performance. The greater part of the book is devoted to the analysis of idealized cycles and to the presentation of performance data, mainly in graph form, for a wide selection of actual cycles such as are used in shaft power generating plants, aircraft engines, blast-furnace blowing, and other applications. The estimation of performance of turbines under conditions other than those for which designed is also treated.

***Deep drawing.** J. Willis. Toronto, Butterworth, 1954. 134 pp., illus., $4.50.

Condensed into this relatively small volume intended for those engaged in the industry, is the substance of the work on the engineering aspects of deep drawing which Professor Swift has been carrying on at Sheffield University over the last sixteen years. Summaries are given of work on single and two stage drawing and on ironing of cylindrical cups, shearing, lubricants, sheet "temper" and punch profile, and simulative tests for materials. Separate chapters are devoted to theory and practical applications. A list of the original papers from which this summary is drawn is included.

The elements of the theory of real functions. 3rd ed. J. E. Littlewood. New York, Dover, 1954. 71 pp., $1.35 pa. (U.S.).

This little book contains the substance of the lectures given by the author at Trinity College, Cambridge. As far as possible, he has excluded philosophy, and has concentrated on matters which, although abstract, are not complicated. The four chapters deal with classes and cardinal numbers, well-ordered series, other types of series and elements of the theory of sets of points.

L'Equilibre des corps déformables. G. Colonnetti. Paris, Dunod, Montreal, Fomac, 1955. 162 pp., diagrs., $7.50.

This work presupposes a knowledge of the mathematical theory of elasticity, as well as of the solution of problems connected with the strength of materials. Basic theories are outlined briefly, whilst new ideas are presented by the author in more detail.

The author, who is a professor at the Turin Technical School, covers such topics as the general theory of equilibrium, plastic deformation, new theories of beams and arcs, etc.

Fifth symposium (international) on combustion; combustion in engines and combustion kinetics. New York, Reinhold, 1955. 802 pp., illus., $15.00 (U.S.).

The hundred and one papers presented at the 1954 Symposium are reproduced in this volume, and constitute an up-to-date body of knowledge on the combustion problems involved in the operation of all types of engines. The papers are divided into nine sections and cover the combustion of solids and fuel droplets, propellant burning, diffusion flames and carbon formation, kinetics of combustion reactions, etc.

As is often the case in publications of this type, there is no subject index, but despite this, the book, together with those containing the papers presented at earlier symposia, should prove useful and interesting to engineers in many fields.

***Gas turbines for aircraft.** I. H. Driggs and O. E. Lancaster. New York, Ronald, 1955. 349 pp., illus., $10.00 (U.S.).

The main subjects treated are cycle analysis; flow of gases through channels and ducts; flow through compressor and turbine; combustion; matching compressor and turbine; control problems; and aircraft performance analysis. Basic thermodynamics are also covered, and the concluding chapter reviews improvements made in gas-turbine engines developed during recent years.

Handbook of engineering materials. D. F. Miner and J. B. Seastone, eds. New York, Wiley, 1955. 1,380 pp., tables, $17.50.

Intended for engineers, research workers and advanced students, this Handbook gives authentic and useful information on the materials of engineering and construction. It is not, however, intended to take the place of specialized textbooks on the various materials.

The three main sections deal with metals, non-metals, and construction materials. This arrangement makes easier the comparison of various materials between which there might be a choice. Much of the information is arranged in tabular and diagrammatic form. Bibliographies are included listing mostly periodical articles on the various materials.

This Handbook is a valuable addition to the library, containing as it does a great variety of information on so many materials.

***Industrial ventilation; a manual of recommended practice.** Lansing, American conference of governmental industrial hygienists, Committee on industrial ventilation, 1954. Various paging, diagrs., spiral binding. $3.00 (U.S.).

The purpose of this manual is to meet the needs of official industrial hygiene agencies for a ready single source of recent data on industrial exhaust ventilation, for standardizing ventilation practices, and for training purposes. The many sketches, graphs, and data tables make the manual useful for anyone, such as the plant engineer, who must deal with ventilation problems.

Introduction to process control system design. A. J. Young. Toronto, Longmans, Green, 1955. 378 pp., diagrs., $7.60.

The author, the head of the Central Instrument Laboratory of Imperial Chemical Industries, presents in this book an introduction to the study of process control systems and the factors influencing their design. He has been engaged in research on the subject since 1946.

He examines the basic principles, using simple mathematics, and always keeps a balance between theory and practice. There is a four-page list of references. The book should prove useful to all engineers concerned with automatic process control.

Introductory nuclear physics, 2nd ed. David Halliday. New York, Wiley, 1955. 493 pp., illus., $7.50.

Although intended as an undergraduate text, additional material is included in small type in the body of the work, and in the appendices, which will be useful to the worker wishing to go into the subject in more detail.

The text has been brought up-to-date and a new chapter added on the elements of wave mechanics, while other topics covered include fundamental particle physics, cosmic rays, molecular beams, and electric quadrupole moments.

Investment precision casting. London, Machinery Publishing Co., 1955. 58 pp., illus., 4/-. (Machinery's Yellowback No. 35)

Known for many years under the name of "lost-wax" process, investment casting has recently been used in the production of engineering components. Much of the information in this book previously appeared in Machinery, and covers dies, waxes and wax injection machines, making wax patterns, investment and pouring the castings.

***Magnetic alloys and ferrites.** M. G. Say, ed. Toronto, British Book Service, 1954. 200 pp., illus., $3.60.

This book deals with the properties and applications in electrical engineering of soft magnetic materials, permanent magnet steels and alloys, permanent magnet ferrites, and magnetic powder cores. The related subjects of materials for magnetic recording and magnetostriction, and non-magnetic ferrous and magnetic compensating alloys are also treated, and an introductory chapter briefly reviews modern ferromagnetic theory.

***Materials for nuclear power reactors.** H. H. Hausner and S. B. Roboff. New York, Reinhold, 1955. 224 pp., $3.50 (U.S.).

Another in a series of concise summaries of essential information on new developments in various fields of science and technology. The present volume deals with criteria for selecting materials for shielding, for cladding of fuel elements, for moderators and reflectors, and for most of the important parts of a reactor. The material is presented in a form understandable to the layman with some technical background.

The mobile manual for radio amateurs. West Hartford, American radio relay league, 1955. 352 pp., illus., $3.00 (U.S.).

The eighty articles in this compilation have all appeared previously in the periodical QST. Various phases of mobile radio are covered; receiving, transmitting, antennas and power supply.

This book will be useful both to the newcomer to mobile radio, and to the expert who will find it a handy reference book.

Nuclear and radiochemistry. Gerhart Friedlander and J. W. Kennedy. New York, Wiley, 1955. 468 pp., $7.50.

Based on the authors' earlier work, **Introduction to radiochemistry,** this book is written from the chemist's point

WILEY BOOKS

THE TECHNOLOGY OF CEMENT AND CONCRETE

Volume I: Concrete Materials

By ROBERT F. BLANKS, Great Western Aggregates, Inc.; and HENRY L. KENNEDY, Dewy Almy Chemical Co., Division of W. R. Grace and Co.

Main emphasis is on portland cement and aggregates—the most important ingredients of concrete. However, other aspects are covered with exceptional scope and inclusiveness, presenting phases of the subject where much-needed information cannot be found in ordinary reference works. Special-purpose cements, too, are discussed in detail.

1955 422 pages 155 illus. $11.00

TURBOBLOWERS

Theory, Design, and Application of Centrifugal and Axial Flow Compressors and Fans

By A. J. STEPANOFF, Ingersoll-Rand Co.

Designers and builders of blowers, fans, and compressors will find in this book a comprehensive discussion of the unprecedented developments which have taken place in the last fifteen years in the field of the application of turbo-machinery for compression of gases and vapors. Offers new methods of attack on turbo-machine problems and analyzes the art of building turbo-compressors in the U.S. and abroad.

1955 377 pages 245 illus. $8.00

DESIGN OF PRESTRESSED CONCRETE STRUCTURES

By T. Y. LIN, Member of the Joint Committee on Prestressed Concrete, ACI—ASCE.

Thoroughly covers all phases of prestressed concrete structures, emphasizing American methods and conditions, and considering today's costs. Formulas, tables, and graphic methods are so introduced that both preliminary and final designs can be made with ease. About 60 examples, each dealing with a specific point concerning the design of prestressed concrete, are included.

1955 456 pages 242 illus. $11.50

VAPOR-PLATING

The Formation of Metallic and Refractory Coatings By Vapor Deposition

By C. F. POWELL, I. E. CAMPBELL and B. W. GONSER, all at the Battelle Memorial Institute

This is the first single source of reference for data and information about these processes; an authoritative review of the applications and techniques of vapor deposition on metals and non-metals. The versatility of vapor-plating is stressed in order to stimulate its use as a flexible tool in many fields of technology. Sponsored by The Electrochemical Society.

1955 158 pages Illus. $5.50

AN INTRODUCTION TO THE THEORY OF AEROELASTICITY

By Y. C. FUNG, California Institute of Technology

Thoroughly up to date, presenting the subject as a science in itself, this work draws material from several branches of mechanics—including structures, aerodynamics, and mechanical vibrations. It focuses attention on physical problems, and the underlying basis of analysis, rather than merely presenting an array of special methods. Brings together a wealth of literature formerly widely scattered.

1955 490 pages Illus. $10.50

INDUSTRIAL FURNACES

Volume II: Third Edition

By W. TRINKS, Associated Engineers, Pittsburgh

This newly revised edition of "the furnace man's bible" places all you need to know for efficient operation at your finger tips. Written by one of the world's leading authorities, it is the only book of its kind. Covers new burners, new furnace types, latest cost data, measures for combating safety hazards, and hundreds of other important subjects.

1955 358 pages 305 illus. $10.00

VOLUME 1: 4th Edition. 1951 526 pages 435 illus. $12.75

BUILDING PLANNING AND DESIGN STANDARDS

By HAROLD R. SLEEPER, F.A.I.A.

This book is an entirely new departure; 331 full-page plates present in graphic form most recent facts assembled from bulletins, catalogs, periodicals, and books. It supplies in one volume the ready information you need for programming, making schematic drawings, and estimating areas for a large variety of buildings. Its diagrammatic form gives you a wealth of information at a glance.

1955 331 pages of plates $9\frac{3}{4}$ x $11\frac{3}{4}$ $12.00

BEARING LUBRICATION ANALYSIS

By R. R. SLAYMAKER, Case Institute of Technology

Covers the general principles of lubrication analysis for full journal bearings and bearing design, plus discussion of the characteristics of various bearing materials and analysis of the so-called oilless bearings. Presents a practical method of predicting temperature rise and oil viscosity in one operation, eliminating trial and error solutions.

1955 108 pages Illus. $5.00

PRINCIPLES OF INDUSTRIAL WASTE TREATMENT

By C. FRED GURNHAM, Michigan State University

First to present a "unit operations" approach that gets directly at the essentials, this work enables the reader more easily to understand present and future developments in the field. Sources of wastes, their pollutional effects, and the methods for their treatment and disposal are covered in a concise and rigorous manner. Written by one of the foremost men in the field.

1955 399 pages Illus. $9.50

HANDBOOK OF ENGINEERING MATERIALS

Edited by DOUGLAS F. MINER, Carnegie Institute of Technology; and JOHN D. SEASTONE, Olin Mathiesen Chemical Corp.

Cuts out much time-wasting searching, because it brings between the covers of a single volume materials data from dozens of special fields. Broader in scope than any similar work, it provides a source of reliable information on materials of manufacturing and construction in every field of engineering and covers all main factors involved in the selection of a material.

1955 1382 pages 450 illus. Semi-flexible Binding $17.50

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of view, and offers a modern introduction to nuclear science. Much of the material has been re-written, and new information has been added on nuclear reactors, energy production in stars, cosmic rays, and cosmic and geological dating methods.

The references at the end of each chapter include books, periodical articles and monographs, and are indexed by author.

The PR in profit; a guide to successful public relations in Canada. L. L. Knott. Toronto, McClelland and Stewart, 1955. 254pp., $6.00.

The first section of this fascinating book tells of some public relations campaigns which actually took place in Canada — both the successes and the failures. The second part might be called the "how-to" section, and outlines the techniques used to create good public relations, all illustrated with concrete examples, drawn from the author's twenty years' experience.

Every business executive, every member of a club executive will find good ideas in this book, and the general public will enjoy reading about the constant efforts made by business in the field of public relations.

A short chapter is devoted to the professional engineer, who has in the past been content for the most part to hide his light under a bushel. Mr. Knott thinks this situation is now being remedied, partly through programmes instituted by some of the provincial organizations. We are sorry that no mention has been made of the work done by The Engineering Institute of Canada towards gaining their just recognition for Canadian engineers.

Powder metallurgy. O.E.E.C. Toronto, Ryerson, 1955. 309pp., illus., $3.00.

In 1953 twenty-eight members of the Powder Metallurgy Mission of the Organisation for European Economic Co-operation visited the United States. This is their report on the practices employed in that country, together with recommendations as to how the methods used might be adapted to the European field.

Various sections of the report deal with electrical and magnetic applications, tungsten wire production, engineering powders and structural parts, pressing processes, etc.

Included in the appendices is a short introductory bibliography to powder metallurgy, and a list of technical and trade literature obtained during the mission's visit.

***Principles of industrial waste treatment.** C. F. Gurnham. New York, Wiley, 1955. 399pp., illus., $9.50.

The greater part of this book for practicing engineers and students is a discussion of operations and processes used to treat wastes before discharging them into natural streams or municipal sewers: sedimentation, filtration, heat transfer operations, and various chemical and biological treatments. Pollutional effects and criteria for evaluating pollution are also discussed, and the last chapter gives brief descriptions of some process industries that have major disposal problems.

Pulp and paper manual of Canada, 23rd ed., 1955. Gardenvale, National Business Publications, 1955. 440pp., illus.

Once again a large section of this useful Manual is devoted to flow sheets of Canadian pulp and paper mills, many of which have been revised for this edition.

There is an alphabetical listing of machinery, supply and service companies, and a classified index of equipment and supplies. There is also a list of Canadian representatives of foreign manufacturers. Among the editorial matter is a review of methods of barking, chipping and chip handling.

River and harbor engineering translation guides; French-English; German-English; Russian-English. R. S. Rowe. Princeton, University, Rivers and harbors section, 1953-54. 3 vols., $1.20 a vol. (U.S.).

The vocabulary listed in each of these Guides was compiled while translating appropriate sections of an encyclopedia in the language. They are intended for translating into English, and each includes a brief review of the essentials of The Engineering Journal. This second

The Guides should prove most useful to all those engaged in technical translations.

Shell moulding. London, Machinery Publishing Co., 1953-55. 2 vols., illus., 4/- each. (Machinery's Yellowback series nos. 34 and 34A).

A review of the first volume of this work appeared in the June 1954 issue of the Engineering Journal. This second volume presents the advances in technique which have taken place since 1953, and includes chapters on casting agricultural machinery gears and automobile parts. Much of the information appeared previously in Machinery.

***Solar energy research.** Farrington Daniels and J. A. Duffie, eds. Madison, University of Wisconsin Press, 1955. 290pp., illus., $4.00 (U.S.).

Based in part on a symposium held at the University of Wisconsin in 1953, this volume includes reports by thirty-one contributors on the present status of the utilization of solar energy. Space heating, power plants, large-scale furnaces, and a wide range of other uses of solar energy are discussed in the eleven sections into which the book is divided. A bibliography is included.

Theoretical structural metallurgy, 2nd ed. A. H. Cottrell. Toronto, Macmillan, 1955. 251pp., $4.25.

The first edition of this work was published in 1948, but there have been so many new developments in the years since then that this edition has been rewritten, and many new sections added. These include accounts of such topics as the theory of dislocations, surface tension of grain boundaries, etc.

The book should prove most useful to all metallurgists, not only to students. Topics are treated in a descriptive way, and centre round the electron theory of metals and the statistical thermodynamics of metals and alloys.

Theory of groups of finite order. W. Burnside, New York. Dover, 1955. 512pp., $2.00 pa. (U.S.).

Another of the Dover "paperbacks" which make available important scientific works in a cheap edition. The publishers are performing a real service in making these works available.

This particular book is a reprint of the second edition which appeared in 1911. The first section explains the notion of substitutions, while other chapters deal with group properties, graphical methods of representation, the theory of groups of linear substitutions, etc.

A treatise on surveying, 6th ed. R. E Middleton and O. Chadwick, rev. by W. F. Cassie, general ed. Toronto, British Book Service, 1955. 2 vols., illus., $5.60 each vol.

Since the publication of the first edition in 1899, this treatise has become a standard surveying text. This sixth edition has been revised to include modern applications of old principles, and all the latest surveying instruments and their uses. Revision in the second volume has been more complete, and recent developments such as echo sounding in hydrographic work are included.

Taken together, the two volumes cover the subject up to the intermediate examinations of the Royal Institution of Chartered Surveyors (London).

Workshop costs and costing. P. S Houghton. Toronto, British Book Service, 1953. 295pp., illus., $6.00.

The author is an engineer who has already published books on other aspects of engineering. In this volume he shows how a costing system can be installed, and then maintained efficiently.

The various items to be included are considered, together with such topics as collecting data, foundry costing, stock accounts, process costing, etc.

There are examples of the various forms, charts, etc. used, and the book should prove extremely useful to many managers faced with the problem of setting up a works costing system.

Journal Issues Wanted

If any member has a January or July 1955 issue of The Engineering Journal he no longer requires, we would be glad if he would return it to the librarian.

• Library Notes

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

American society of civil engineers. Separates:

No. 732—An analytical procedure for calculating truss displacements, by A. C. Scordelis and C. M. Smith. No. 733—Prestressing practices in bridge building, by J. C. Rundlett. No. 734—Influence lines for moment and shear in a continuous beam, by Anthony Hoadley. No. 735—Natural frequencies of continuous flexural members, by A. S. Veletsos and N. M. Newmark. No. 736—Impact in railroad bridges, by E. J. Ruble. No. 737—Morro Bay steam electric plant, by J. G. Thon and G. L. Coltrin. No. 738—Owens Gorge project, by S. B. Morris. No. 739—Principles of Federal hydro-electric power development, by William Whipple. No. 740—The high-syphon circulating water system for Meramec plant, by C. E. Buettner and P. A. Pickel. No. 741—Theory for the design of underground pressure conduits, by D. J. Bleifuss. No. 742—Hydraulic pressure in concrete, by T. C. Powers. No. 743—Critical flow meters (Venturi flumes) by Armando Balloffet. No. 744—Synthesis of rainfall intensity-frequency regimes, by D. M. Hershfield, L. L. Weiss, and W. T. Wilson. No. 745—The importance of fluvial morphology in hydraulic engineering, by E. W. Lane. No. 746—Discharge coefficients for gates and valves, by C. W. Thomas. No. 749—The role of the sanitary engineer in the nuclear energy program, by R. J. Morton. No. 750—Biological treatment of highly alkaline textile mill waste-sewage mixture No. 751—A study of filtration through uniform sand filters, by J. Tso-Ti Ling No. 753—Foundation conditions in Charleston, S.C., by L. K. Himelright No. 754—Rock weathering classification of excavation slopes, by J. D. Welch. No. 755—Field vane shear tests of sensitive cohesive soils, by Hamilton Gray. No. 756—Settlement analysis of sand drain projects, by E. A. Henderson. No. 757—Seepage forces in a gravity dam by electrical analogy, by H. A. Johnson.

Canada. Department of northern affairs and national resources. Forest products laboratories of Canada:

Program of work, May 1955—June 1956.

Canada. National research council. Associate committee on soil and snow mechanics. Technical memoranda:

No. 31—The international classification for snow (with special reference to snow on the ground) (Issued by the Commission on snow and ice of the International association of hydrology) No. 34—Palaeobotanical method in the prediction of sub-surface summer ice conditions in northern organic terrain, by N. W. Radforth. No. 36—Proceedings of the eighth Canadian soil mechanics conference, December 16 and 17, 1954.

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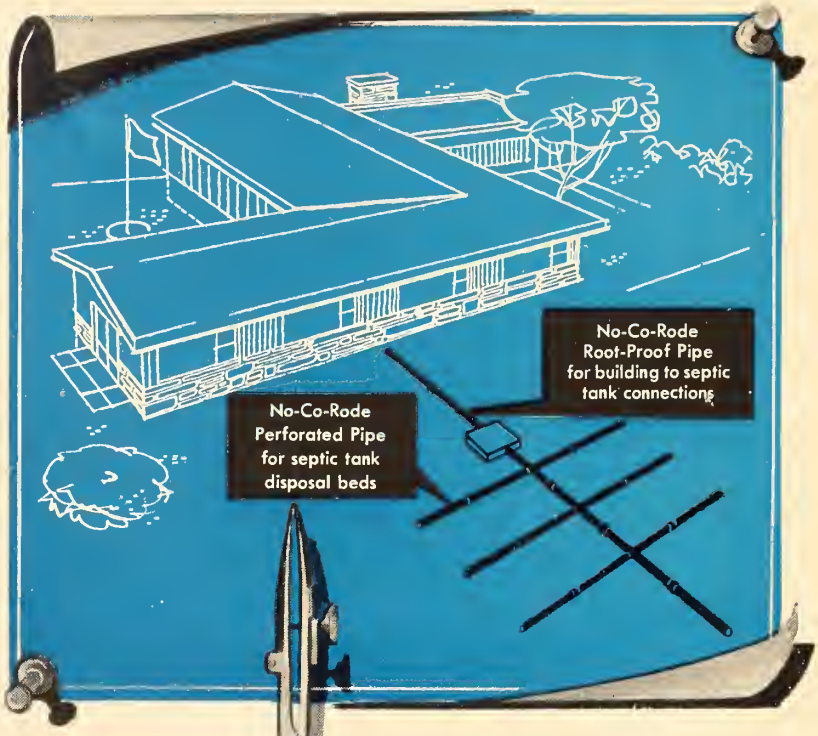

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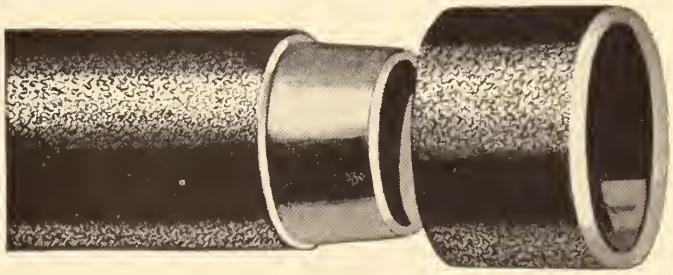

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Canadian good roads association:
Proceedings of the thirty-fifth convention, Toronto, November 8-10, 1954.

The Chase Manhattan bank. Economic research department:
America's road problem.

Illinois University. Bulletins:
No. 428—Strength in shear of reinforced concrete beams, by Armas Laupa, C. P. Siess, and N. M. Newmark. No. 429—Observed and computed settlements of structures in Chicago, by R. B. Peck and M. E. Uyanik.

United States. National research council. Highway research board. Bulletin:
No. 106—Manpower needs in highway engineering.

American society of civil engineers. Proceedings separate:
No. 761—Survey of salaries for civil engineering positions. 50 cents. (U.S.).

Atomic energy of Canada. Papers presented at the Geneva Conference, August 1955.
No. 200—Uranium prospecting in Canada; ground and aerial surveys, by A. H. Lang. No. 202—Electric power in Canada; regional forecasts in relation to nuclear power possibilities, by J. Davis. No. 207—Health and safety activities in reactor operations and chemical processing plants, by A. J. Cipriani.

British chemical plant manufacturers association:
British chemical plant, 1955 edition.

Canada. National research council:
Handbook of scientific and technical societies of Canada. 50 cents.
List of technical translations, suppl. No. 1.

Canadian construction association:
Proceedings of the thirty-seventh annual general meeting, 1955.

Canadian standards association. Approvals laboratories:
List of approved equipment, 5th ed., suppl. "B".

Cooper union. Bulletin:
No. 33—The humanistic-social stem of engineering education, a classified bibliography. . . .

Institution of mechanical engineers:
Proceedings of the conference on hydraulic mechanisms; a discussion on positive displacement oil-hydraulic machinery for power transmission. March 1954.

National society of professional engineers:
Proceedings of a conference on professional development; the responsibility of industry and the engineer, June 1955. $4.00 (U.S.).

Packaging catalogue of Great Britain, 9th ed., 1955.

South African institute of electrical engineers. Monograph:
The protection of open-wire communication systems from lightning damage and interference with particular reference to South Africa, by D. P. J. Retief, I. C. Ramsay and C. F. Boyce. £2.

United States. Highway research board. Bulletin:
No. 107—Vehicle operation as affected by traffic control and highway type.

STANDARDS REVIEWED

A.S.T.M. standards, American society for testing materials, 1916 Race Street, Philadelphia 3, Pa.

A.S.T.M. standards on glass and glass products. $1.50 (U.S.)

This compilation has a new section covering specifications for cellular glass insulating block and a method of test for structural non-load bearing cellular glass block. Other sections with revised specifications and methods of test include: Glass and glass containers; Glass insulators and Glass textiles.

There are 18 methods of test, three specifications and one list of definitions in this compilation which will be of value to engineers and manufacturers in the glass industry.

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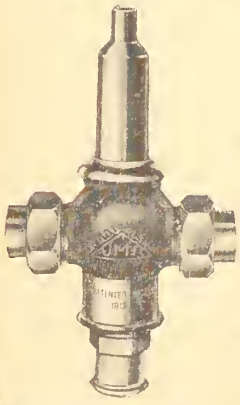
for steam or air



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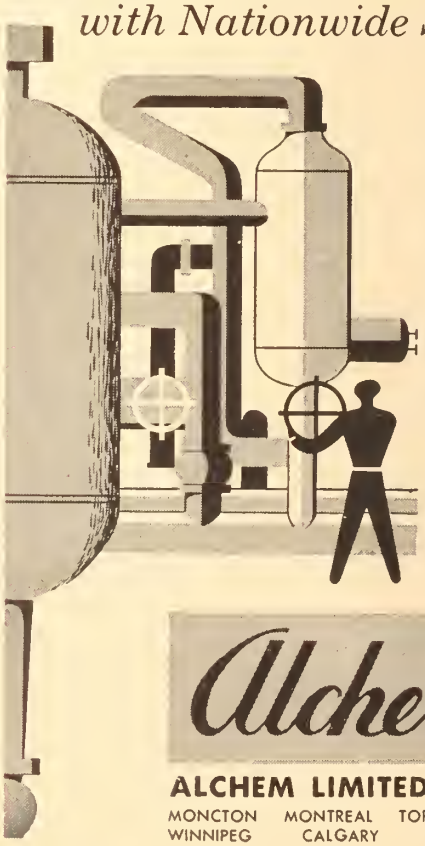

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pounds per hour!

Detroit Edison to make power generation history at new River Rouge Plant . . . with a tradition-shattering high-pressure turbine of 300,000 kw capacity, served by a Foster Wheeler Steam Generator, the largest in the world!

IT TAKES COURAGE and foresight to break with tradition—to plan and execute a power project which far surpasses anything ever done before. But the break has been made and a thrilling new chapter in power plant history is now being written. It's the story of Detroit Edison's River Rouge Plant.

Here, late in 1957, the largest steam turbine-generator in the world will go into operation. Rated at 300,000 kw, it will set completely new standards of efficiency and economy — producing a kilowatt of electricity for less than three fourths of a pound of coal!

Steam for the giant turbine will be supplied by a single Foster Wheeler steam generator with a capacity of two million pounds per hour at 2450 psi pressure and 1050 F at the superheater outlet. Reheat facilities will resuperheat the steam to 1000 F after it has passed through the initial stages of the turbine. This, the largest single steam generator ever to be built, represents a great forward step in power plant engineering.

The awarding of this record-making order is therefore a gratifying vote of *confidence* from Detroit Edison. Past achievements show that this confidence is well placed. With more than fifty years of experience in steam generation, and the finest modern manufacturing facilities in three large plants, Foster Wheeler welcomes the opportunity to help Detroit Edison make history at River Rouge. ***Foster Wheeler Limited, St. Catharines, Ontario.***

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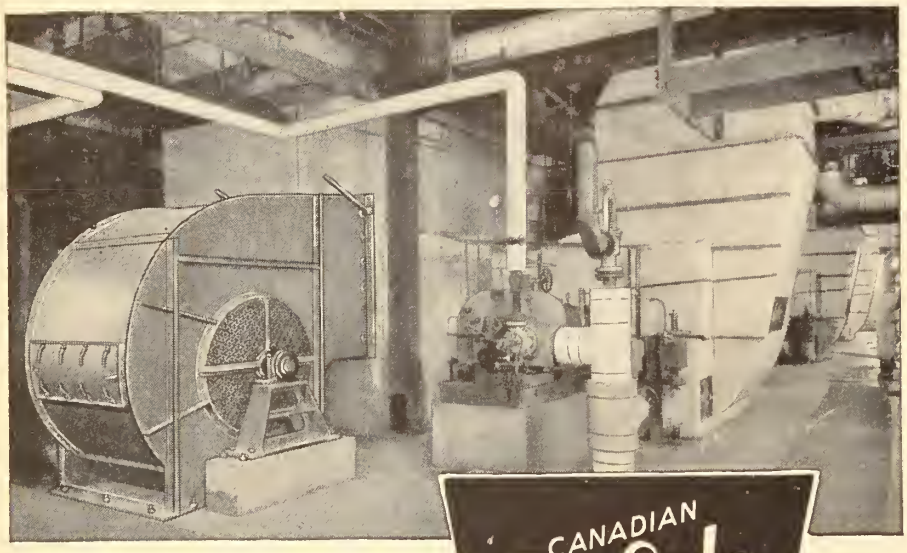
CONTROLLED HURRICANES

FOR STEAM POWER PLANT



DESIGNED BY CANADIAN Buffalo

The above forced and induced draft fan installation at the Canadian Chemical Company's Plant at Edmonton, was specially designed by Canadian Blower & Forge to meet high-pressure requirements in air supply and flue gas exhaust.

The installation consists of four forced draft fans operating at 1170 r.p.m., two driven by 300 H.P. motors, two by steam turbines and four induced draft fans operating at 870 r.p.m., moving flue gas at 425°F. Two of these are driven by 400 H.P. motors, and two by steam turbines. Boilers were built to specifications by Foster Wheeler Ltd. of St. Catharines. The layout permits easy access to all parts of the installation.

This is another example of "Canadian Buffalo" at work designing and building industrial fan equipment. It is also evidence of C.B.&F. readiness to meet any fan or ventilation problem with the specialized knowledge that gets jobs done quickly, efficiently and economically.

Canadian Buffalo

CANADIAN BLOWER & FORGE
COMPANY LIMITED
HEAD OFFICE: KITCHENER, ONTARIO

CBF 50TH. ANNIVERSARY 1905 1955

ENGINEERING SALES OFFICES
Montreal, Toronto, Hamilton
St. John
Winnipeg, Edmonton, Vancouver

• Library Notes

British standards, British standards institution, 2 Park Street, London, W.1. British standards are available from the Canadian standards association, National research building, Ottawa.

B.S. 1250: 1955—Domestic appliances burning town gas. 3 parts, 5/- each.

First published in two parts in 1945 and 1946, this Standard is being revised and will eventually comprise six parts.

Part 1: 'General requirements'. Specifies general requirements for the construction and performance of appliances, and includes methods of test common to all appliances.

Part 2: 'Specific requirements for cookers, hot plates, grillers and boiling burners'. This part also specifies performance tests and oven cooking tests.

Part 3: 'Specific requirements for water heaters other than wash boilers and washing machines'. Deals with design and performance requirements for the various types of water heaters, instantaneous heaters, storage heaters, circulators, central heating units and bulk water heaters.

B.S. G.151: 1955—Tachometer generators (synchronous type) for aircraft. 3/-.

This standard specifies the requirements for generators suitable for fitting to aircraft engines to give an indication of the engine speed on a remote reading indicator, or indicators. Two types of generator are covered by the British Standard, one to operate one indicator, and one to operate two indicators.

Canadian standards, Canadian standards association, National research building, Ottawa.

Z102. 5: 1955 — Cleated plywood boxes. 75 cents.

This specification covers the materials and details of construction for cleated plywood boxes. It is to be used in conjunction with other C.S.A. specifications for plywood, preservatives, nails, etc.

Institution of electrical engineers, Savoy Place, London, W.C.2.

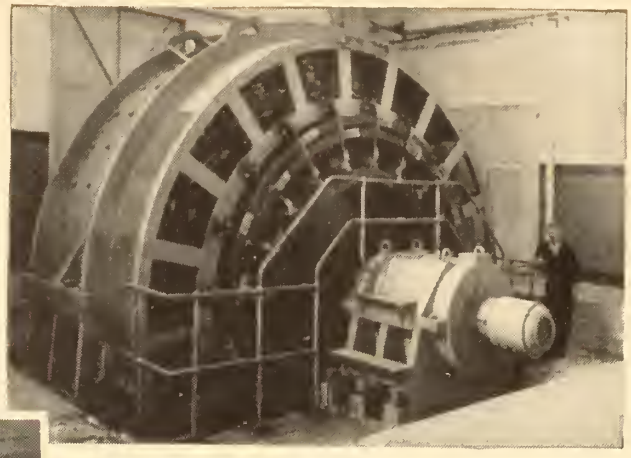
Regulations for the electrical equipment of buildings, 13th ed., 1955. 8/6.

The first edition of these "Regulations" was issued in 1882, and now as then they are designed to ensure safety in the use of electricity in and around buildings, and apply to both a.c. and d.c. installations. Topics covered include installation of conductors and cables, grounding, etc.

Underwriters' laboratories of Canada, P.O. Box 38, O'Connor Postal Sta., Toronto 16, Ontario.

Standard for above ground tanks for flammable liquids. 1955.

This standards represents the basic requirements for the construction and performance of aboveground tanks, both horizontal and vertical of a cylindrical nonpressure type for the storage of flammable liquids such as gasoline. The minimum capacity is 2,100 imperial gallons.



Reversing D.C. Motor, peak torque capacity 200 metre-tons, for driving stainless steel strip mill. Supplied to the order of Firth-Vickers Stainless Steels Ltd.

A mercury-arc rectifier equipment with total capacity of 21,000 kW; installed at the Abbey Works of the Steel Company of Wales Ltd., for an 80-inch hot-strip finishing mill drive.

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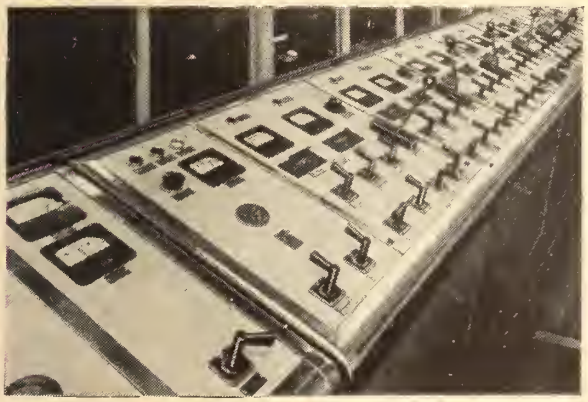

The operator's desk in the control pulpit of a continuous hot rolling mill.

Seventeen BTH D.C. mill motors, totalling 6,850 h.p., in the motor room of a two-strand continuous rod mill at the Works of Guest, Keen & Nettlefolds (South Wales) Ltd.

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BUSINESS & INDUSTRIAL BRIEFS

A Digest of Information

received by

The Editor

Appointments and Transfers

C.G.E. Post.—Dr. Colin Holstead has been appointed specialist, resin development, in the chemical materials section of Canadian General Electric Company.

●

Steel Firm Head.—Edward P. Garry has been appointed president of Vanadium-Alloys Steel Canada Ltd., according to an announcement by the company. Mr. Geary, recently executive vice-president of Atlas Steels Ltd., succeeds J. Gordon Barker who has been appointed vice-chairman of the board of directors.

●

Canadian Westinghouse President. — The board of directors of Canadian Westinghouse Company Limited announce the election of George L. Wilcox, former executive vice-president of the Westinghouse Electric International Company, New York, as president and director of Canadian Westinghouse. The board also announce the election of two new directors, W. E. Phillips of Toronto, president of Duplate Canada Ltd. and L. E. Osborne, vice-chairman of Westinghouse Electric Corporation. The intention of the Company is to elect, in addition to Mr. Phillips, other Canadian directors to its Board so that not only the independent shareholders but also the Canadian economy will be substantially represented.

George L. Wilcox

●

C.N.R. Vice-President. — Dr. O. M. Solandt, O.B.E., chairman of the defence research board and one of Canada's foremost figures in the field of scientific research, is to be appointed to the Canadian National Railways as assistant vice-president, research and development, as announced by CNR president Donald Gordon. Dr. Solandt is expected to assume his new duties early in 1956.

●

Sylvania Appointment. — Appointment of Mr. W. H. Rempel as commercial engineer, Lighting Division, Sylvania Electric (Canada) Ltd. is announced by F. W. Fulle, general sales manager of the Lighting Division.

●

Post-Graduate Fellowship. — Federal Public Works Minister Robert Winters has announced the award of a $1,200 fellowship by Central Mortgage and Housing Corporation to Arthur S. Henderson of Montreal for post-graduate study in community planning for the academic year 1955-56. Eight similar awards had been announced previously.

●

Refinery Manager.—The appointment of L. T. Wilson as manager of Shell Oil Company of Canada's Montreal East refinery is announced by G. Davidson, vice-president—manufacturing. Mr. Wilson takes over at Montreal refinery during a major $14 million expansion program scheduled for completion in mid-1956.

Joins Y.W. Organization. — E. W. Burford, general manager of Y. W. Small Parts, Ltd., Toronto, announces the appointment of Frank Ormerod as plant superintendent in charge of production.

●

Diesel Engine Manufacturers.—Peter Alliston has been appointed commercial manager of F. Perkins (Canada) Ltd., Toronto, the Canadian company belonging to the British diesel engine manufacturers.

●

Application Engineering Department. —Electric Panel Manufacturing Limited, Vancouver and Edmonton, announce the formation of an Application Engineering Dept. Kenneth C. Jarratt will be in charge of the new department, which is designed to afford engineering assistance to the company's customers in western Canada.

●

Sandwell Appointment. — Harold A. DeRice, P. Eng., formerly of Portland, Oregon, has joined the Vancouver office of Sandwell & Company Ltd., consulting engineers. For the past eleven years Mr. DeRice has specialized in the design of sawmills and other wood processing plants.

●

Canadian Inspection and Testing. — Bernard Eyden, of Toronto, has been appointed chief mechanical engineer of the Canadian Inspection and Testing Co. Ltd., Toronto, it was announced recently by general manager S. Darby.

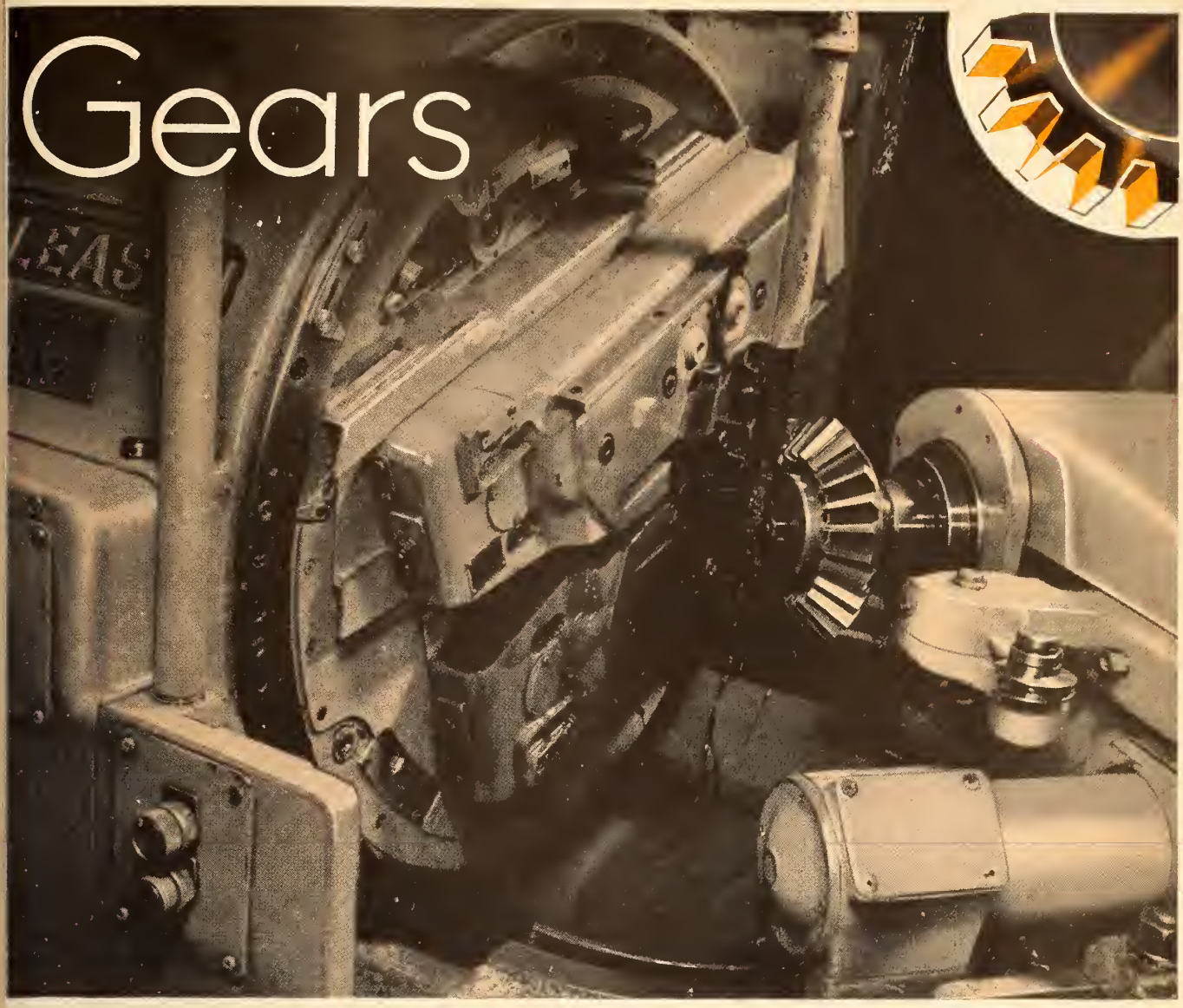
●

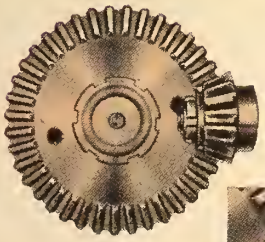
Defence Production.—The Department of Defence Production has announced the appointment of N. R. MacLean as deputy financial adviser, and of W. F. Murphy as one of two assistant directors of the Aircraft Branch.

●

Jenkins Bros. Appointment.—Jenkins Bros., Limited, announce the appointment of J. E. Nelligan as chief chemist and metallurgical engineer. Mr. Nelligan

Gears





In patented CONIFLEX design—the tooth is crowned from end to end—usually by one to two thousandths of an inch. The above illustration shows the localized tooth bearing which results from this crowning, allowing wider operating tolerance, smoother operation and easier assembly.

CONIFLEX, the patented Gleason bevel gear with localized tooth bearing, can be made to your specifications at Hamilton Gear. CONIFLEX permits adjustment in assembly and displacement under operating loads—without dangerous load concentration on the ends of the teeth. In addition, the unique CONIFLEX design assures proper distribution of the load over the tooth surface. CONIFLEX bevel gears are available at Hamilton Gear up to 3 D.P. and 3½" face from ratios of 1-to-1 mitres to 10-to-1. Mitre gears can be made to 17 inches diameter, increasing to 24-inch diameter for the 10-to-1 ratio. For further information on CONIFLEX gears, write or phone Hamilton Gear, suppliers of gears to Canadian industry since 1911.

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Racks

Helical Gear Reducers

Helical Gears

Spur Gears

Bevel Gears

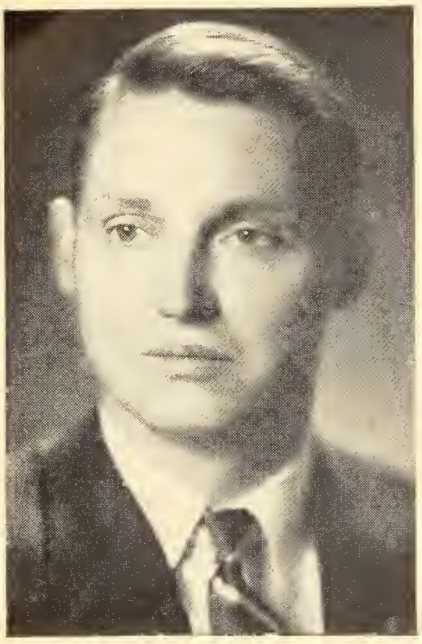
Herringbone Gears

Worms and Wormgears

Internal Gears

Wormgear Reducers

Bus. and Ind. Briefs



J. E. Nelligan

has been with Jenkins Bros., Limited since 1948 and succeeds Bernard Collitt who is about to retire.

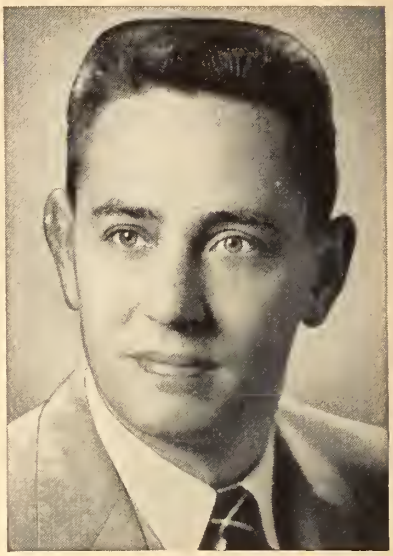
Standards Medal for Canadian.—The United States' highest award for work in voluntary standards has been given to a Canadian this year for the first time. James G. Morrow has received the Standards Medal for outstanding services and leadership in the development and application of standards. Mr. Morrow, a metallurgical engineer, is in charge of standardization in chemical methods, metallurgical processes and products for The Steel Company of Canada, Ltd. He is past chairman of the Canadian Standards Association. He signed for Canada the American-British-Canadian Declaration of Accord on Screw Threads (1948). A member of many societies, Mr. Morrow is vice-president of the Canadian Industrial Preparedness Association and past-president of the American Society for Testing Materials.

●

C.E.M.A. Elections.—At a recent meeting of the Canadian Electrical Manufacturers Association in Niagara Falls, A. E. Jameson, manager of Meter and Instrument Sales for the English Electric Company of Canada Limited, was elected secretary of the Watthour and Demand Meter Section of the Association. W. A. Snodgrass, manager of Switchgear Sales for English Electric, was elected secretary of the CEMA's Switchgear Section.

●

Sales Engineering Representative. — Canadian Blower & Forge Co. Ltd., and



H. N. Charles

Canada Pumps Ltd. announce the appointment of H. N. Charles as sales engineering representative for Ottawa and district.

●

Canadian Car Vice-President. — R. E. Henderson, of Fort William, has been appointed vice-president in charge of manufacturing in the automotive and aircraft division of Canadian Car and Foundry Co. Ltd.

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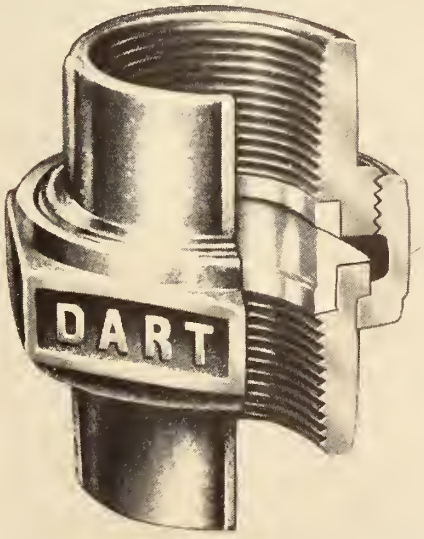
UNIONS
for efficient service
and economy



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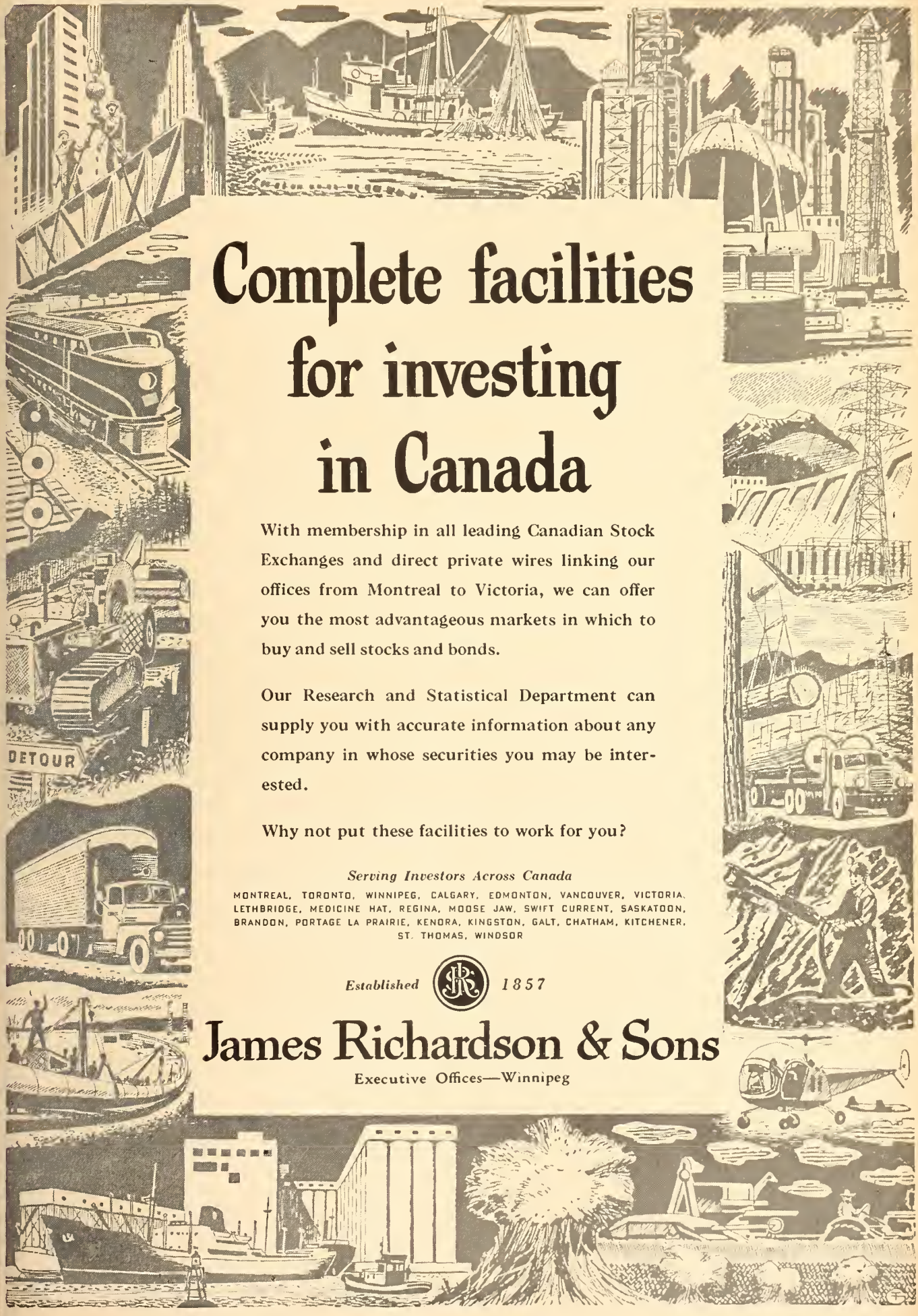

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James Richardson & Sons

Executive Offices—Winnipeg

New Equipment and Developments

New Stud Driver.—A new stud driver by Remington which can be operated with either one or two hands, is now available in Canada through McDermid Bros. Ltd., of Toronto. The stud driver has interchangeable barrels and chamber bushings which can be exchanged rapidly, on the job, to drive quarter or three-eighths studs firmly and securely into steel or concrete. A complete range of multi-purpose studs and of suitable 22 and 32 calibre power loads is available.

●

Canadian Aircraft for Antarctic.—Two Canso amphibian aircraft are being specially fitted by Field Aviation Company Limited, at Oshawa Airport, for their role in the British Government's Antarctic expedition this winter. Manned by Canadian and British crews, they leave Oshawa in November for a 50,000-square-mile aerial survey of the Grahamland Peninsula in the Antarctic. One of the Cansos is fitted with a tail-mounted magnetometer so that mineral search can be conducted as well as photographs taken. Williamson Eagle IX vertical cameras were installed in the floor of the hull with a camera drift and aiming sight in the nose. F.24 oblique cameras will also be carried.

●

Gas Turbine Generating Sets. — The City of Edmonton have placed an order with Brown Boveri (Canada) Limited to supply two 20,000/30,000-kilowatt gas turbine generating sets. This installation will rank among the largest gas turbine generating plants in the world. The first unit is expected to be "on the line" by 1958, in time to cope with the increased power demand that is forecast for that period. A 35,000-kilowatt steam turbo generator supplied by the same maker and presently under erection will take care of interim demands for increased power in Edmonton.

●

British Cables for Canada. — Enfield Cables Limited, of Brimsdown, Middlesex, England, announce that they have been awarded a contract to the value of approximately $500,000 by the Hydro-Electric Power Commission of Ontario. The cables will be laid in Ottawa, and will cross the Rideau Canal. Two and one-half miles of 115,000-volt, double-circuit, 80,000 kVa. pipeline compression cables (conductor size 300 mcm.) are to be laid by Enfield Cables Contract Department. The installation is due to be ready for service on May 1st, 1956.

●

Canadian Industries (1954) Limited—Equipment is being moved into part of the York paint plant of Canadian Industries (1954) Limited to set up a temporary polythene technical service laboratory. One of the laboratory's main purposes will be to carry out trials and demonstrations for manufacturers of polythene products and assist them with their problems. All equipment will be of commercial size to enable plastics engineers to recreate exact conditions manufacturers have to face. The equipment will be of a diversified nature and will include extruders, injection molding equipment, a film-blowing unit, wire covering apparatus and many other machines.

●

Saskatchewan Power Corporation.—A former professor of electrical engineering and an expert on hydro-electric power, David Cass-Beggs has assumed his duties as general manager of the Saskatchewan Power Corporation, as announced in Regina by Hon. J. A. Darling, provincial minister of public works and chairman of the board of directors of Saskatchewan Power Corp.

●

Electrical Company Operations. — Woods of Colchester, long known in the fan and ventilating field, became a division of the Amalgamated Electric Corporation Limited. This is the first step in the transfer of the operations of the British General Electric Co. (Canadian) Ltd., to Amalgamated Electric Corporation Limited, an Associate Company of the General Electric Co. Ltd., of England.

●

Generator Order.—An order valued at approximately $3,000,000 for four 150,000-horsepower waterwheel driven generators has been received by Canadian General Electric Company from the Quebec Hydro-Electric Commission. Scheduled for delivery in 1957 and 1958, the generators will be installed at Hydro-Quebec's Bersimis Lac Casse development on the Bersimis River.

●

Bristol Britannias for C.P.A.—Canadian Pacific Airlines has placed an order with the Bristol Aeroplane Company Ltd. for three Bristol Britannia turbo-prop airliners, with an option on five more. The aircraft are to be delivered in 1957.

●

Microwave Communications. — The longest private commercial microwave communications system in Canada will link Hydro-Quebec's giant new power development on the Bersimis River to Montreal. The contract for engineering and construction of this electronic system has been awarded to RCA Victor Company, Ltd., Montreal. The system will cost approximately 1 million dollars. It will include 30 telephone circuits as well as teletype, telemetering and load frequency control circuits, all utilizing microwaves as means of transmission. The electric power produced at, and transmitted from Bersimis will be remotely indicated at the Hydro-Quebec Building from where power consumption will be controlled by means of the load frequency control circuits.

●

Anchor Bolts.—The design principle used for Stelco Hi-Bond reinforcing bars has now been applied to anchor bolts. This design improvement increases the holding power of the bolts considerably, and eliminates the hooks which were necessary on the old style anchor bolts. The absence of hooks provides greater versatility in placement and shorter lengths can be used due to the better bonding provided.

●

Plastic Expansion Joint.—Specifications for concrete structures throughout the Cote St. Catherine Lock of the St. Lawrence Seaway and Sir Adam Beck pumped storage reservoir of the Ontario Hydro Electric Power Commission call for the use of an extruded vinyl (polyvinyl chloride) waterstop and expansion joint. This type of waterstop, known as "Durajoint", is a product of Electrovert Ltd., Montreal. It is extruded from a flexible vinyl compound specially formulated for the application by Canadian Resins and Chemicals Limited.

●

New Plastics Plant. — A $3,500,000 chemical plant will be built by B. F. Goodrich Canada Limited in Thorold Township, near Niagara Falls, Ontario, for the production of geon polyvinyl plastic materials, it was announced recently by Ira G. Needles, president. Construction will start early 1956, with completion scheduled for early 1957. The new facilities will be operated as a chemical division of B. F. Goodrich Canada Limited with headquarters in Kitchener.

●

New Boilerhouse.—A new boilerhouse costing approximately $600,000 will be built by Canadian Industries (1954) Limited at its chemicals plant in Shawinigan Falls, Que. The building will house two oil-fired boilers which will generate 30,000 pounds of steam per hour and develop a pressure of 250 p.s.i.

●

Steel Pipe Manufacture. — Formation of the Prairie Pipe Company, Ltd., of Regina, Saskatchewan, to manufacture steel pipe for the oil and gas industries was announced by D. W. Darnell, chairman of the board of the Fluor Corporation, Ltd., Los Angeles, and president of the new firm. Operating as an affiliate of the Fluor Corporation, the new company's plant will be located on a 110-acre site on the outskirts of Regina. The plant, scheduled to go into operation April 1, 1956, represents a total investment of more than $3,500,000.

●

Reactor Test Equipment. — Atomic Energy of Canada Limited have announced that a contract has been awarded to Canadian Westinghouse Limited for the design, development and fabrication of multi-purpose "loop" test equipment for the new NRU reactor now nearing completion at Chalk River. This equipment is used as an addition to the standard reactor equipment and allows for testing of materials, particularly fuels and fuel assemblies, in the interior of the reactor under a variety of conditions.

●

Contract for Reactor.—Atomic Energy of Canada Limited have announced that Canadair Limited of Montreal has been awarded a contract to prepare a design and a cost estimate for a "swimming pool" type reactor. It will be a low-power, low-flux machine and will be used at Chalk River for research related to Canada's power reactor program. The reactor will probably cost between $250,000 and $300,000.

●

Liquid Cargo Dock.—Dravo of Canada Limited, Toronto, has been awarded a contract by Liquifuels Limited to construct a new liquid cargo dock on Lake

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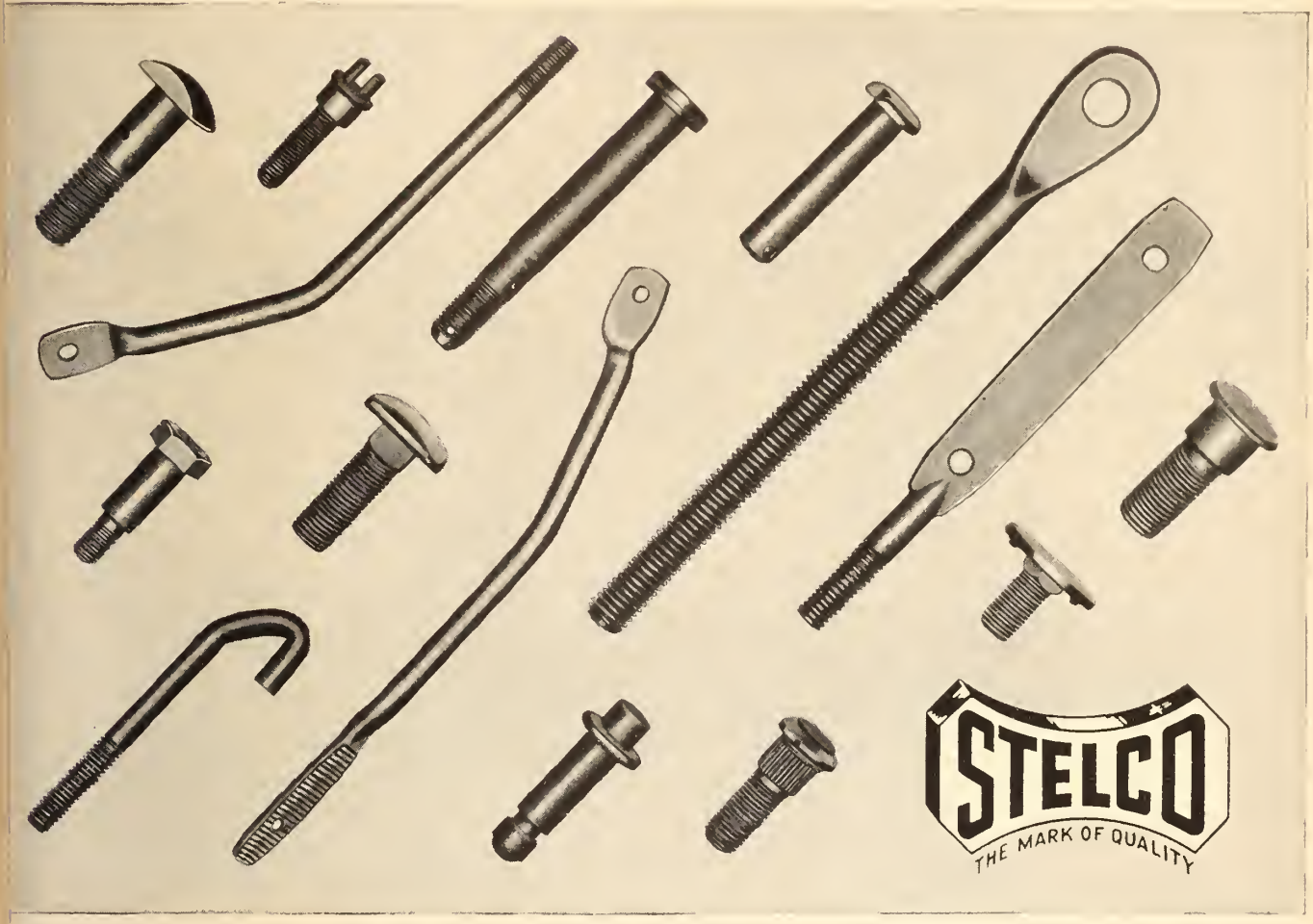

The "specials" shown illustrate some of the many processes that Stelco's four bolt plants are equipped to perform. Stelco's engineers co-operated with designers in industry to produce these pieces — and hundreds of others — to show initial cost savings, reduced assembly time, and improved product strength and appearance.

In most cases these parts are cold headed or cold worked. Fasteners with eccentric contours — for example, offsets, wings, flats, or ovals — can be readily made. Quality is high, because only material that is free from all defects is suitable for upsetting and extruding. Unit costs are low, because production rates are high . . . and because the cost per pound of coiled wire for heading is much lower than that of bar stock for machining.

Stelco's Engineering Service is at your disposal. If you use parts comparable in any way to those shown, Stelco can probably save you money. Your enquiry will be handled promptly by any Sales Office.

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122.8

Bus. and Ind. Briefs

Ontario at Millhaven, Ontario, near Kingston. The dock, in its initial stage, will consist of two 35-foot diameter mooring cells constructed of steel sheet piling and filled with crushed rock. A cell similar to the mooring units will support a walkway. This dock has been designed to moor lake tankers. Future plans call for an enlargement of the facilities by three additional cells so ocean-going tankers may be handled at the site. Thirty feet of water will be provided at the dock face.

●

Hard-Facing Electrodes.—A new line of manganese - chromium - molybdenum hard facing electrodes which feature high impact and abrasion resistance is now available from Wall Colmonoy (Canada) Limited, Montreal, Que. The new material can be used to advantage in mining, rock drilling, railroad, construction, ore dressing, agricultural and other heavy duty applications, including many basic steel industry requirements.

●

Combined Enterprises Ltd.—A commemorative brochure has been issued by Combined Enterprises Limited on the occasion of their tenth anniversary of incorporation. The brochure reviews the subsidiaries and operating divisions of the group: Gutta Percha & Rubber Ltd.; American Wringer Company; St. Lawrence Rubber Company; Turnbull Elevator Co. Ltd.; Hamilton Gear and Machine Co. Ltd.; Stuart Brothers Company Ltd.; and Conant Paints Division.

●

Trans-Canada Pipe Lines.—Orders for the purchase of 335 miles of natural gas pipeline for the Toronto-Montreal section of its project have been placed by Trans-Canada Pipe Lines Limited. The 20 and 24 inch pipe will cost about $9 million; delivery is due by spring of 1956.

As a further development, Trans-Canada's president, N. E. Tanner, and vice-president E. D. Loughney of Canadian Gulf Oil Company signed a contract for 1,300,000 million cu. ft. of natural gas from Canadian Gulf's Pincher Creek field of southern Alberta. Contract calls for Trans-Canada Pipe Lines to buy at least 100 million cu. ft. a day for the first year and 170 million cu. ft. a day for the balance of the 25-year contract.

●

New Type Dry Battery.—A new "wafer cell" has been developed by Burgess Battery Company, Niagara Falls, Ont. Hand operations are eliminated from manufacture and the cell consists of a sandwich of manganese dioxide between flat zinc and carbon disc electrodes. This cell is machine-wrapped and heat sealed in pliofilm. Connections between cells are made by a new conductive silver wax. A single column of 15 cells, only two inches long, develops 22½ volts; a 300-volt battery occupies less than 20 cu. in. One use is as miniature high-voltage batteries for heavy duty electronic applications.

Canadian Representation. — F. J. Edwards Ltd., London, England, machinery and machine tool manufacturers, announce that their sole agents in Canada will be The A. R. Williams Machinery Company Ltd., of Toronto.

●

Change of Address.—Stein Structures Ltd. announce their move into a new manufacturing plant at 157th St. and 118th Ave., Edmonton, Alta. Hugh A Bowman has been appointed chief engineer and a vice-president of the company.

●

Generator for Smelter. — Andrew Robertson, president of Eastern Smelting and Refining Company Limited, has announced the placing of a $400,000 order with Canadian General Electric for the supply and installation of a 40,000 k.v.a. generator. The unit will be installed on the Chicoutimi River at Chicoutimi, Que., where Eastern Smelting and Refining Company is constructing a $20 million smelter for treatment of copper-nickel concentrates. The power plant will cost an additional $6 million.

●

Induction Heating Service. — The Canadian Westinghouse Company is offering the services of a 20 kw. radio-frequency generator in its Electronics Division at Hamilton to promote induction heating by actual processing of small customer production runs. The unit will be used for the treatment of small parts in hardening, soldering, brazing, selective annealing and softening operations. Work will be conducted by a widely-experienced operating and consulting staff.

●

Cement in Edmonton. — Under construction on the western outskirts of the City of Edmonton is the $8,000,000 plant of Inland Cement Company Limited. With production scheduled to commence before July 1st, 1956, the first stage of this large project will, when completed, produce about 3,500,000 bags of cement per year.

●

Canadian Company Formed. — The British Thomson-Houston Co. Ltd. of England announces the formation of The British Thomson-Houston Company (Canada) Limited to handle sales and service of B.T.H. products in Canada. The B.T.H. Co. (Canada) Ltd. will carry on the business previously handled by the branch of the British Company at the same address in Toronto. H. G. McHaffie is appointed general manager and also a director of the new company. The British Thomson-Houston Co. Ltd. is one of the Associated Electrical Industries group of companies, which employs over 75,000 people and is the largest electrical manufacturing organization in the United Kingdom.

●

Canadian Survey of Ceylon.—Under provisions of the Colombo Plan for the economic development of South and Southeast Asia, a contract has been awarded to the Photographic Survey Corporation, Limited, of Toronto, extending over a period of two years, to make an aerial survey of Ceylon. A similar project was undertaken by the Photographic Survey Corporation in Pakistan, which aroused the interest of government officials in Ceylon. Accordingly, Canada was requested to make provision under the Colombo Plan for a resources inventory of the entire island, covering an area of approximately 25,000 square miles.

●

Sandwell & Company Ltd.—An agreement for co-operation in the professional engineering field on an international scale has been reached by Sandwell & Company Ltd., Vancouver, and Electro-Watt Electrical and Industrial Management Co. Ltd., Zurich, Switzerland. Sandwell president P. R. Sandwell announced today.

The Swiss firm will place at the disposal of the Canadian company its extensive engineering experience in the electrical power industry while Sandwells will provide the experience in the forestry products industry.

●

Federal Public Works Contracts. — Works Minister Robert H. Winters announced that contracts involving expenditures totalling $2,522,098.53 were awarded by the Federal Department of Public Works during the month of September, 1955. The amount of new works is $1,271,596.70; for the repair and maintenance of existing structures $700,269.25; and for dredging $550,232.60.

●

New Induction Heater.—A new 30 kw. motor-generator set combination unit is the latest addition to the line of induction heating equipment available from the Canadian Westinghouse Company's electronics division at Hamilton. The new MG combination forms a building block unit that includes all the elements required for induction heating. Three basic components—a 30-kw. 10,000-cycle water-cooled MG set with generator control, a high-frequency output control cabinet and a work table—may be combined to accommodate every type of induction heating job. Thirty-two standard combinations are available.

●

Patent Institute of Canada. — Alan Swabey is the newly-elected president of the Patent Institute of Canada. Among many professional appointments Mr. Swabey is also chairman of the patent committee of the Chemical Institute of Canada. Eric L. Medcalf, Q.C., is secretary-treasurer of the Patent Institute of Canada.

●

New Headquarters. — New, enlarged headquarters have been established in Vancouver's Granville Island industrial community by Brown, Fraser & Company, specialists in the supply and servicing of major construction equipment and related units. The Granville Island building, formerly occupied by Wright's Canadian Ropes, has been taken over and is being renovated in the expansion program.

●

Residential Streetlighting. — A new bulletin featuring the Form 63 Luminaire for residential streetlighting is available from Lighting Equipment Sales, Canadian General Electric Co. Ltd., 212 King Street West, Toronto.

NO MATTER HOW YOU LOOK AT IT...

FAIRBANKS MORSE

MEANS

DEPENDABLE MARINE POWER

You are looking down into the engine room of the M.V. *Iroquois*, Canada Steamships Lines' latest canal-size freighter. This twin-screw motor vessel was specially designed to carry Labrador iron ore from Montreal to Great Lakes ports and, on the return voyage, carry grain from Great Lakes ports to Montreal.

To obtain maximum hold length and cubic capacity, and also to give good trim characteristics, it was necessary to have the engine room as short as possible. At the same time, with an overall length of 259 ft. and hold capacity of 176,000 cu. ft., the *Iroquois* needed rugged, powerful engines. The answer was provided by the 2 Fairbanks-Morse, 4-cylinder, 640 h.p. Model 38D8-1/8 x 10 O.P. diesels, shown above in their 22-ft. long engine room.

From tugs and fishing boats to ice-breakers and heavy duty cargo vessels these tough, simply designed power plants have earned themselves a most remarkable reputation for dependability. Ask Fairbanks-Morse for the full facts.

Facts about the M. V. IROQUOIS

Collingwood Shipyards Limited was able to launch the *Iraquais* on June 4, 1955, a mere 109 days following the laying of her keel. Her fitting, dock and sea trials proceeded so well that she was delivered to C.S.L. the middle of July.

The problem, as in all canal vessels, is to obtain the maximum amount of cargo deadweight in a restricted length, breadth and draft. The problem was increased somewhat in this instance by assigning the vessel a maximum summer draft of 17'6" and also making the tank top plating and stiffening strong enough to withstand the pounding of iron ore, buckets and clams.

The restricted engine room size and sloped stern made it possible to maintain the midship section throughout practically the whole cargo hold length. There are 3 separate holds, with the spaces between hatches being raised up to form a flush trunk so that automobiles may be carried over the hatches and the raised portion of the deck.

A special feature is Pilot House Control for the engines so that they can be handled directly by the Captain in the Wheelhouse. The Pilot House Control Pedestal has been situated so that the man at the wheel can operate the engines.

THE CANADIAN

FAIRBANKS-MORSE

COMPANY LIMITED

Sixteen Branches Across Canada

FM55-23T

Bus. and Ind. Briefs

Canadian Guided Missile. — A Canadian designed guided missile has been shown to the public for the first time with the appearance of a Canadair supersonic air-to-air guided missile test vehicle in that company's exhibit at the Air Industries and Transport Association's annual meeting.

The vehicle, on which test firings are continuing as part of the development program, has been constructed for the RCAF and Canadian Armament and Development Establishment in pursuit of an experimental program. Originally designed by CARDE at Valcartier, Que., Canadair has worked jointly with the Government agency on further development. Successfully ground-launched initially, the missiles had their first successful air-to-air firings last year from both Canadair F-86 Sabre jets and Avro CF-100's. Further details are still classified by the Government.

Canadair's missile program is conducted for the RCAF under design authority of CARDE and in co-operation with Canadian Westinghouse, A. V. Roe Canada Limited, De Havilland Aircraft of Canada, and Computing Devices of Canada.

●

Annacis Industrial Estate.—Seven companies announced their intentions to establish on Annacis Industrial Estate at a meeting held in the office of Gilbert Hardman, B.C. agent for the Estate. The seven firms are the first to establish on the 1200-acre industrial site being developed by The Grosvenor Estates. They are: Atlas Asbestos Company; Bartle and Gibson Co. Ltd.; The Bay Co. (B.C.) Ltd. and The Tide Co. (B.C.) Ltd., electrical and mechanical engineering and contracting; W. R. Campbell Ltd., warehousing and distribution; Dreem Boats & Marina Ltd.; and John Laing & Son (Canada) Ltd., Equipment Division; also the Stanley Door Co.

Custom-built factories will be constructed for four of the firms while the other three will move into terraced plants which are in the process of completion. In each case the building and site is leased. Services such as roads, power, sewage, drainage and rail lines are provided. Largest factory will be a 17,000 square foot building due for completion at the end of November which will be occupied by the Equipment Division of John Laing & Son (Canada) Ltd. This firm is doing preliminary construction on the Estate, as well as the 22-storey B.C. Electric Company head office and other buildings in the Vancouver area.

Two buildings will be constructed for Bartle & Gibson Co. Ltd., one of 12,000 square feet—main warehouse—the other a 4,000 square foot pipe warehouse. The company intends to make this a waterworks and industrial supply division of their business. John Laing & Son (Canada) Ltd. start construction next week with the completion date scheduled for the end of March.

The 11,000 square foot factory for Atlas Asbestos will feature asbestos products on walls, roof, etc. It will be completed at the end of March. Atlas is the Canadian subsidiary of Turner. Newall Co. Ltd., the British asbestos organization which is located in Trafford Park Industrial Estate, Manchester.

The Stanley Door Co. specializes in electronic commercial garage doors and is distributor in Western Canada for Stanley cubicle curtains for hospitals, manufactured by the Stanley Works, New Britain, Connecticut. They are in the process of moving into their plant.

The Bay Co. (B.C.) Ltd. have just completed a $1,500,000 job on the Canadian portion of the Haines-to-Fairbank pipeline which was recently turned over to the U.S. Government. The Bay Co. (B.C.) Ltd. is the mechanical engineering and contracting firm while The Tide Co. (B.C.) Ltd. handled the electrical contracting. W. D. Whinery is president of both companies while Paul Cote is vice-president of The Bay Co. (B.C.) Ltd. and H. L. Fritz is vice-president of The Tide Co. (B.C.) Ltd.

Construction will start in three weeks on a warehouse for W. R. Campbell Ltd This will be completed in March.

Dreem Boats & Marina Ltd. will manufacture "Dreemboat" surf liners and surf cruisers for sale in Canada and the U.S. This new company will also be distributors for other Canadian manufactured lines of pleasure crafts, marine supplies and sporting goods. The company headed by President George Carey, Vancouver, has offices in Seattle and North Vancouver.

●

Canadian Organization Changes.—The board of directors of Millspaugh Limited, Sheffield, England, wish to announce changes in their Canadian organization. The name of Had-Mil (Canada) Limited has been changed to Millspaugh (Canada) Limited and the Companys' head offices will be located at 1224 St. Catherine St. West, Montreal. The Montreal office will house the sales and engineering departments of the company as well as the commercial and accounting sections. Service engineers will be available at all times. James J. Ross, who for the past five years has been a director of Had-Mil (Canada) Limited and managed the company's affairs, remains on the board of directors and becomes executive vice-president. A. T. Sutherland, who is well known to the Canadian paper industry has joined the organization and becomes vice-president engineering.

●

Consulting Engineers' Publication. — The board of directors of The Association of Consulting Engineers of Canada (incorporated May 26th, 1925), has announced that the Daily Commercial News and Building Record has been designated as the official publication of the Association. Officers are: E. A. Cross, M.E.I.C., Toronto, president; R. R. Duquette, M.E.I.C., Montreal, vice-president; G. Demers, M.E.I.C., J. G. Frost, M.E.I.C., W. W. Lea, all of Montreal, J. F. McLaren and J. H. Ross, M.E.I.C., both of Toronto, directors: W. G. Swann, Vancouver, and K. E. Whitman, M.E.I.C., Halifax, associate directors; H. H. Angus, M.E.I.C., Toronto, A. T. Hurter, M.E.I.C., and E. A. Ryan, M.E.I.C., both of Montreal, past presidents (ex-officio); F. J. Friedman, M.E.I.C., Montreal, honorary secretary-treasurer; R. W. Gould, 620 Cathcart Street, Montreal, secretary.

●

Contract for Steel Pipe. — National Tube Division of United States Steel Corporation has announced that a firm commitment has been made for 34-inch high-pressure steel pipe required for the western leg of the Trans-Canada Pipe Lines Limited gas pipe line project. This pipe, produced in 40-foot lengths and weighing 355 tons per mile, will be manufactured at McKeesport, Pa., and Orange, Texas, commencing in February, 1956, and will be completed in the summer of 1956. The large tonnage of line pipe required for the 1956 construction program will be laid from the Alberta-Saskatchewan border to Winnipeg, Man. The total line of approximately 2,300 miles involves the largest tonnage of steel pipe for any single pipe line project ever built.

●

Wire Rope Slings.—New wire rope sling catalogue, just issued by Donald Ropes and Wire Cloth Limited, contains valuable sling data. The catalogue is complete with rated capacity data tables on all types of Talurit, spliced, braided and grommet slings. Sling fittings are described by dimension tables. Illustrated are many typical sling applications. Available from Donald Wire Ropes and Cloth Limited, Hamilton, Ont.

"Business & Industrial Briefs"

This section of the *Journal* is intended to keep readers informed on developments and changes in those business and industrial enterprises, and on new products, which affect the engineer.

If you write with respect to any of the items in this, or other, sections please mention

THE ENGINEERING JOURNAL

Save time and money on water line installation

In this recent installation, faster line assembly permitted following the digger closely.

On this tough job, snow, ice and frozen ground caused no installation slow-down.

In this installation, flexible Ring-Tite joints permitted conformance to gradual curves.

Transite® Pressure Pipe with the new Ring-Tite® Coupling

Goes together fast! Locks tight automatically!

In community after community, water district after water district. Transite Pressure Pipe and the new Ring-tite Coupling have made possible important cost-savings in water line installation time.

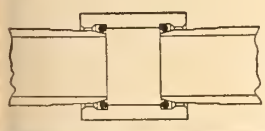
The Ring-Tite Coupling is effecting installation savings everywhere because of its special features. To begin with, pipes are aligned quickly, easily. Coupling design not only provides automatic aligning but also automatic adjustment for expansion. Rubber rings are simply popped into grooves for assembly; lubricated pipe ends then slide in under rings smoothly, easily, and surely.

Pipe ends are automatically separated within the coupling. This separation gives the line flexibility to withstand shock and vibration, relieves line stresses, permits conformance to curves.

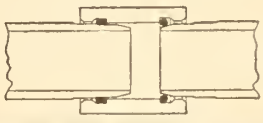
Like Transite Pressure Pipe, the Ring-Tite Coupling sleeve is made of asbestos and cement . . . it is strong and durable, cannot rust, and is highly resistant to corrosion. Installations can be completed under adverse weather, temperature or terrain conditions. No complicated equipment is required.

For more information write Canadian Johns-Manville, 565 Lakeshore Rd. E., Port Credit, Ont., No. 5485.

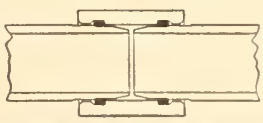
I-365



A. Rubber rings popped into grooves before assembly.



B. Lubricated pipe slides in under rubber rings.



C. Both pipes in assembled position. Rings compressed and locked in place.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE PRESSURE PIPE

AN ASBESTOS-CEMENT PRODUCT

Lt. Col. John By . . . Biographical Notes

(*Continued from page 1548*)

at being accused of illegal acts, while in reality he was only following orders.

The colonel never came back to Canada. Owing to failing health he was once more placed on the "unemployed list" and retired to his estate near Frant, Sussex, where he died on February 1, 1836, at the age of fifty-six, though his tombstone in the Frant parish churchyard gives his age as fifty-three.

So much for a sketch of Col. By's career. What kind of man was he?

Col. By was a man of "sterling character and of an unusually k i n d l y disposition", "enlarged views and a good heart" and "an able and efficient officer", "always willing to encourage everything calculated to advance the prosperity of Bytown and ever ready to oppose what he believed to militate against its interests." He "always predicted a brilliant future for the place" and entertained the idea of the union of the provinces, with Bytown as its capital, but little credence was given to his words.

A "man of great energy and determination", when the nearly finished Hog's Back dam on the canal was swept away for the second time by a spring flood, "he said he would build it again and again until it would stand, (even) if he had to do it with solid half-crown pieces".

At the beginnings of Bytown, Col. By was virtually the emperor of the place. It must have taken a good deal of his time to keep some of its unruly elements in order, especially as he was frequently away from the town for long periods on trips along the canal. He administered by "military rule". "He dealt promptly with abuses, e.g., he found a liquor store playing havoc with his workmen (and) gave the proprietor twenty-four hours to get (a) license or quit. When he didn't, Col. By raided the store and closed it."

Col. By was Canada's leading engineer of the time, who, through no fault of his own, spent the last years of his life under a cloud. When he returned to England, "instead of meeting with the reception which he merited, he received nothing but reproaches. . . . This treatment acting on a naturally weak constitution, finally caused his death. Many affirm that he died of a broken heart, having looked forward to some royal mark of favour or honour for his successful exertion in carrying out the great work which is . . . mighty evidence of his professional skill and assiduity".

"As o'er the past my vision runs,
Gazing on Bytown's elder sons,
The portly Colonel I behold,
As plainly as in days of old,
Conjured before one at this hour,
By memory's undying power;
Seated on his great black steed,
Of stately form and noble breed,
A man who knew not how to flinch,
A British soldier every inch,
Courteous alike to low and high,
A gentleman was Colonel By."

William Pittman Lett, 1874

News of Other Societies

Canadian Institute of Mining and Metallurgy (1117 St. Catherine St. W., Montreal) . . . the sixth Empire mining and metallurgical congress, Canada, April 1957. A series of major conventions in the larger Canadian cities; tours, inspections, publication of five large volumes on Canadian mining, milling, petroleum and related subjects. Sponsored by mining and metallurgical institutions of the Commonwealth.

●

Fifth World Power Conference (Canadian Committee, Laurentian Building, 54 Albert Street, Ottawa 4, Ont.) . . . Vienna, June 17-23, 1956. The theme of the conference is "World Energy Resources in the Light of Recent Technical and Economic Developments". Main divisions of the program are as follows: I — The State and Development of Power Production and Utilization in Individual Countries; II — The Preparation and Conversion of Fuels; III — Utilization of Primary Sources of Energy; IV — Purification of Waste Water and Waste Gas in the Production and Use of Energy; V — International Collaboration in the Production and Use of Energy.

●

Canadian Electrical Association (159 Craig St. W., Montreal) . . . eastern zone meeting for all divisions, Nova Scotian Hotel, Halifax, N.S., January 16-19, 1956; western zone meeting for all divisions, MacDonald Hotel, Edmonton, Alta., March 19-22, 1956 . . . B.C. Fairchild, C.E.A. managing director was honoured at the recent annual convention having completed twenty-five years of service to the Association.

●

Canadian Electrical Manufacturers Association . . . H. M. Turner of Toronto was elected president at the annual meeting in October. Mr. Turner is chairman of the board of Canadian General Electric Co. Ltd.

●

Canadian Institute of Timber Construction (160 Laurier Ave. W., Ottawa 4) . . . the annual meeting at the Royal York Hotel, Toronto, March 28-30, 1956.

●

The American Institute of Chemical Engineers (25 West 45th St., New York 36) . . . the annual meeting at the Statler Hotel, Detroit, Mich., November 27-30, 1955.

●

Institute of the Aeronautical Sciences (2 East 64th St., New York 21) . . . Raymond L. Bisplinghoff, professor of aeronautical engineering at Massachusetts Institute of Technology will give the Wright Brothers Lecture on December 17, 1955.

●

National Research Council (Ottawa 2) . . . Dr. Leslie E. Howlett, director of the Division of Applied Physics, has been elected a member of the International Committee of Weights and Measures. The committee is the recognized international body for formulating standards to represent the basic units of physical measurement, such as those of length, mass, and electricity.

●

Patent Institute of Canada . . . Alan Swabey, patent attorney, Montreal, was elected president at the recent annual meeting.

●

American Society for Engineering Education . . . Dr. Lisle Rose, professor of general engineering and director of engineering information and publications, has been appointed editor of the A.S.E.E. publications, and public relations director. A.S.E.E. headquarters and editorial offices are now at University of Illinois . . . Dr. Maynard M. Boring, consultant on manpower at the General Electric Company, is the president of the Society.

●

Society of Plastics Engineers (S. A. McElroy, Hercules Powder Company, 865 Union Commerce Bldg., Cleveland, Ohio) . . . the 12th annual meeting, Hotel Statler, Cleveland, Ohio, January 18-20, 1956.

●

Institution of Electrical Engineers (Savoy Place, London, W.C.2, England) . . . a convention on digital computer techniques, in the Institution Building, April 9 to 13, 1956. Ten sessions and additional specialist sessions, visits to digital computer installations.

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16,700 copies of this issue printed

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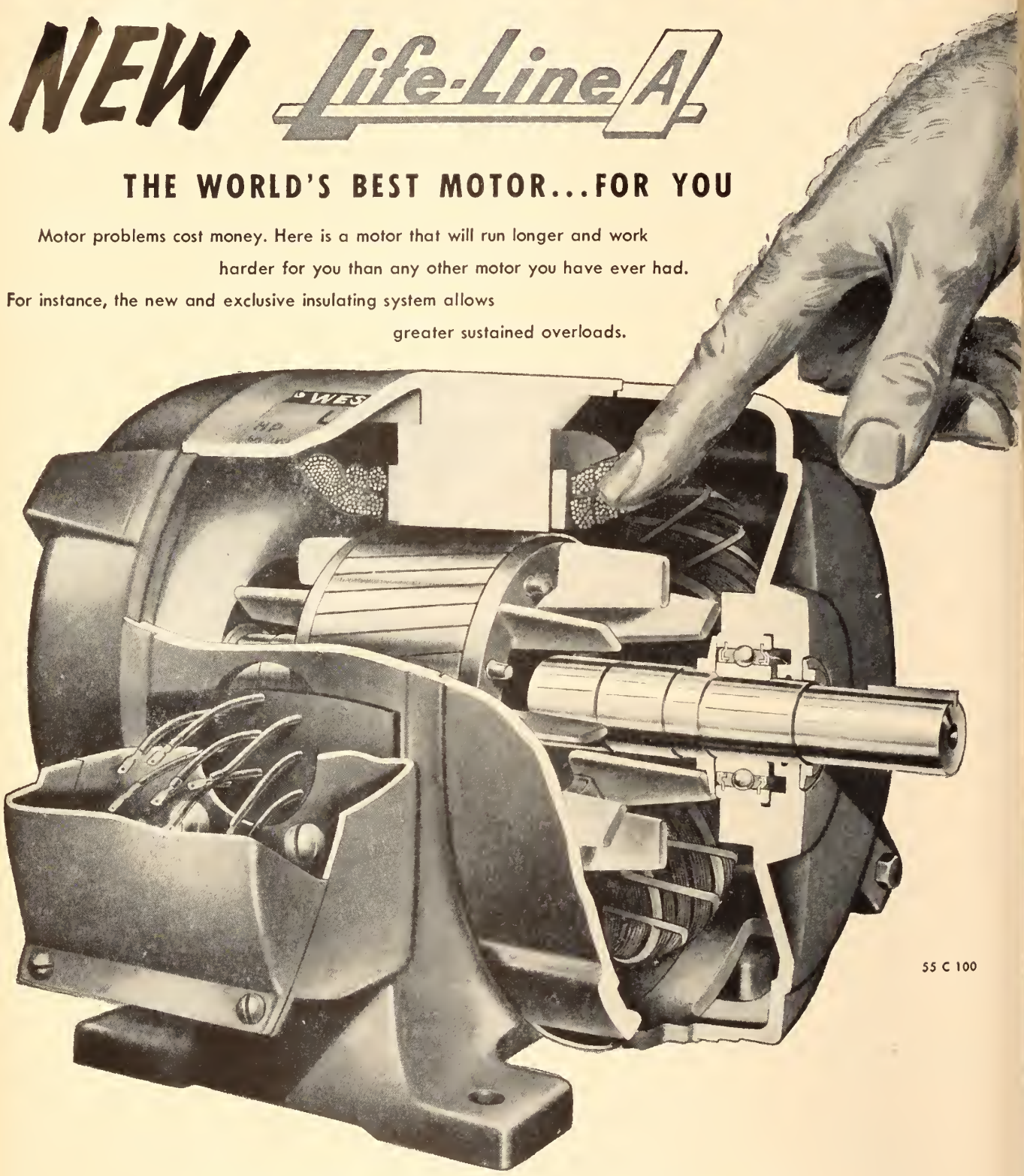
IT'S WESTINGHOUSE...

NEW Life-Line A

THE WORLD'S BEST MOTOR...FOR YOU

Motor problems cost money. Here is a motor that will run longer and work harder for you than any other motor you have ever had.

For instance, the new and exclusive insulating system allows greater sustained overloads.



55 C 100

The new Bondar insulating enamel lasts three times longer than conventional enamels.

The new Mylar slot cell insulation is stronger than will ever be needed.

The new Bondite impregnating varnish sheds water and shrugs off corrosive elements.

YOU CAN BE SURE ..IF IT'S Westinghouse CANADIAN WESTINGHOUSE COMPANY LIMITED, HAMILTON

"See TV's top dramatic shaw Westinghouse 'Studio One' Mondays at 10 p.m."

The Helicopter . . . and the Engineer

by

W. H. D. Hanchet, M.E.I.C.,

Doman-Fleet Helicopters,
Fort Erie, Ont.

Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

As an extension to the original function of the bush aircraft in serving remote areas, the helicopter has emerged since the last world war. The characteristics and application of the helicopter in the field of engineering in Canada are discussed in this paper.

One of the major obstacles to the expansion and development of Canada is lack of adequate transportation; another obstacle is the shortage of technical manpower, which is aggravated by the former.

In the period between the world wars, the bush airplane was used extensively to provide transportation to our north country. Thus surveyors, geologists, engineers and other technical men were enabled to carry out their work without spending an undue amount of time reaching it. This outstanding advantage was partially offset by an important and inherent limitation of the airplane, i.e., the requirement of a large open stretch of land, water or snow for landing and take-off. While this limitation was and still is insignificant in those parts of the country where potential landing areas, particularly lakes and rivers, are plentiful, the airplane could not provide rapid transportation in mountains, muskeg and solid bush.

Shortly after the end of world war II, there emerged a vehicle closely related to the airplane in a sense, but possessing quite different characteristics — the helicopter. It is this vehicle, its characteristics and its application in the field of engineering in Canada which are discussed in this paper. These are presented from the point of view of the customer of helicopter service rather than that of the designer or operator, although these will be mentioned for amplification.

According to the Oxford Dictionary, the helicopter is a "flying-machine deriving both its lift and its propulsive power from horizontally revolving blades or rotors, and capable of ascending and descending vertically". For the purposes of this paper, it is necessary to add that the helicopter is a vehicle, not just a flying machine, and that it can hover and fly sideways and backwards in addition to ascending and descending vertically.

The important flight characteristics of the helicopter can be readily deduced from Fig. 1 which shows power required to maintain level flight vs. forward airspeed. This graph applies, in general, to all current helicopters, hence percentages of b.h.p and Vmax are used, rather than absolute values.

Curve ABCD shows the power required by the helicopter to maintain level flight, and EF shows the engine power available. Level flight is possible only where ABCD is below EF. The point G, where ABCD meets EF is one where level flight is just possible; an increase in speed would result in loss of height, hence G′ represents Vmax.

Point B is the lowest point on ABCD, and is therefore the point at which maximum power is available for climbing or acceleration. B′ represents Velimb, which is about 50 per cent of Vmax. The point of tangency between ABCD and a straight line through the origin is point C, which is where the greatest V for the least b.h.p. occurs. Thus C′ represents Vmax. range, which is about 75 per cent of Vmax, and which is usually close to the actual cruising speed.

The fact that point A is below point E indicates that the helicopter can maintain level flight at zero forward airspeed, i.e., it can hover. AE represents the excess power available for vertical climb.

Figure 1 indicates that the conditions shown apply to one gross weight and one density altitude only. When the gross weight increases, the curve ABCD is moved upwards on the graph. When points A and E coincide, the helicopter can just hover, and if gross weight is increased further, the helicopter can maintain level flight only with some forward airspeed. It should also be noted that as ABCD moves upwards, point G moves to the left, i.e., Vmax is reduced. When gross weight is reduced, ABCD moves downwards, and less power is required to hover and Vmax is increased. In general, increase in gross weight results in decrease in performance, and vice versa.

Density altitude is an expression of air density in terms of altitude. On a "standard day", the density altitude at a point 3,000 ft. above sea level is 3,000 ft. On a hot day, the density altitude at this point might be 5,000 ft., and on a cold day it might be 1,000 ft.

Increase in density altitude not only moves ABCD upwards, but moves EF downwards, as available engine power is adversely affected. At a given gross weight, density altitude may be increased to the point where A and E coincide. This density altitude is called the "hovering ceiling" and applies only to one gross weight. The lower the gross weight, the higher the

hovering ceiling, and vice versa. Also, the lower the density altitude the higher the performance, and vice versa.

As will be pointed out later, the most important single characteristic of a helicopter is its ability to hover, so that the prime concern of the operator and his customer is, in terms of Figure 1, to keep point A below point E at all times. Since density altitude cannot be directly controlled, variation in gross weight is the only tool available to accomplish this feat.

The question of weight is all-important in the aircraft industry, as will be appreciated by referring to Fig. 2. This graph shows the weight breakdown of a typical helicopter in terms of range or endurance. The weight empty includes unusable and reserve fuel, emergency rations, radio, etc., in addition to aircraft weight, and does not vary with range or endurance. The crew weight includes the pilot and any others who may be necessary for the operation of the helicopter, e.g., air engineer, navigator, co-pilot. This does not vary with range or endurance.

Fuel weight is zero for zero range or endurance and increases in proportion to those factors. The line AB represents gross weight, which is independent of range and endurance, and payload is what remains between AB and the fuel line CD. Payload is higher over short distances than over long distances where greater fuel is required. Since payload consists of cargo and passengers who are carried for pay on a cost per pound basis, it is apparent that weight empty, crew weight and fuel weight should be kept as low as possible, and that gross weight should be as high as possible for maximum available payload and maximum potential revenue.

In Canada, the Department of Transport establishes a maximum gross weight for each model of helicopter. In addition, performance limitations may force operation at gross weights lower than the maximum, as previously discussed, hence payload is caught in a squeeze. Payload is kept high by operating the helicopter over the shortest possible distances, which is also desirable from other points of view, and is also achieved by paring all unnecessary weight from the helicopter. It is vital, however, that gross weight should be increased only to the point where performance is adequate for the job in hand plus a margin of safety.

Under normal conditions, the helicopter can climb at any forward speed from zero to 100 per cent Vmax, but does so most efficiently at about 50 per cent Vmax. Similarly, in the "power-off" condition, the helicopter can descend in controlled autorotation at virtually any speed, but does so most efficiently at about 50 per cent Vmax. Autorotation may be likened to the glide of an airplane, but the ability of the helicopter to settle to the ground at or near zero speed renders it much safer than the airplane, as it has a much wider variety of safe landing areas, and can actually land in solid bush fairly safely, although it will suffer damage.

In order that the helicopter pilot may be prepared for autorotation at any time, it is desirable to accelerate to 50 per cent Vmax as soon as possible after take-off, and to approach for landing at approximately the same speed, although the final landing is made at zero speed. Thus the ideal operating base for a helicopter should have clearance for inclined take-off and landing paths. The actual button or platform on which the helicopter sits need be only large enough to accommodate the landing gear plus a small margin, but a much greater area is required for rotor clearance. Thus a mountain peak fifteen feet square might suffice for a helicopter base if there were no trees or other obstacles in the area, whereas an area at least 200 feet square, with a fifteen foot square level patch in the middle, would be necessary for the smallest helicopter if surrounding trees were no greater than fifty feet high. Thus, although the helicopter should theoretically operate from bases which permit rotor clearance only, this does not hold true in practice. It should be remembered, however, that there are many times more natural landing places for a helicopter than for an airplane, and that the effort required to clear a suitable area in the bush is much less than would be required for the smallest of airstrips.

The ease of piloting a helicopter is of concern to the operator and designer, but not the customer. The Canadian helicopter pilots who fly in our bush country are all professionals, and the idea of amateur helicopter pilots flying in remote areas is to be discouraged.

Similarly, helicopter maintenance is performed by a trained air engineer, whose main duties are refuelling, lubrication and inspection. A typical crew consists of one pilot and one air engineer who, between them, can supply sufficient muscle power to carry out any anticipated work in the bush. Incidentally, the air engineer does not usually fly on operations, but oversees cargo loading and unloading.

Closely related to the work of the air engineer is the subject of spare parts. A small stock of commonly replaced items such as seals, gaskets, and small parts is kept with the helicopter at its base in the bush, but major units are held at some main base or depot. Thus, if some unforeseen emergency arises and a major spare part is required, some rapid means of transportation between the bush

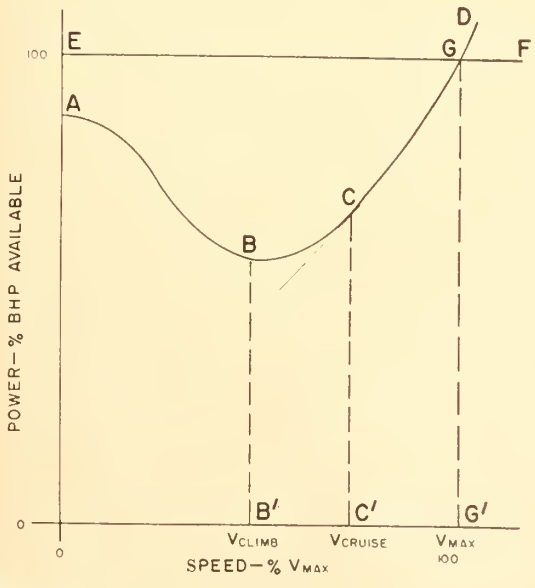


Fig. 1. Power required to maintain level flight *v.* forward airspeed. 1. Constant gross weight. 2. Constant density altitude.

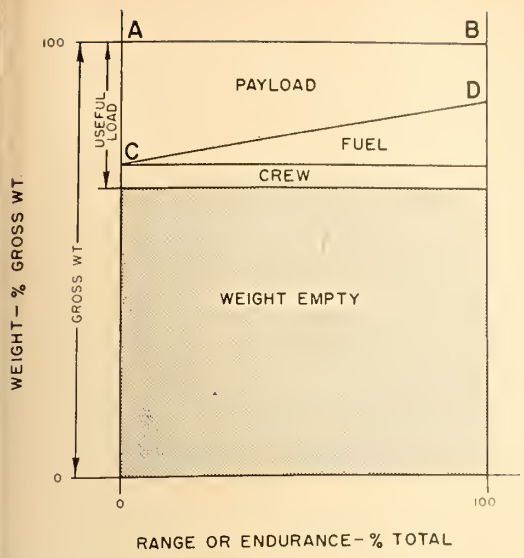


Fig. 2. Typical helicopter weight analysis, in terms of range or endurance.

base and main base must be provided.

The fuels and lubricants required by a helicopter are those used extensively in the aviation field, and transportation to the bush is the major problem presented by these items. Time and cost dictate the means of transportation used to supply gas caches, and these run from barge to helicopter. It is not unusual to establish gas caches for a helicopter operation a year in advance, nor is it impossible to begin an operation almost from scratch — at a cost!

Types of Helicopter

Up to this point in the paper, the term "helicopter" has been used in a general sense. Those used commercially in Canada do happen to fall into two distinct categories, each of which is described below.

The first type includes both the Bell 47 and Hiller 360, and carries a pilot and up to two passengers or 400 lb. Cruising speed is about 65 m.p.h. and useful maximum range is about 100 miles. The initial cost is about $35,000 in Canada, and the prevailing charter rate is $100 per flying hour and up. Since the Bell 47 outnumbers the Hiller 360 in Canada by a substantial ratio, the word "Bell" will be used hereinafter to cover this type.

The second type is the Sikorsky S-55 which carries a pilot and up to seven passengers or 1,500 lb. Cruising speed is about 85 m.p.h. and useful maximum range in the neighbourhood of 200 miles. The Canadian selling price is about $155,000, and the charter rate starts at about $200 per flying hour.

The above figures may be called average or typical; they are not taken from the manufacturers' sales literature, but represent the opinions of several experienced Canadian helicopter operators.

Serving The Engineer

Up to this point this paper has dealt with the helicopter in general, its characteristics, landing requirements and operator's problems, and has described the two types used in this country at present. It is time now to superimpose this information on that concerning the problems of Canadian engineers, and to determine how the helicopter can serve the engineer.

Since the helicopter is, by revised definition, a vehicle, it appears logical to compare it with other vehicles in order to find out what particular advantages enable it to compete with other vehicles, and under what circumstances these advantages are most impressive.

Broadly speaking, the helicopter is faster than any land or water borne transport, and requires no prepared road or track other than small clear areas to land and take-off. The following general formula applies to all forms of transport:

$$\text{cost per ton mile} = \frac{\text{cost per hour}}{\text{ton-miles per hour}}$$

The high hourly cost and low carrying capacity of the specific helicopters discussed above renders the cost per ton-mile very high, in spite of their speed, and it is apparent that the helicopter does not compete with trucks, trains and boats, which carry large payloads at moderate costs in areas where these vehicles can maintain fair speeds. If, however, the cost per hour of, say, a truck were to include the cost of a special private road, or if the only available road reduced truck speed by 90 per

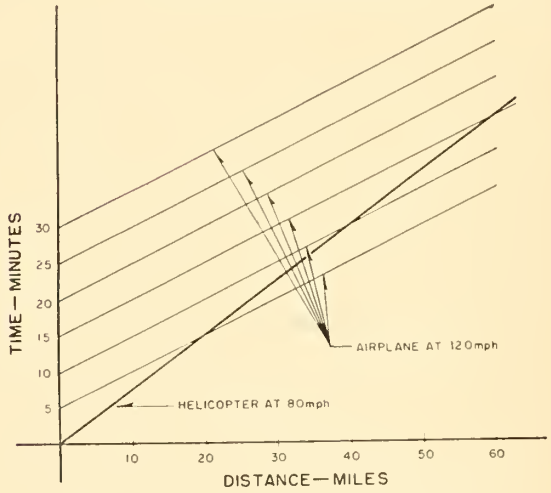


Fig. 3. Elapsed time: 80-m.p.h. helicopter v. 120-m.p.h. airplane.

cent or more, then the helicopter would almost certainly compete favourably. A general statement that the helicopter competes with surface transportation only where the latter is very slow due to lack of facilities, or costly if facilities must be provided, leads to the specific conclusion that such conditions prevail in the Canadian bush. The term "bush", of course, includes mountains, muskegs and bodies of water as well as the forests implied in the name.

Since the helicopter depends largely upon speed and economy for competitive survival with ground vehicles, one might well wonder how it survives in the presence of the airplane, as a typical bush airplane is faster and cheaper and carries more payload than its helicopter counterpart. One explanation of this apparent paradox is that, while the airplane has a higher cruising speed, it wastes a certain amount of time in taxiing and manoeuvring, and actually takes longer to travel between two points than the helicop-

ter where the two points are close together.

Figure 3 illustrates this point by showing an 80-m.p.h. helicopter leaving at zero time chased by 120-m.p.h. airplanes at five minute intervals. The first plane catches the helicopter in 20 miles, the second in 40, the third in 60 and so on. This means that an 80 m.p.h. helicopter is faster between any two points up to 60 miles apart than a 120 m.p.h. airplane if the latter spends 15 minutes or more in taxiing and other manoeuvring. This is, however, only one aspect of the whole question.

Even more significant is the fact that the airplane can not, in general, take off from the exact spot where the payload originates, nor can it land at the ultimate destination. Thus the actual time for airplane transportation is increased by the time required for ground transportation of one sort or another, and the actual cost is increased by ground transportation costs. The helicopter, in general, can eliminate this extra time and cost thanks to its ability to operate from small spaces. In addition, bulky loads can be carried externally by helicopter, thus reducing loading and unloading time to a minimum.

In areas suitable for airplane operation, the helicopter might compete on an overall time basis over distances of one or two hundred miles, but on a cost basis, helicopter competition is limited to distances of a very few miles.

In certain areas, airplanes are unable to operate owing to lack of landing areas, and during freeze-up and break-up most bush airplanes are grounded. In such cases, the helicopter alone is able to provide air transportation, and competes only with ground vehicles, if any.

Although there is, perhaps, a small amount of competition between the helicopter and the airplane, the two vehicles are complementary rather than competitive. The airplane carries its payload as close as possible to the destination, and the helicopter takes over to close the gap. Since the airplane is an older vehicle than the helicopter, it is, perhaps, more tactful to say that the latter enhances the value of the former rather than vice versa. The airplane does play a role in the success of the helicopter operation in that it provides a lifeline back to civilization, and may be used to carry fuel and spare parts for the helicopter as required. Thus, the two vehicles operate as a transportation team in the Canadian bush — an unbeatable team in nearly every respect.

It has been established, therefore, where the helicopter may be used to best advantage; it remains to examine the need for transportation in order to establish specific applications.

The need for transportation in the Canadian bush arises from the fact that these areas are rich in the natural resources upon which some of our basic industries depend. The primary industries of Canada, as defined in the Canada Year Book, are: agriculture, fishing, trapping, forestry, mining, and electric power. Of these only forestry, mining, and electric power are of direct concern to the engineer, and it is to these that the application of the helicopter are studied in this paper.

Topographical Maps

Before discussing each separately, there is one feature common to all and that is the need for accurate maps. The Dominion Government has undertaken to provide topographical maps of various scales for the entire country, and uses aerial photographs with ground triangulation and altitude control for this purpose. Photography is, of course, carried out from high-flying airplanes, but helicopters are playing an important part in the ground survey.

In triangulation work, helicopters have been used extensively by the Canadian Army and the Department of Mines and Technical Surveys for more than five years. The areas of operation range from the Yukon to Northern Quebec, and could not conceivably be classified as anything but bush areas.

To date, the Bell helicopter has been used almost exclusively on this work, and its application is quite simple and straightforward. It is used to carry surveyors, instruments, and targets from base camps or close to triangulation points. Base camps are moved frequently during the season by means of a supporting bush airplane such as the Beaver, which also serves as a link with civilization. In some areas, it may be necessary to use a larger helicopter, such as the S-55, for support if the terrain is such that the Beaver cannot operate.

The use of helicopters on triangulation work reduces the time and energy required to travel to and from stations, permits flexibility in the day to day selection of stations, and, in conjunction with the use of a support airplane, eliminates the need for pack horses. Secondary benefits, such as continuous rapid contact with civilization in the event of emergency, continuous daily control at base camp, and the fact that more comfortable living conditions prevail cannot, perhaps, be measured in dollars and cents, but these benefits contribute to the morale and

Fig. 4. Bell helicopter (Model 54) operating in Labrador.

Fig. 5. Department of Transport Bell helicopter landing on the Arctic supply ship *C. D. Howe.*

efficiency of the party. These benefits usually apply to all other helicopter operations in the bush.

It has been found from actual experience that the cost of mapping one square mile by means of helicopter is approximately the same as the cost using ground transportation, and that the former method permits four to five times the amount of coverage in a season. This means that a relatively small number of survey parties can map a much larger area than before at the same cost.

Another aspect of topographical survey is horizontal control. It has been found that barometric survey using a helicopter can be done rapidly and economically within acceptable limits. Not only is it much faster than conventional levelling, but it can be carried out in areas such as muskeg where conventional methods are impossible. The technique employed is to fly a predetermined pattern, and read the barometer at regular intervals. Deviations from the pattern can be made for spot checking individual features, thus a certain flexibility of operation is possible.

To summarize, briefly, the helicopter permits topographical survey work to be carried out much more rapidly than before, and at no extra cost. For a country the size of ours with its small population and chronic shortage of technical manpower, this contribution assumes great importance.

Geological Reconnaissance

In addition to providing topographical maps, the Dominion Government has undertaken to conduct a geological reconnaissance of the entire country, i.e., 3.6 million square miles of land area. The Geological Survey of Canada, which is a branch of Mines and Technical Surveys, has been tackling this job for over a century, and has not yet completed one-third. Since the remainder is more difficult than the part completed, owing to distance and the fact that it is largely bush country, it would be almost impossible to predict when the task might be completed unless new techniques were introduced. Following a series of successful experiments, however, it now appears that a complete geological reconnaissance of Canada is made possible within a generation by using helicopters for transportation.

The technique employed is to fly predetermined traverses from a base camp, with a geologist as observer. When the geologist spots interesting features, the helicopter lands, while he obtains samples, and if the area is uninteresting geologically, alternate traverses are omitted to save time. This method has several outstanding advantages over earlier methods which depended largely on canoe transportation. The cost, using helicopters, is no greater than before, and probably less, while the area covered in a season is about 25 times as great. Control and supervision are improved because all members of a party operate from the same camp, hence the quality of the results is more uniform. Complete flexibility of operation is possible, permitting more time to be spent on interesting features, and less on uninteresting ones, and uniform coverage is assured because there is no dependence upon waterways as there is in the case of canoe transportation. Finally, the length of the working season, formerly limited to the time between break-up and freeze-up, is increased, as the helicopter is not limited by these factors; this is particularly important in the far North where the season would otherwise be very short or non-existent

In addition to reconnaissance work, the helicopter has been used purely to transport geologists to and from difficult if not inaccessible spots. This is somewhat similar to its use in topographical survey work.

Bell helicopters have been used exclusively on geological survey work so far, but this year S-55's will be used on an operation in the Arctic Islands. It is used rather than the Bell, in this instance, to provide both greater range and greater payload. The main use of the helicopters will be transportation, but it is expected that some reconnaissance will also be carried out.

The Dominion Government is not the only user of helicopters for survey work. In Labrador, last year, the British Newfoundland Corporation employed two Bell helicopters and several Beaver airplanes on their engineering and mineralogical surveys. The techniques used were comparable to those discussed previously, and the operation of both helicopters and aircraft was so satisfactory that it will be repeated in extending the work this year. Officials of the Corporation stated that only the use of helicopters made it practicable to conduct such a survey in that portion of Labrador.

Mining

Of the three primary industries in question, mining has probably used helicopters more extensively than the others, and will be considered first on that basis. Mining, for the purposes of this paper, is taken to include the search for minerals, including petroleum, and their removal from the ground. It is in connection with the search that helicopters are used most extensively.

The presence of a mineral in the ground may be indicated by geological methods, by one of the many airborne and ground based devices which indicate changes in

radioactivity, magnetism and gravity, by recording the results of an artificial earthquake on a seismograph, and no doubt many others. In most cases, however, the final proof of the presence of a mineral is obtained by drilling a hole in the ground.

The use of the helicopter for geological survey by the Government has been discussed, and the same remarks apply to its use by petroleum and mining companies who use it frequently for this work. Most airborne detecting devices have been carried in airplanes until now, as the high speed and long range of the latter enabled large areas to be surveyed in a short time. Newer instruments which give more accurate results are under development. At least some of these require slow and accurate contour flying, and it appears that the helicopter will prove useful in this work. In petroleum exploration work, Bell helicopters have frequently been used for gravity meter surveys. This is similar in technique to barometric levelling, and produces rapid results economically. The main problem in seismic work is to carry a drill and other heavy equipment between individual points over a predetermined route, and the S-55 was used experimentally for this work last year. The experiment proved successful, and more extensive application is scheduled for this year. Seismic work is vital to the petroleum industry, and in muskeg this could only be carried out in the winter when the ground was frozen. Now, the helicopter makes seismic exploration possible on a year round basis in Canada.

During the past two summers, Hudson Bay Mining and Smelting has carried out mineralogical exploration work in the Yukon using an S-55. This helicopter was used to transport geologists and prospectors from camp to camp, and keep them supplied from the base camp. In addition, a specially designed diamond drill rig and drill crew were carried by helicopter to promising locations in order that sample cores might be obtained on the spot. It is interesting to note that the drill and other loads carried were tailored to fit the capabilities of the helicopter—an important precept in helicopter operations.

On this project, the helicopter replaced pack horses, and a comparison shows that the use of this helicopter increased the area covered more than 600 per cent and reduced the cost more than 50 per cent.

Fig. 6. Sikorsky helicopter approaching a mountain ledge base operated during the Hudson Bay mining development.

Last year, two independent helicopter operators based S-55's in Ontario and moved many drill rigs in the bush for Eastern drilling and mining companies with considerable success.

The helicopter, then, is suitable for use in many different methods of mining exploration and has, in fact, been used successfully in this role in Canada. This, perhaps, is the only important direct use of helicopters in the mining industry, but they were used in connection with the railroads built to take ore from Knob Lake in Labrador and Lynn Lake in Manitoba. On these projects, Bells were used primarily to carry supervisory personnel on inspections, and were also used for survey and location, and to provide emergency evacuation of sick or injured men.

Electric Power

The electric power industry uses helicopters in several different ways. The Hydro-Electric Power Commission of Ontario has used Bell helicopters to patrol power transmission lines for several years, and has realized several benefits from the changeover from ground transportation. The method of patrol used is to fly at low speed a short distance above and beside the lines while an observer notes imperfections in lines and towers. Using this method, the entire Ontario Hydro network can be inspected in a short time, and because of the flexibility of operation of the helicopter it is possible to inspect more closely than heretofore. Almost inaccessible lines, such as long spans across water or ravines present no additional problem to the helicopter, whereas formerly such lines had to be lowered for inspection.

In addition to patrol, Ontario Hydro helicopters have been used for repair and other emergency work, thus reducing service interruption, particularly in the winter. They have also been used to survey and locate new lines in bush country, and have been used to string lines over difficult obstacles.

The helicopter has already made a contribution to the St. Lawrence

Seaway and its associated power project, as an RCAF machine was used to carry out soundings in a stretch of water where boats could not operate, and where no other method was practicable. Similar work had been done in connection with the Niagara Remedial Works. Thus the usefulness of the helicopter to the engineer is by no means restricted to the bush.

Hydro-Quebec also used helicopters for power line location in connection with the Bersimis River power development project, but unlike Ontario chartered Bells from commercial operators rather than owning its own. The helicopters were intended primarily for survey and location work, and proved very successful in these roles. They were also pressed into service as surveyors' targets, carried provisions from civilization to camp, moved camps and carried injured and sick men out for treatment.

Kitimat

The uses of helicopters by the Hydro Commissions of both Ontario and Quebec might almost be termed routine, but another electric power development in British Columbia used helicopters on such a scale and in such a way that there was no hint of the routine. The project is usually referred to simply as Kitimat, and must certainly be familiar to members of the Engineering Institute.

At the very outset of this project, a chartered helicopter was used to conduct an initial survey. This lasted 10 days, instead of an estimated three years had a helicopter not been used. The long water tunnel was located by triangulation in six weeks using a helicopter, whereas this job might well have taken two years otherwise.

The major job required of the helicopter fleet was to fly men and materials to construction camps in the mountains. To do this, the helicopters first carried in pre-cut lumber from which landing platforms were made, and, on at least one occasion, carried up a small village of pre-fabricated houses. In effect, a small airline service was provided between mountain platforms and the main camp in the valley. In this way travelling time from camp to work was kept to a minimum, and supplies were made available on a few minutes' notice. So the work at Kemano was expedited, and so also was the construction of the power line to Kitimat.

Apart from the main work, helicopters were called upon frequently to pinch hit when surface transportation broke down, and on one memorable occasion sprayed lampblack on a frozen lake to open it for transportation earlier than usual. Many injured men received prompt care when evacuated by helicopter, and several owe their lives to its work. For the first time in commercial helicopter operation, outsized loads were carried under the S-55, and many useful refinements of this technique were worked out on the project.

By 1953, the fleet of seven Bells and two S-55's accumulated over 2,000 hours on the job, and carried over a million pounds of cargo and an untold number of passengers in the process. This is the briefest of summaries, but some idea of its relative importance may be judged by the fact that Carl Agar, who operated the helicopter fleet, was recently honoured by the American Helicopter Society for his contribution to the progress of helicopter operation. He is the first commercial operator in the world to be so honoured, and the award is based largely, but not entirely, upon his work on the Kitimat project. Mr. Agar's company, Okanagan Helicopters, is the largest helicopter operator in the world, and is unique among the other major Canadian operators in that it owns no fixed wing airplanes.

Fig. 7. Large item of drilling equipment being carried to Hudson Bay development.

Forestry

Turning now to the final basic industry, we find that helicopters have been used successfully, but on a small scale in forestry. One of the most valuable contributions of the helicopter in any field in Canada is that of forest fire fighting, and here the helicopter has been used successfully. For the most part, helicopters have been supplied by the RCAF, RCN or Ontario Hydro, as most companies and agencies will apparently use helicopters freely, particularly if they are supplied free of charge, but appear reluctant to pay for them. There are exceptions to this rule, notably the Province of Ontario, and it is hoped that more protective agencies will follow suit, as there is no doubt as to the value of the helicopter in this role.

Other jobs which have been carried out by helicopter are timber cruising, road location, log drives, and transportation of supervisors for inspection. Complete camp supply and personnel transportation by helicopter to save road construction time and costs is a worthy field for the forestry indus-

(*Continued on page 1656*)

Chemical Atomic

The economical production of power from nuclear energy is now a subject of world-wide interest. It is the intention of the *Engineering Journal* to keep abreast of developments in this field, particularly as they affect Canada. This paper discusses one aspect, though a major one—the chemical items in the eventual cost of atomic power. Another paper in this issue deals with the design of Canada's prototype demonstration nuclear-electric power plant.

The attainment of economic atomic power is coming closer but there is still a tremendous amount of development work to be done. One's first reaction is to think that a lot of this will be done by the physicists but this is not so. It is true that all the basic work was done by them, and they will continue to contribute a great deal, but most of the work from now on will be done by the chemists and engineers. The final cost of atomic power will be made up of many items, capital, fuel inventory, operations, fuel processing, etc., and of these the items which could be called chemical are far from negligible. This discussion deals with chemical items only.

There are two rather serious obstacles which limit the discussion. The first is security and the second is the absence of practical experience which comes from designing and operating plants. By making a few assumptions, however, it is hoped that a fairly clear picture can be presented of just how much the chemical operations will cost and in what directions cost reductions may be possible. Only the Canadian viewpoint has been considered.

The first question that comes to one's mind is, "with all the water power, oil, etc., we have in Canada do we need atomic power?" To answer this question the whole energy picture will have to be examined.

Putnam in his book "Energy in the Future"[1] makes a thorough study of the subject from all angles. Briefly his conclusions are that we are now living on our "capital" of fossil fuels and the "capital" is being depleted rapidly. This can best be illustrated by Figure 1. Here the increase in energy consumption is about 4 per cent per annum. This increase is made up of two factors, a world population increase of about 0.9 per cent per annum, and an increase in per capita consumption of energy of about 3 per cent per annum.

The important fact to note is that if the fossil fuels were the only source of energy and the energy consumption curve is as shown, the world's supply of fuel would be exhausted by about 2020 A.D. Nuclear fuels, on the other hand, can produce an estimated 575Q or 575 x 10^{18} B.t.u., which even if the curve was projected on would only last until around 2100 A.D. This is too long a projection to be significant, since the curve has to flatten out eventually and this may happen before 2100 A.D.

Putnam considers that "income" sources of energy such as solar energy, wood, waterpower, can only provide 7-15 per cent of the energy required for the next century at a cost not over twice that of 1950. Therefore fossil and nuclear fuels will have to provide some 65Q during the next century. With only a total of about 27Q available from fossil fuels it is obvious that well over 40Q will have to come from nuclear fuels by 2050 A.D. This clearly indicates that nuclear fuels must be developed. Putnam believes that unless their utilization begins by 1975 the effect of increased energy cost may become noticeable.

Canada's Position

The long range energy picture for any large country in the world will be somewhat as above. It will probably be true for Canada. The short range picture for each country will be a little different depending on local energy sources.

Electricity is the most convenient form of energy so for the rest of this discussion it will be the only form dealt with. Canada is well endowed with water power and it used to be considered that the supply was inexhaustible. This is certainly not true of some areas. It is quite evident[2] that there is still much undeveloped water power but not much left near the area of greatest population and energy consumption — Southern Ontario. In fact this area already has several coal-fired power stations. A plot of the peak load

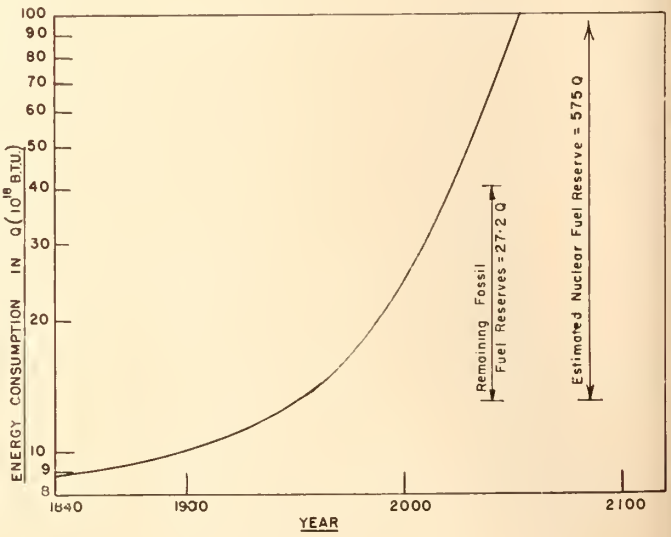


Fig. 1. Predicted cumulative world energy consumption. (Assuming world population in 2050 A.D. will be 6000 million and per capita increase in energy consumption constant at 3% a year.) Fossil fuel reserves taken as all recoverable at twice 1950 costs. Nuclear fuel reserves are uranium and thorium produced for less than $100/lb.

Read at a joint meeting of the Chemical Institute of Canada and E.I.C., Brockville, Ont., Feb. 1955.

Factors in Power Development

by

W. M. Campbell,

Head, Chemical Engineering Branch,
Atomic Energy of Canada Limited.
Chalk River, Ont.

curve for this area shows that the energy consumption is increasing at the rate of 5.7 per cent per year[3] and by about 1962 coal or nuclear power will be the only means of satisfying this increasing demand. Lewis[4] has assessed the power supply and demand in Canada for several decades and after making allowances for expansion in water and coal power he concludes that nuclear power is going to provide a large part of the new demand. His predicted growth of nuclear power is shown in Fig. 2. It is assumed here that nuclear technology can be developed rapidly enough to permit this expansion, but this assumption does not seem unreasonable.

Basic Nuclear Considerations

With the long range need for atomic power established and the short range predictions for Canada presented the next step is to see how much the chemist and chemical engineer will contribute to this. But first some of the basic physics and chemistry of a power reactor scheme will have to be considered.

Most of the reactors use natural uranium, a material which contains one part of U^{235} in 140 parts of U^{238}. Without this small amount of U^{235} a natural uranium reactor would not operate. Uranium 235 is fissile and when a neutron, an uncharged particle made up of one proton and one electron, strikes a U^{235} nucleus the following reactions take place.

neutron + U^{238} nucleus ➤
2 fission product nuclei + 2.5 neutrons (1)

One of the 2.5 neutrons released carries on the chain reaction by striking another U^{235} nucleus. For every U^{235} atom which undergoes fission, one fissile atom is lost but this can be replaced by a second reaction as follows:

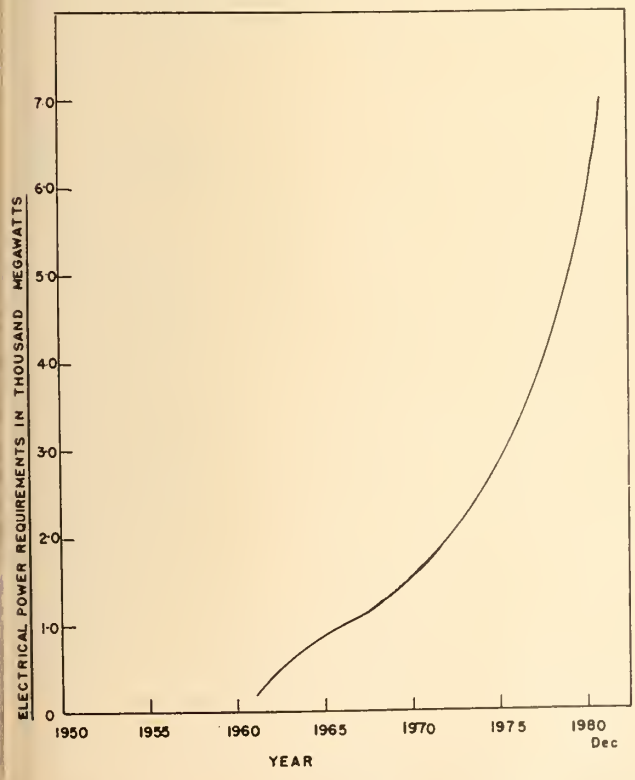


Fig. 2. Predicted growth of nuclear power in Canada. (Ref. AECL report DR 35A).

neutron + U^{235} nucleus ➤
U^{239} nucleus ➤
Np^{239} + β particle ➤
Pu^{239} nucleus + β particle (2)

Pu 239 so produced is fissile in the same way as the U^{235}. The overall result of the two reactions is that the fissile atom concentration remains the same and 0.5 neutrons are left over.

If any part of the 0.5 neutron residue could be made to follow the second reaction the amount of fissile material would increase rather than remaining constant and breeding would result. Under some conditions this has been accomplished. Most reactors are non-breeders, however, and the 0.5 neutrons are lost by escape into the shielding or are absorbed by materials inside the reactor which do not produce other neutrons. One of the major problems in reactor design is to reduce neutron losses, and in all non-breeding reactors more than the 0.5 neutrons are lost thus robbing the second reaction and resulting in a gradual decrease in fissile atom concentration.

The fission products formed by reaction (1) continually build up in the irradiated fuel. Some of these fission products have a very great "appetite" for neutrons. Therefore if they were allowed to accumulate in the fuel eventually there would not be enough neutrons to bring about the useful reactions and the "fire" would go out. Long before this happened, however, the fuel would have to be removed and processed.

There are three main factors which limit the length of time the fuel can be left in a reactor:

(*a*) the fission product poison build-up described above

(*b*) the decrease in fissile material in a non-breeding reactor, also described above, and

(*c*) metallurgical deformation of the fuel elements under irradiation —a factor which is very important when using accurately machined metallic fuel.

Depending on the fuel and reactor design, any of the three factors might be controlling, but for the present discussion it need only be recognized that there is a limit to the irradiation a particular fuel element can take. When removed from the reactor, the element will still contain useful fuel so chemical separations will have to be carried out to remove the fission products

and to reform the fuel for recycling back to the reactor.

The Form of the Reactor

With this description of some of the reactions which take place inside a reactor, it will be of interest to consider the physical form of a reactor. In Canada, the thermal, heavy water moderated reactor with solid metallic fuel is the only type being considered at present. Figures 3 and 4 show a diagrammatic sketch and a photograph of the NRX reactor respectively. The heart of the reactor is a cylindrical aluminum vessel 10 ft. high and 8 ft. in diameter called the calandria. It is very similar to a shell and tube heat exchanger. The heavy water moderator is on the shell side and inside the tubes the fuel assemblies are suspended.

The fuel element, a cross section of which is shown in Figure 5, is a uranium rod 10 ft. long and 1.36 in. in diameter. It is sheathed with aluminum and around the sheath another tube is drawn leaving a narrow annulus for cooling water. Ten-foot tubes are connected to the top and bottom of the sheathed rod and the whole 30 foot assembly is lowered into the calandria through the top shielding. Cooling water connections are made at the top and bottom of the assembly. The two 10 ft. end sections allow these connections to be made outside the shielding. An eight-foot thick concrete shield surrounds the reactor to protect the operators. The NRX reactor now operates at 40 Mw. but all the heat is merely used to heat up the cooling water, i.e. no useful power is produced.

A power reactor might be designed with somewhat the same form but there would be several important differences. If steam is to give an acceptable efficiency in the generation of electricity it must be at least 450° F. Thus if liquid water was the coolant then the whole reactor would have to be under a pressure of at least 400 psi. This would complicate fuel charging and discharging. The heat removed by the coolant would then have to be converted into steam for use in the turbine. This could be done in an external heat exchanger.

The fuel being fed into NRX is natural uranium, and plutonium is recovered from the irradiated fuel but is not recycled. In a power reactor, on the other hand, all the plutonium recovered would be fed back to produce more power and reduce the amount of natural uranium fuel required. The recycled plutonium could be mixed with the uranium to produce a single type of fuel or it could be made into a separate fuel. In the latter case there would be two types of fuel in the reactor, plutonium and depleted uranium probably mixed with some natural uranium. (Depleted uranium is uranium which has been irradiated and contains less than the natural concentration of U^{235}.) Pure fissile material like plutonium would not be used since the heat liberation per unit volume of metal would be tremendous and it would be practically impossible to provide enough heat transfer area. Thus the plutonium probably would be made into a dilute alloy with some metal which would not absorb neutrons appreciably. Aluminum is an obvious choice for the diluent so if this was used the fuel would be a plutonium-aluminum alloy.

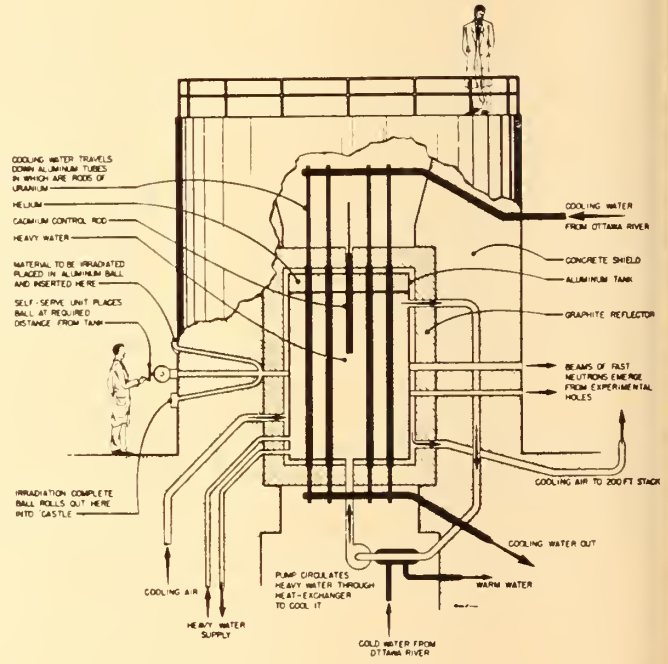


Fig. 3. Diagrammatic sketch of the NRX reactor.

With a two-fuel type of reactor one arangement which has been proposed is to have the plutonium in a central or core region and the uranium in the outer or blanket region. In such a reactor the only reaction taking place in the core would be fission with the liberation of large amounts of heat. In the blanket, neutron capture resulting in plutonium production would be the main reaction although some fission and heat production would also take place. Since this arrangement has a number of advantages the following discussion will be confined to a core-blanket reactor using plutonium and uranium fuel.

Power Reactor Flowsheet

Figure 6 illustrates a type of power reactor plant. Spent core fuel containing plutonium, fission products and diluent would be processed in the core processing plant. Plutonium would be the desired product and fission products the waste. The diluent is also shown as going to waste. This would be dictated by economics but it is unlikely that it could be recovered economically. The plutonium recovered from the core plant would be mixed with that from the blanket plant and sent back to the core for a further irradiation period.

Two products would be produced by the blanket plant, plutonium and depleted uranium. Most of the depleted uranium would be sent back to the blanket. Since a non-breeding reactor has been assumed, more fissile material is burned up than is formed so the loss has to be made up from an outside source. This could be with natural uranium, U^{235} from an isotope separation plant or plutonium from another reactor. In the flowsheet it has been assumed that natural uranium would be used. Only a small fraction of the U^{238} added in the natural uranium will be converted to plutonium so the rest would have to be removed to keep

the U^{238} inventory constant. This depleted uranium would be stored and might be used in some later reactor.

Fission product disposal is a very essential part of the processing. These materials are very radioactive and very dangerous so they must be disposed of in a manner which cannot harm humans or animals.

Quantities to be Processed

As mentioned previously quantitative considerations will be restricted by security and the lack of practical operating and design experience. Sufficient assumptions may be made, however, to give a satisfactory picture of the chemical operations involved.

The optimum size of a reactor depends on many factors some of which will not be known until one or more reactors have been built and run. For the following discussion it will be assumed that a 400 thermal megawatt reactor is the optimum size and that the heat liberation is equally divided between the core and blanket. (1 megawatt=1000 kilowatts). At 25 per cent thermal efficiency the reactor will produce 100 electrical megawatts.

Consider the core first. For every megawatt day of thermal energy produced by fission approximately one gram of fissile material is burned and one gram of fission products is formed. Therefore in the core 200 grams of plutonium would be burned and 200 grams of fission products formed per day. (The heat produced by the 200 grams of plutonium would be equal to about 1300 tons of coal.) The next important question is how high can the fission product concentration be allowed to rise? This is unknown so it will be assumed that the residual plutonium and fission products can have equal concentrations. Therefore the daily production of spent fuel would contain 200 grams of plutonium, 200 grams of fission products and an unspecified amount of diluent.

A similar calculation can be made for the blanket assuming that the uranium would have to be removed when the fission products become 0.3 per cent of the fuel. Since 200 gm. of fission products would be produced per day in the blanket, the amount of blanket fuel to be processed would be 67 kgm. or 147 lb. per day.

In order to reduce costs several

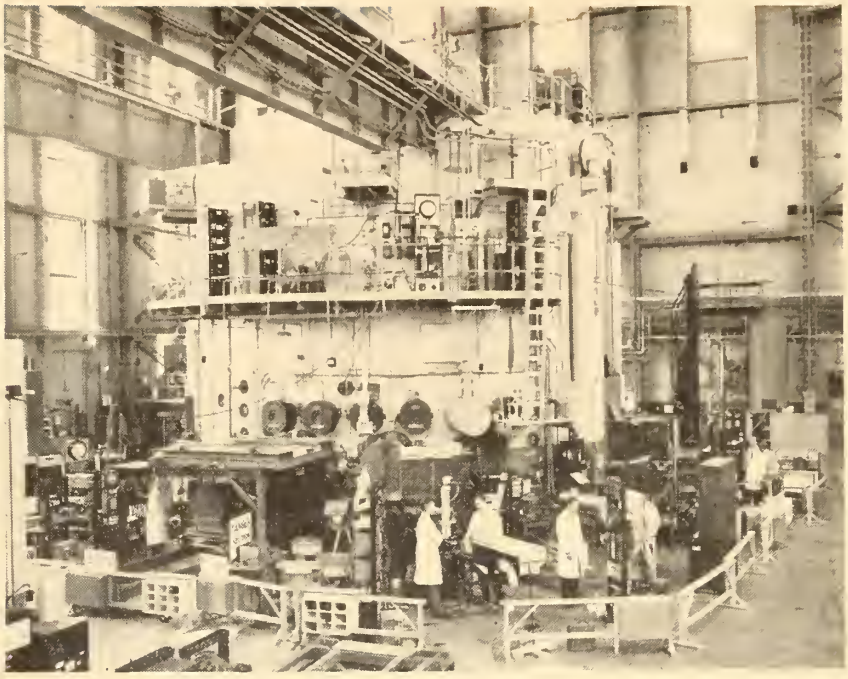
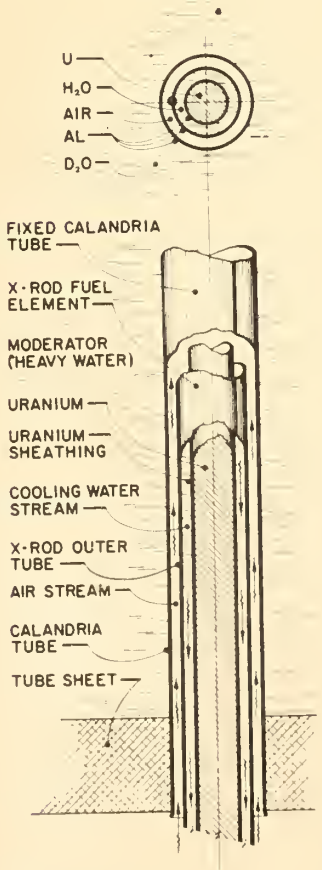


Fig. 4. Photograph of the NRX reactor at Chalk River.

Fig. 5. Schematic diagram of X-rod assembly in calandria tube.



of these 400 megawatt reactors would probably be located in a group. Suppose 10 such reactors would constitute a central power station of 1000 electrical megawatts. Figure 2 shows that such a station would be required by December, 1966. For this station the quantities of fuel to be processed are therefore 4000 gm. of Pu + F.P.'s mixed with the diluent and 1470 lb. of blanket fuel per day. By the usual industrial standards these amounts are small but the intense radioactivity of the material makes the processing difficult and expensive.

The 4000 gm. of fission products produced daily as they come from the reactor would have a combined activity of several tens of millions of curies (1 curie is equivalent to one gram of radium in radioactivity). The activity drops on standing and as shown in Figure 7 the biggest drop is in the first few hours. It only drops by a factor of about 7 in cooling from one day to 100 days. The fuel is expensive and storage increases the inventory charges so the aim will be to process as rapidly as possible. Processing will probably be done with less than a month of cooling which will mean the handling of perhaps millions of curies of fission products per day.

Processing Economics

A number of separation processes might be used and for some of them reasonable cost estimates can be made. This data is classified, however, so the next best approach

is to start at the other end and estimate what the processing costs would have to be if the power is to be economically competitive.

A recent survey[5] shows that power from modern coal-fired stations will be 5½-8½ mils/kwh. in the northeast area of the U.S. Lewis[4] has estimated the cost of the reactor, heavy water, uranium, etc. for an atomic power plant in Canada. The total cost which he arrives at is 7.40 mils/kwh. Only 6.8 per cent of the total or 0.5 mils/kwh. has been allowed for chemical processing. This is equivalent to $3/gram of fission products and includes both the processing and the refabrication of the fuel elements ready for recycling back on the reactor. If this processing objective cannot be met, other items such as the capital cost of the reactor will have to be reduced to compensate for it.

As discussed above the 400 megawatt reactor produces 400 grams of fission products per day. Therefore the allowable processing cost is $1200 per day. This has to be divided between core and blanket fuel. The different steps required are separation and disposal of fission products, forming of the fuel elements, and sheathing of the fuel elements. The cost of the sheath is also included. If zirconium is used for the sheaths this last item is far from negligible.

Some idea of the future magnitude of this chemical processing can be obtained by combining the $3/gm. of fission products allowance with Figure 2. Figure 8 shows the result. In twenty years the cost of processing nuclear fuels could amount to $10,000,000 per year and beyond that time the growth would be rapid.

Larger throughputs would lower the unit costs. Thus if one processing plant handled the output of the 10 reactors in the central power station proposed above the unit costs certainly would be lower. One factor which is peculiar to the processing of fissile material, however, will prevent the full realization of the advantage from large throughputs. This factor is criticality. Fissile material if present in one place in sufficient amounts, in sufficient purity and having the correct geometrical arrangement will become an atomic bomb. There are many fairly easy ways of avoiding this condition but it often imposes a limit to the size of tanks,

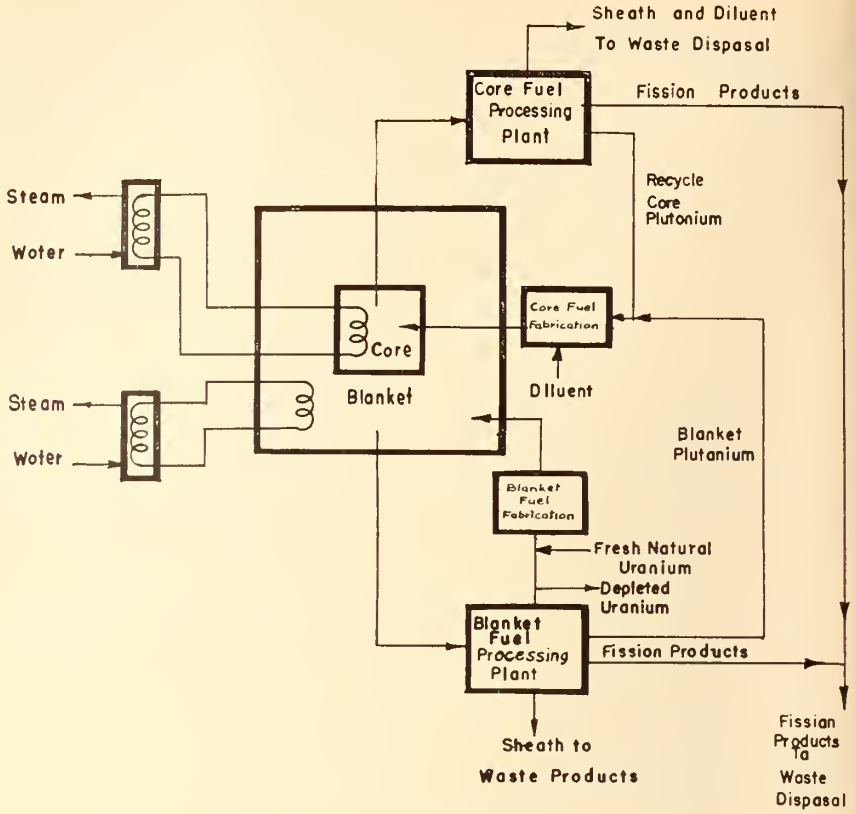


Fig. 6. A power reactor flow sheet.

separation vessels, etc. This may lead to multiplication of units rather than the cheaper method of sealing up.

Heavy Water

All the previous discussion has dealt with the reactor and the handling of the fuels from it. Another important cost item is the moderator. Either graphite or heavy water is used but in Canada the conditions are such that heavy water is preferable. The production of heavy water is almost entirely a chemical operation.

To understand the function of the moderator it will be necessary to refer back to the discussion of what takes place in the reactor. When the 2.5 neutrons are liberated at fission they have very high energies — equivalent to a velocity of about 10,000 miles per second. At these high energies the neutrons do not readily react with the U^{235} or Pu^{239} nuclei and fission is a rare occurrence. If, on the other hand, the neutrons are slowed down to a thermal energy equivalent to about one mile per second fission takes place more readily. The moderator does this slowing-down operation. When a neutron collides with a light nucleus and is not captured it bounces off and in so doing loses some energy. After many such collisions the neutron is slowed down to the thermal velocity. The moderator in addition to containing a high concentration of light atoms (the lighter the better) must not contain any atoms which have a large "appetite" for neutrons. Heavy water, D_2O, combines all these desirable properties to the greatest extent.

Unfortunately heavy water is not readily available. All hydrogenous material contains deuterium with an H:D ratio of about 6900. Ordinary water is one of the best sources of heavy water but in it there is less than one pound in three tons. A few figures will show what this will mean to future atomic power developments. It was pointed out that by December, 1966 Canada would need about 1000 megawatts of new electrical power and that this might come from 10 nuclear reactors of 400 thermal megawatts each. Lewis[4] assumes that each reactor will need 100 tons of heavy water — i.e. 1000 tons would be required by the end of 1966. The major part of this will have to come from natural water. If 8 years are allowed to produce this amount and a recovery of 50 per cent of the D_2O in the water is assumed then the amount of feed water to be handled is 640 gal./min. This will give some idea of the quantity of water to be handled.

Fractional distillation of natural water is a possible way of making D_2O since H_2O and D_2O boil at 100° C and 101.4° C respectively. But it would require about 800 theoretical plates to produce essentially pure D_2O from natural water, and with a plate spacing of 1.5 feet and a plate efficieney of 70 per cent the total column height would be about 1,700 feet. Fractionation of natural water is only one of several possible methods of producing heavy water but whatever method is used it will have to be carried out on the above scale.

The eost of heavy water has been estimated at $83 per pound [6]. Lewis [4] more recently predicted that it could be produced for $30 per pound. But even at the $30 figure Lewis' estimate shows that it would contribute 11.6 per eent or 0.85 mils/kwh. to the total power cost.

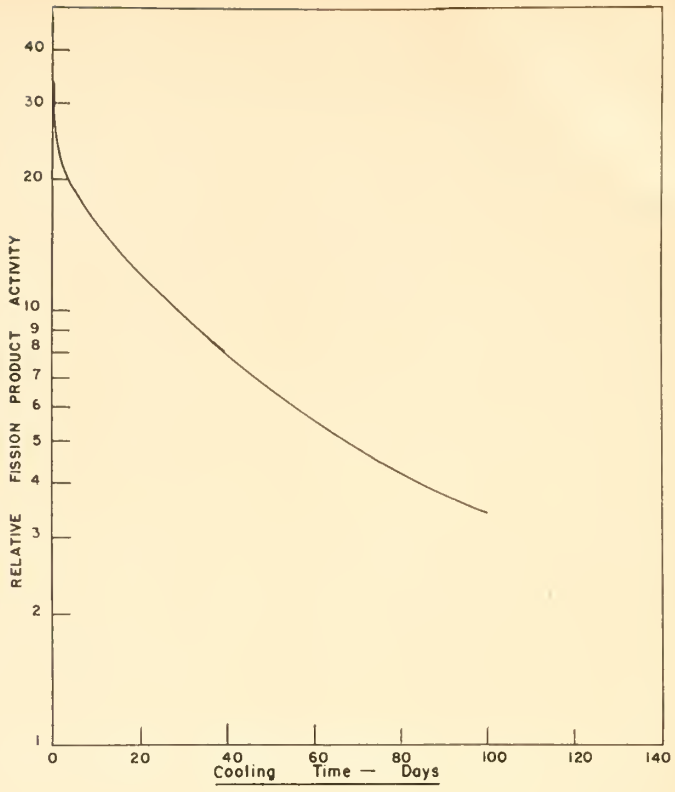


Fig. 7. Radioactivity decay of irradiated uranium.

Future Development

Now that atomie energy is nearing practieal peacetime application, economics will dictate what direction the development will take. In Canada the heavy water moderated thermal reactor fueled with natural uraninm might be the first type of power reactor [4]. Table I shows the predicted cost distribution for such a reactor scheme using solid metallic fuel.

Some of these figures are objectives whieh have not been attained yet but which may be by the time the first plant is ready to operate.

The biggest item is the capital cost of the reactor. Solid metallic fuel complicates the design of the reactor and requires a large amount of handling equipment. This might be greatly redneed by the nse of a fluid fuel. At Oak Ridge a small power reactor was run for some months nsing an aqneous solution of uranyl snlphate as the fnel [7]. Undoubtedly this led to a much simpler reactor design and fuel handling system but there probably were other problems which are not met in metallic fuel reactors. Molten metal fuels having the fissile material either dissolved or suspended have been proposed and some experimental work has been done [8]. On the whole the fluid fuel reactors are very attractive but they will require a great deal of intensive development work before they will be on a practical basis.

Table I.

Predicted Power Costs from a 100 Electrical Megawatt Thermal Reactor[4]

	Annual Charge	Per cent of Total
Generating Plant ($8 M at 13%/year)	$1,040,000	20.1
Reactor ($20 M at 13%/year)	2,600,000	50.0
Heavy Water ($6 M at 10%/year) (100 tons at $30/lb.)	600,000	11.6
Uranium Inventory ($2.4 M at 3%/year) (66 tons at $20/lb.)	79,200	1.5
Uranium Consumption (at 3% burn-up)	160,000	3.1
Fuel Processing (at $3/gm. fission products)	350,000	6.8
Operating	350,000	6.8
	$5,179,200	

cost per kwh. = 7.40 mils

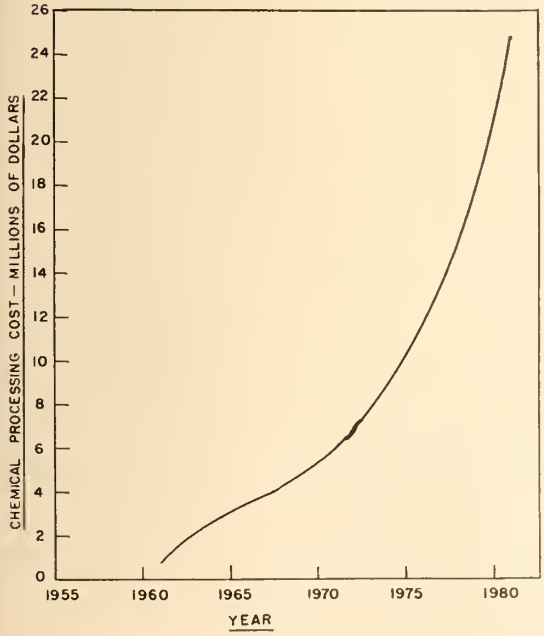


Fig. 8. Predicted annual cost of processing nuclear fuels in Canada. (Based on AECL report DR 35A)

The development of cheap heavy water processes is going to require considerable effort. Eventually heavy water can be regarded as a commodity which the power producers will buy on the open market. In some chemical plants there may be waste streams which are slightly enriched in heavy water, and it may be profitable for the companies running such plants to recover this heavy water either as a partially or fully purified product. The bulk of the heavy water, however, will have to be made in separate plants which will have this as their major product.

Some speculation can be made on how atomic power producers would fit into the normal industrial life of the country. In the U.S. the first industrial power groups formed consisted of both chemical and power companies. This is significant since it emphasizes the importance of chemical operations in atomic power development. This pattern might be followed in Canada. Another possibility might be to keep the power and chemical companies separate, the first to design and run the reactor and the second to supply the fuel, on a normal commercial basis. With this arrangement the chemical company might buy the spent fuel from the reactor, separate the plutonium and uranium for sale to the power company and either dispose of the fission products or sell them if there was a market. Whatever the final arrangement will be the chemical companies have an opportunity ahead of them.

Conclusion

The evidence at the present time shows clearly that large scale atomic power will soon be a reality. The biggest question mark is "when?" But this can only be determined by economics. It is inevitable that the cost of other power will rise and that of atomic power will fall. If a large development effort is made available the cost of atomic power will fall rapidly and the competitive point will soon be reached—perhaps 10 years, perhaps 20 but certainly it will be reached.

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THE HELICOPTER AND THE ENGINEER

by W. H. D. Hanchet

(Continued from page 1649)

tries to investigate, and it is hoped that such an experiment will be conducted. There are reasons why the forestry industries appear slower to embrace the helicopter than others, perhaps beyond the control of the industries themselves, but it is expected that this fertile ground will not remain overlooked much longer.

A specialized application of helicopters having no apparent connection with engineering is that of ice reconnaissance for Department of Transport icebreakers and Arctic supply ships. The Bell helicopters in question not only steer their mother ships through ice fields, but, on occasion, maintain a physical link with the shore to permit specialists to spend more time on shore, and, conversely, to permit the ships to spend less time in port. At some future time, it is not impossible to conceive a development project in the Arctic being supplied by ship based helicopters, in fact a small scale version of such a scheme was effected at Kitimat for a short time.

Another application of helicopters, which, while it does not involve commercial operators or basic industries, is of interest to engineers, is the construction of our Northern radar network. The exact nature, scope and location of this project must remain in a wrap of secrecy, and rightly so, but it is known that transport aircraft and helicopters will play a vital role. It is hoped that security will permit at least part of the story of the airlift to be told at some future time.

These examples, which are not intended to present a complete history, show how present day helicopters are carrying out vital work in the Canadian bush today on a money-for-value-received, i.e., unsubsidized, basis. Our Canadian operators have demonstrated that the helicopter, usually operating as part of a helicopter-airplane team, can provide a rapid, economical and often the only means of transportation in our bush country. In this way they materially assist Canada, and Canadian engineers in particular, in the rapid development of our God-given resources.

Turning to the immediate future, there is no doubt that the present applications of helicopters will continue and expand in scope. As new resources are uncovered, the secondary industries, such as construction, will have ever-increasing requirements for helicopters similar to those which arose at Kitimat. Additional applications depend largely upon the imagination of Canadian engineers. The helicopter industry can only point out what the helicopters can do; what the helicopter can do for you is a matter for you, with your intimate knowledge of your own transportation problems, to decide.

In the distant future, which is any time up to a decade away in the aircraft industry, the possible applications of helicopters stagger the imagination. Perhaps giant helicopter cranes will move prefabricated buildings and bridges from an assembly plant to location over distances of many miles. Perhaps the very nature of our cities will change even more radically than when the automobile came into being.

In any event, the helicopter of tomorrow will be another tool in the engineer's bag of tricks, even as the helicopter of today is.

Acknowledgement

The author wishes to express his gratitude for the co-operation and assistance extended by members of the following organizations: Department of Transport; Department of Mines and Technical Surveys; Department of National Defence; Hydro Electric Power Commission of Ontario; Ontario Department of Lands and Forests; British Newfoundland Corporation; Hudson Bay Mining and Smelting Co., Ltd.; Spartan Air Service, Ltd.; United Helicopters, Ltd. ✓

The Preliminary Design for NPD

by

H. A. Smith,

Director, Nuclear Power Project,
Hydro-Electric Power Commission of Ontario.

To keep abreast of current progress in the field of power production from nuclear energy, particularly in Canada, this paper is published. Originally read at the National Industrial Conference Board Annual Conference, October 1955, in New York, the paper deals with the work leading to the decision to build Canada's first demonstration nuclear-electric power plant. In addition to his position with Ontario Hydro, the author is also head of the Nuclear Power Branch, Atomic Energy of Canada Limited.

During the next few years, the first phase of Canada's programme for development of economical nuclear power will be completed with the construction of a demonstration nuclear-electric power plant in the Province of Ontario. To be known as NPD (nuclear power demonstration), the plant will supply power to the Ontario Hydro System at a location adjacent to the System's existing Des Joachims generating station on the Ottawa River. Design and construction of the plant will be undertaken jointly by Atomic Energy of Canada Limited, The Canadian General Electric Company Limited, and Ontario Hydro.

This paper is intended to describe the objectives, studies and preliminary design work leading to the decision to build NPD. Although the relatively low rating of 20 Mw., and consequent high unit capital cost of this plant, will prevent its unit energy cost from being competitive with that of conventional plants it is believed that the approach adopted in preparing a preliminary design for NPD will, in many respects, be similar to that required to provide an optimum design for a large plant.

Objectives of NPD

In considering the purpose of NPD in the development of nuclear power in Canada, the following conditions are worth noting:

(1) The requirements for nuclear power in any given area are contingent on its cost relative to other sources of power, and on its flexibility for adaptation to systems of various operating characteristics. In Canada, because of substantial undeveloped water power in some areas, cheap fossil fuel in others, and the size or nature of power systems in areas not so favoured, it appears unlikely that any substantial requirement for nuclear power will exist prior to 1963 at the earliest. However, after that time a relatively large potential requirement, depending on the cost factor, is expected to develop, at least in Ontario.

(2) Canada has abundant supplies of natural uranium, but has not built a plant for separating the uranium isotopes.

(3) A very considerable backlog of experience exists in the design, construction and operation of low-temperature research reactors of the natural-uranium heavy-water-moderated type.

(4) Little experience exists in the design of power reactors or in the supporting experimental work required for such design.

(5) Experience with heavy-water-moderated research reactors indicates that this type, designed for power production, is as promising as any for the production of economic nuclear power in Canada.

Under these conditions, it appears logical to undertake the construction of a small plant of the heavy-water type, as a forerunner to subsequent large plants. This, then, is the purpose in constructing NPD. More specifically, the objectives of this plant are:

(i) To demonstrate the generation of nuclear-electric power from a plant of relatively low rating, but of which the scale and design characteristics are adequate to provide information for designing a future full-scale plant.

(ii) To provide a basis for estimating the economics of future full-scale nuclear power produced by "power only" reactor plants.

(iii) To provide a focus for coordinating development work on power reactors.

(iv) To gain experience in the design, construction and operation for such plants, particularly on phases which differ from those obtained from high-temperature loops in research reactors, such as reactor-turbine control.

(v) To train personnel in design and operation.

(vi) To achieve these objectives at relatively low capital cost.

Organization for Preliminary Work

The initial work on NPD consisted of preparing a preliminary outline design for the plant with an accompanying estimate of capital cost, exclusive of site and development costs. This work was assigned to a small group of engi-

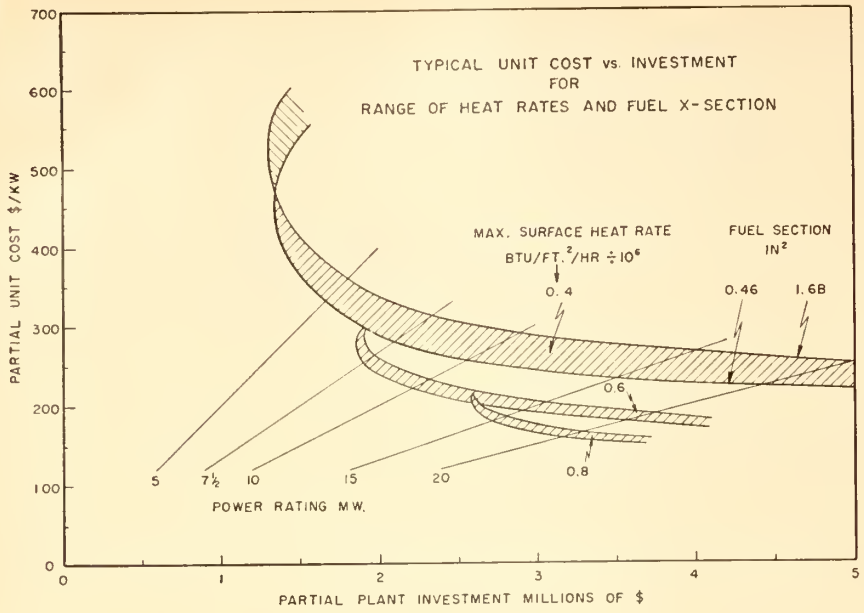

Fig. 1. Typical unit cost vs. investment for range of heat rates and fuel cross-section.

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neers, largely provided by various Canadian companies, which was directed by Atomic Energy of Canada Limited and functioned as a unit of that company. Six members of the group assembled, early in 1954, to commence training. By August, 1954, the number had increased to nine, the intervening period having been spent in training, accumulating and co-ordinating data on material characteristics, and in doing rough cost analyses. At that time the NPD work was assigned to the group with the requirement that it be completed in eight months. During the latter period the group was augmented by two members of A.E.C.L. staff.

In all, the previous general experience of the group averaged 13 years per person covering various electrical and mechanical phases of power system, industrial and chemical development engineering. Only the two engineers provided by A.E.C.L. had recorded previous experience in reactor engineering.

The total effort expended on the preliminary design work for NPD amounted to somewhat less than six man-years.

Scope of Studies

The scope of the preliminary design work was defined by setting conditions with respect to the capital cost of the plant and the type of reactor to be employed.

The condition set on capital cost was such as to limit the maximum rating of the plant to the order of 20 Mw. electrical.

The reactor was restricted to a type employing natural uranium in the form of metal rods, moderated by heavy water and designed for power production only; i.e., no consideration of the value of plutonium produced was intended. Some further restrictions were placed on the reactor, based on previous A.E.C.L. experience and other information. These included the conditions that the fuel should be in the form of long rods, sheathed with a zirconium alloy and cooled by pressurized water.

With the scope of the work thus defined, the preliminary design work was approached in three stages—first, the establishment of an outline specification; second, the determination of a physical design for the entire plant; and third, the preparation of cost estimates.

Stage I—Outline Specification

In order to establish an outline specification for the plant, those factors which were expected to influence plant costs considerably were selected, analyses were made of the economic effect of variations in these factors, and, from these analyses and other considerations, suitable values were assigned to the factors to form the outline specification.

A complete economic analysis of this type would have required the preparation of total unit energy cost estimates for many values of the basic design factors. Such a detailed approach did not appear feasible or warranted in view of the large effort required and the lack of adequate cost information on fuel processing and operating. Therefore, two major simplifications were made in carrying out the economic study.

First: Only capital costs were considered in making economic comparisons. This seemed justified since the contribution of fuel processing and operating toward total unit energy cost is unlikely to be greater than 30 per cent. Furthermore, in unenriched systems of the size under consideration, fuel processing costs may be considered as relatively independent of plant capital cost.

Table I. Outline Specification for NPD

Containment System	—	Pressure Vessel
Coolant	—	Heavy Water
Max. Sheath Temperature	—	550° F.
Max. Surface Heat Rate	—	600,000 BTU/Ft²/Hr.
Max. Fuel Temperature	—	1100° F.
Fuel Sheath Thickness	—	0.030 in.
Coolant Channel Thickness	—	0.125 in.
Mean Moderator Temperature	—	135° F.
Neutron Reflector	—	Light Water
Fuel Geometry (Tentative)	—	Pipe Type Approx. 1.5 in² Cross-Section.
Power Rating	—	Range from 7.5. Mw. to 20 Mw. Electrical
Primary Coolant Temperature	—	490° F.in; 525° F. Out.
Steam Conditions	—	450° F. Dry Saturated
Feed to Steam Generators	—	300° F.

Second: Only a part of the total plant capital costs was considered, on the assumption that the remaining fraction was either independent of the basic design factors or was roughly proportional to the partial cost actually studied. The latter included the manufactured price of basic reactor materials, heat transfer equipment and pumps, main turbine equipment and electrical station equipment.

Although these simplifications resulted in only a relative cost comparison, the method was believed to be adequate for determining the effect on cost, within the prescribed scope of the study, of the following basic design factors: fuel rod geometry, maximum fuel temperature, fuel sheath

thickness, maximum sheath temperature, primary coolant material, coolant annulus thickness, coolant pressure system, maximum surface heat rate, moderator temperature, type of neutron reflector, and plant rating.

The method followed in developing the cost information was straightforward. The work was systematized by design sheets and charts and the group acted essentially as a computer in studying more than sixty combinations of values for the basic design factors. One-group lattice calculations were made for each of these combinations for at least five plant power ratings and, from these calculations, core sizes were determined and reactor material costs estimated. Then for each core so determined, characteristics of a suitable saturated steam cycle were determined and the cost of its equipment estimated. Finally, estimates of the cost of electrical equipment required to handle plant output were prepared. The resulting cost information was then correlated in chart form in terms of fractional unit power cost, fractional investment and plant rating, a typical case being shown in Fig. 1.

From the economic studies, and other considerations, the following conclusions were drawn, and values assigned to the basic design factors as shown in Table I.

(1) Of the two coolant containment systems studied — pressure vessels and pressure tubes—neither exhibits an important cost advantage. However, a pressure vessel offers the advantage of using well-known materials and practices, as opposed to the incomplete information on materials such as zircalloy that would be suitable for pressure tubes.

(2) The use of heavy water as the reactor coolant offers some overall capital cost advantage, although presenting a considerable containment problem because of its high unit cost. However, light water coolant in its competitive cost range implies the use of a lower surface heat rate than is desirable for a future full-scale plant, a larger number of fuel rods to complicate pressure vessel design and reactor operation, and a lower margin of safety in case of accidental displacement of coolant from the rods. These undesirable characteristics leave heavy water coolant as the preferred alternative.

(3) The studies have indicated that the highest practicable sheath temperature is desirable from a cost standpoint. Due to unknowns in the characteristics of zircalloy, the setting of this design factor becomes a matter of choosing a value that may reasonably be met during the next few years. Since the trend in this factor may be expected to be upward as development proceeds, it appears reasonable to set a value somewhat higher than can be guaranteed as satisfactory today. Based on the intention to design the reactor for relatively easy replacement of zircalloy components, and on advice from senior A.E.C.L. and Bureau of Mines personnel, values of maximum sheath temperatures were chosen as 550°F. for two-year service and less, and 525°F. for components intended for longer service.

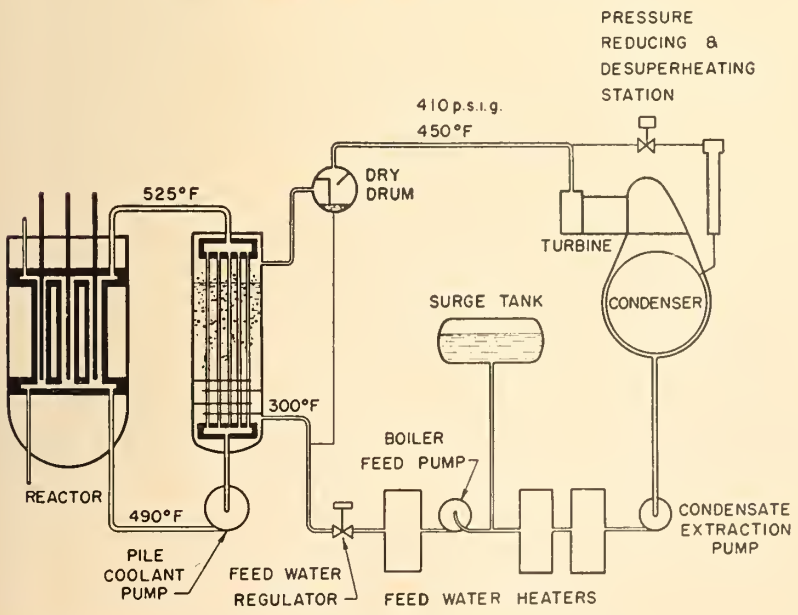
(4) With the preceding factors determined, the economic studies indicate a heat rate of 0.6 million B.t.u./ft²/hr. as the desired value for NPD. Although a higher value might show a small advantage for a 20 Mw. plant, it was considered this would require an unwarranted extrapolation from present design experience.

(5) In the power range of interest, several of the remaining factors showed a relatively small effect on plant capital cost. In general, a high peak fuel temperature, thin fuel sheath, thin coolant annuls and low moderator temperature were indicated. Values for these factors were accordingly assigned somewhat arbitrarily as indicated in Table I.

(6) Of the three reflectors studied, graphite, light water and heavy water, graphite appeared to give minimum capital cost on the basis studied. However, it was felt that its apparent cost advantage might well be offset by costs that would have to be incurred for canning, providing extra thermal shielding for the pressure vessel and for making the necessary allowances for its peculiar change of properties under irradiation. On this basis a light water reflector was chosen, being considerably cheaper than the heavy water type.

(7) Of the fuel geometries studied — clusters of small-diameter solid cylinders, clusters of flat strips and pipe-type elements—some indicated an appreciable effect on capital cost. However, these effects appeared to be largely balanced out, when annual costs of sheathing were capitalized. For this reason, and since a final selection of this factor must be based on irradiation experiments, a pipe-type element of approximately 1.5 in.² cross-section was arbitrarily adopted for physical design work. This type will permit ratings between 7½ and 20 Mw. with the values chosen for the preceding factors, gives a reasonable number of rods, and represents an upper limit for fuel diameter, thereby giving flexibility for choice of other

Fig. 2. Diagram showing the NPD power cycle.



types if subsequently found desirable.

(8) The only other factor studied—plant rating—has, of course, an important bearing on plant cost. Since the overall study was required to indicate the effect of rating, it was decided to develop a physical design and cost estimate for 20 Mw., and estimate cost decrements for 10 Mw. and 7½ Mw. ratings.

Stage II—Physical Design

The second stage of the group's work on NPD consisted of selecting a general physical arrangement for the plant based on the outline specification established in stage I. This was accomplished essentially by pooling various proposals made by members of the group. These proposals were then assessed as carefully as possible in the time available. The assessment was done largely on a qualitative basis supported by rough quantitative calculations where time permitted and where the necessary data were available.

Because of this approach, only very preliminary consideration could be given to such aspects of the design as heat production from irradiation, stresses due to such heat production, shielding dimensions and corrosion conditions under irradiation Thus, at least in the case of the reactor portion of the plant and its auxiliaries, it must be emphasized that the design proposed herein is only tentative and that considerable analytical and experimental work will be required before it can be considered a certain basis for final detailing.

Figure 2 shows an elementary flow diagram for the plant. Heat produced in the reactor is transferred by pressurized heavy water to two steam generators at a temperature of 525°F. The steam generators produce steam from light water at approximately 450°F. which is dried and supplied direct to a saturated steam turbine. It is intended that the turbine have special arrangements for moisture extraction, and, if of more than one stage, may have interstage water separators. Bleed points which would normally supply steam to feed water heaters will also serve as drain points so that the mixture to the feed heaters will be about half steam and half water. The final feed temperature proposed is 300°F. A pressure-reducing and desuperheating station is included to permit continued reactor operation during loss of turbine load, if desired. All other equipment in the power cycle is conventional.

The main section of the plant building provides for a single operating level divided into three main areas—turbine plant area, reactor plant area, and fuel handling area. The turbine area is separated to localize possible contamination. The remainder of the building, of single-storey brick construction, will house the control room, offices, change room, small laboratory and maintenance shop, all at the same level as the main operating floor.

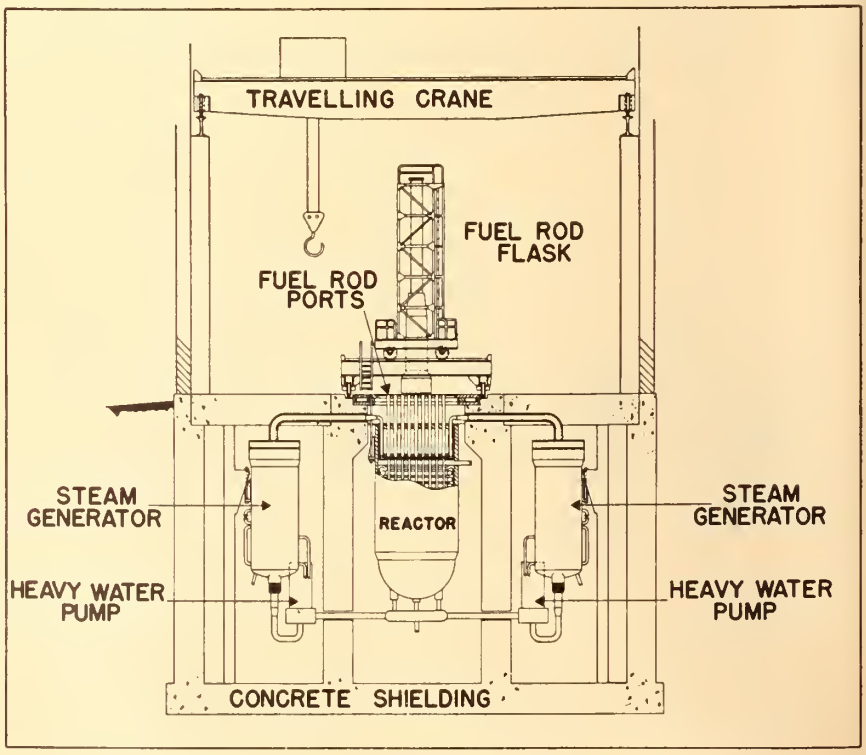
The central reactor section contains the reactor proper, main steam generators, primary coolant pumps, and main reactor auxiliaries, all located directly below the main operating floor, as shown in Fig. 3. The reactor is supported in a silo-type structure which also provides primary shielding for the steam generator pits located on either side. Access to these pits would be permitted only during shutdown and is accomplished through removable concrete panels in the main floor. Fuel changing and discharging operations will be done by means of a mobile shielded flask located on the operating floor of the reactor room. Such operations will only be done in the shutdown condition.

The turbine plant section is located to the left of the reactor plant and houses all of the equipment associated with the steam-electric generation system except an outdoor transformer station which will be located directly behind this section.

The fuel handling area is located to the right of the reactor plant. It includes a water trench system for handling irradiated rods discharged from the flask, facilities for separating, storing and shipping the fuel portions of rods for reprocessing, and facilities for the testing and assembly of new fuel rod assemblies. In addition, a water treatment unit for cleanup of fuel trench water is included as well as a special ventilating and filter system for the reactor and fuel handling rooms.

The reacting core of the reactor proper is contained in a pressure vessel consisting of a central cylindrical section closed with a hemispherical lower head and a cellular type upper head. The upper head is fabricated from parallel tubes, on the same pitch as the fuel lattice, welded into upper and lower tube sheets and interconnected with welded separator strips. This assembly is contained in a cylindrical wrapper to form

Fig. 3. Central reactor section of the plant (schematic diagram).



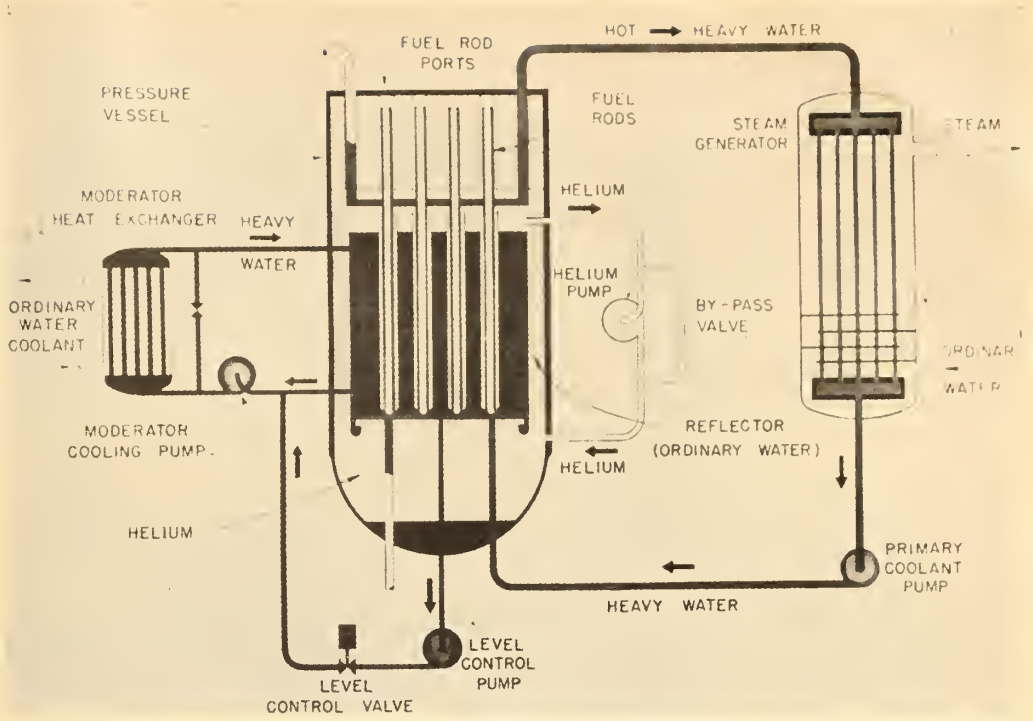


Fig. 4. Schematic diagram of the important circuits in NPD.

the upper head. The tubes are extended above the shell through concrete shielding to the operating floor at which point they are closed by means of screw fittings which permit the insertion of the fuel rod and coolant tube assembly. Interstices in the upper head are filled with circulating pressurized light water to serve as shielding and cooling. The entire shell is of boiler plate construction lined with stainless steel on all internal surfaces.

The upper coolant header consists of two close-spaced stainless steel tube sheets suspended from thin-walled tubes welded at their upper ends to the head tubes. Coolant leaves the reactor through eight of the suspension tubes. A similar, but inverted, arrangement is used for the bottom header, it being supported on a truss at the top of four vertical coolant entry pipes which penetrate the lower shell head. Upper and lower headers are connected by coolant tube assemblies composed of a zircalloy tube and concentric outer aluminum tube. The upper end fitting of this assembly is fastened into the upper coolant header, the lower fitting forming a slip joint in the lower header. In operation, the space between the zircalloy and aluminum tubes is filled with helium, providing thermal insulation between coolant and moderator. These coolant tube assemblies can be withdrawn through the pressure vessel head for maintenance.

The core is surrounded on sides and bottom by a neutron reflector of light water contained in aluminum. The side container is formed of coiled aluminum tubing resting on an internal ring fixed to the pressure vessel, while the bottom reflector is contained in a thin aluminum tank resting on the lower coolant header.

The ring supporting the side reflector is of such shape that it, together with the lower coolant header, provides an annular opening, connecting the core space with the sump space, which in cross-section is a U-tube. In operation, heavy water moderator is pumped into the core space from the sump below and set at a suitable level by maintaining the necessary pressure differential between helium gas occupying the sump space and the freeboard space above the moderator. The helium system supplying gas to the reactor is used to pressurize the entire moderator, coolant, reflector and upper head systems at a nominal pressure of 1200 p.s.i. which prevents the primary coolant from boiling. Four valved lines connect the sump space to the space above the moderator to permit equalization of helium pressure in the two spaces, thus allowing moderator to fall by gravity through the main dump annulus for emergency shutdown.

Fuel rod assemblies consist of a solid steel upper section which is inserted through and seated in the tubes of the pressure vessel head and from this section is suspended the fuel section in the coolant tube assemblies. Each rod is equipped with a throttling orifice to equalize coolant effluent temperatures from various rods. No firm proposal for monitoring has been developed. Coolant flow monitoring by measurement of effluent temperature or pressure differentials is under consideration. Sheath monitoring may be accomplished by measurement of gaseous fission products, delayed neutrons or gamma activity in the effluent.

The main reactor auxiliaries include a moderator cooling system capable of maintaining moderator temperature at any value between about 80°F. and 300°F., an ion-exchange system for heavy water clean-up, a reflector and vessel head cooling system, and a helium system.

Heat is removed from the reactor by circulating the primary coolant through two vertical, straight-tube, single-pass, removable bundle steam generators. Each unit is rated 140,000 lb./hr. of dry saturated steam at 425 p.s.i. from 300°F. feedwater. The primary coolant temperatures are 525°F. in and 490°F. out. The units are of stainless steel construction using small tubes to reduce heavy water holdup. Circulation is provided by two canned-rotor pumps for each unit with no spare pump units provided. The

pumps are so rated that breakdown of a single unit will somewhat limit reactor power, but the plant can continue to operate at reduced rating until repairs can be made. It is believed that the thermo-siphon effect of the cooling system will dissipate shutdown heat.

The control system for the reactor is believed to be unique in that all control and emergency shutdown will be accomplished by moderator level and temperature only, resulting in no moving parts in the reactor vessel. Figure 4 shows the important circuits in schematic form. Moderator level is used as the primary control method. It is determined by adjusting the difference in rate between inflow from the moderator level control pump and the outflow from the core through open drain pipes into the sump space in the lower vessel head. This dynamic system provides fail-safe operation since moderator level falls if pumps or valves fail. In order that differential helium pressure does not control moderator height it is necessary to circulate helium. This is done by constant-displacement pumps which transfer gas from above the moderator to the sump space whence any excess pressure above that required to maintain moderator height is relieved by gas bubbling back through the U-tube annulus and up through the moderator. The rate of bubbling thus imposes an upper limit on the rate at which moderator level may be increased.

A secondary method of control is provided by the relatively slow acting regulation of moderator temperature. This permits operation with maximum moderator height even during periods when the potential reactivity of the core is greatest. Furthermore, it provides a convenient means of overcoming xenon buildup during short shutdowns.

Emergency shutdown is effected by opening valves in the helium pressure equalization lines previously described.

This, then, is a brief outline of the physical design representing the second stage of the group's work.

Stage III—Capital Cost Estimates

The final stage of the preliminary design work on NPD consisted of preparing estimates of capital cost in sufficient detail to form the basis for securing appropriation of funds and for commencement of detailed design work.

Due to the manner and the relatively short period of time in which the physical design information was developed, considerable detail was available for estimating costs in the case of some elements of the plant and very little in others. Furthermore, the time limitation on the work precluded obtaining manufacturers' estimates of equipment costs other than in a few cases. Therefore, costs were derived essentially as follows:

(1) Manufacturers' estimates were used where available.

(2) In cases where design detail was adequate, costs were derived by estimating material, labour, and tooling costs for each of the component parts.

(3) In all other cases, bulk unit prices for material and labour were used. In many cases these were obtained from records of actual work costed during recent construction of similar plant elements. In other cases, estimates were derived from published data on average costs for similar industrial equipment.

(4) For the reactor portion of the plant, a total of 26 per cent was applied as an overhead rate to all material, labour and services, 16 per cent being applied to the remainder of the plant. Corresponding contingency rates used were 15 per cent and 10 per cent respectively.

The cost estimates so derived are shown graphically in Fig. 5 for plants in the range of $7\frac{1}{2}$ to 20 Mw. A partial breakdown applicable to the main sections of cost is indicated. In considering these estimates, it should be remembered that, while some allowance has been made for overhead costs associated with training a design organization, in accordance with the requirements of the study, no allowance has been made for experimental development and site costs. The former may add from 1 to 3 million dollars for a plant of any rating in the range considered.

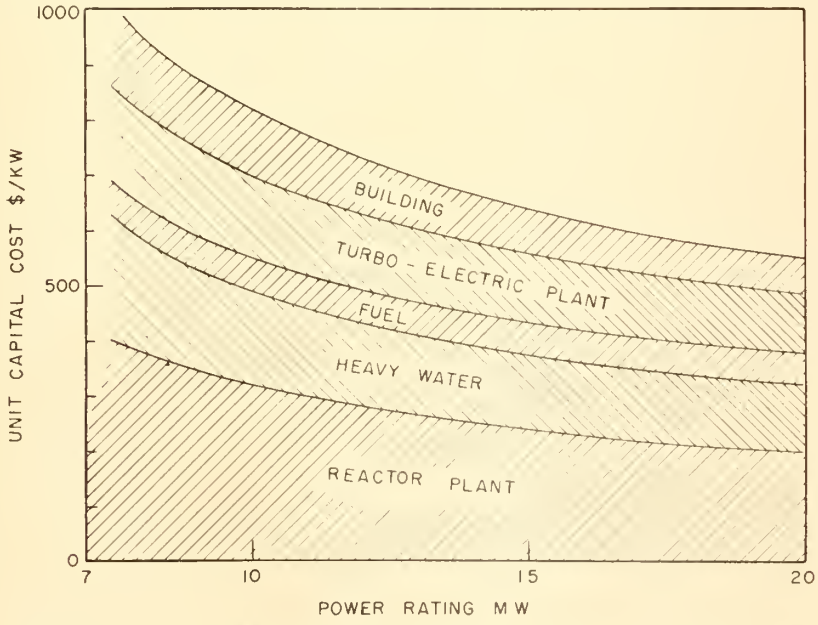


Fig. 5. Capital cost estimates for plants in the range 7.5 to 20 Mw.

Arrangements for Construction of NPD

Following completion of the preliminary design study, Atomic Energy of Canada Limited, the Canadian General Electric Company, and Ontario Hydro agreed to undertake the design and construction of NPD in the 20 Mw. rating, and work is now in progress. Under the agreement, Canadian General Electric will act as the prime contractor, undertaking the design and manufacture of the reactor portion of the plant (less building shell), the construction work for the entire plant, and will contribute design and development costs up to $2,000,000. Ontario Hydro will be responsible for the design and costs of the building and the conventional part of the plant and will provide a suitable site. Atomic Energy of Canada Limited will be responsible for all other capital costs and will provide special development services and data required for reactor design. √

Economic and Design Advantages of

Niagara Hydraulic Models

by

J. B. Bryce, M.E.I.C.,

Hydraulic Engineer, Generation Department,
Hydro-Electric Power Commission of Ontario.

Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May, 1955.

A comprehensive program of model testing was carried out before the recent redevelopments at Niagara. The paper outlines the major problems met, their solution, and estimated economic advantages of the model analysis. Many design advantages were obtained from the use of models.

In the redevelopment at Niagara, from the remedial works in the Niagara river through the intakes, tunnels, and canals, to the Sir Adam Beck-Niagara Generating Station No. 2, many unusual and varied problems in hydraulic design arose. The magnitude of the new Canadian diversion of flow from the Niagara river, up to some 45,000 cubic feet per second, required conveying and controlling structures of large dimensions, which necessitated correspondingly large capital investments. In view of these factors and the complex nature of the design problems, it was considered most advantageous to carry out a comprehensive programme of model testing. While the primary purpose of these tests was to ensure efficient hydraulic design, past experience indicated that in all probability substantial economies would also be realized in view of the large quantities and capital investment involved. In this paper an outline is given of the major problems encountered, their solution, and whenever possible an estimate of the economic advantages of the model analysis.

Use of Hydraulic Models

As hydraulic models are a relatively new design tool, it is thought to be of interest to trace their acceptance into the design program of Ontario Hydro. So far, some fifty-three separate models have been tested by this Commission, the first tests dating back to 1918 at the time of the Sir Adam Beck-Niagara Generating Station No. 1 at Queenston. In Fig. 1 is shown a cumulative plotting of the number of models tested against the date of their test. This graph shows the large increase in the number of tests in the last fifteen years. It should be noted also that these later models are in general much larger and more comprehensive than the earlier ones, and involve much more time and effort. Although the many models tested in this later period are due in a large measure to the many developments that have been constructed in this period, they do illustrate also the increasing confidence in such tests and the value attached to them.

Summary of Niagara Model Tests

To obtain a perspective of the Niagara model testing program, the design features so investigated are shown on the accompanying general plan, Fig. 2, and are summarized below along with the general nature of the problems noted:

(*a*) *Niagara River Remedial Works.*—Design of excavations on the Horseshoe Falls flanks; design of Grass Island Pool control structure.

(*b*) *Niagara River Intakes.*—Location of tubes and required river improvement; detailed design of tubes.

(*c*) *Tunnel Control Gates.*—Analysis of hydraulic loading.

(*d*) *Tunnel Bends.*—Determination of minimum loss bend dimensions.

(*e*) *Tunnel Outlet Structure.*—Design of efficient transition from tunnels to canal.

(*f*) *Canal Crossover.*—Design of intersection of power canals.

(*g*) *Forebay.*—Design of forebay shape and interconnecting canals.

Niagara River Remedial Works

The model studies and investigations leading to the design of the Niagara river remedial works were the most comprehensive of all Niagara model tests. For these investigations, a large model of the Niagara river extending from the Rainbow bridge to the tip of Grand Island and including all the existing intakes diverting flow from the river, was constructed at Ontario Hydro's A. W. Manby transformer station and service centre at Islington, Ontario, in a building designed and built specifically for this model*, of which a photograph is shown in Fig. 3. This building has subsequently been extended and now houses a number of similar models for the St. Lawrence Power project.

The scales chosen for the model were horizontal 1:250, vertical 1:50, thus producing a distortion ratio of 5:1. Because of the great width of the river relative to its

* A full description of this model, the tests carried out, and the solutions obtained, is given in a paper "Niagara Remedial Works" by Dr. O. Holden, Chief Engineer, Ontario Hydro; *The Engineering Journal*, Apr. 1955.

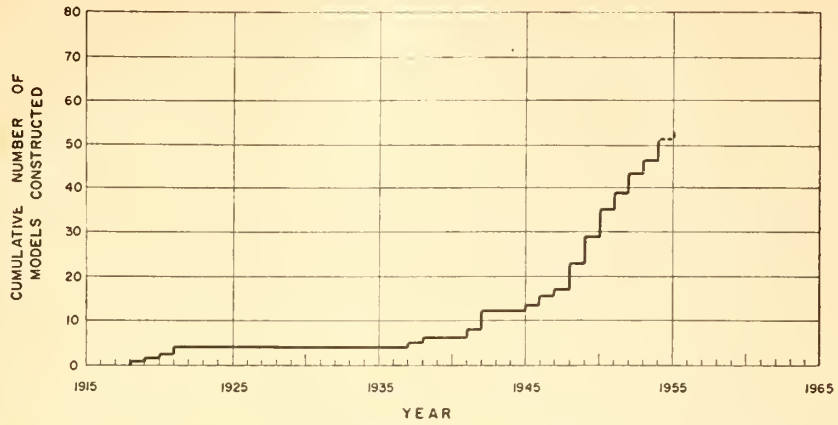


Fig. 1. Graphical representation of the increasing use of hydraulic models by the Hydro-Electric Power Commission of Ontario.

depth, this distortion was necessary in obtaining similar flow patterns in model and prototype. The distortion, however, combined with the different types of flow encountered at the Falls, in the Cascades, and in the Grass Island pool, required original solutions to be made in obtaining the proper bed roughness to produce accurate levels and velocities. As may be seen in Fig. 3, roughness in the form of embedded steel strips was developed to produce similar model and prototype conditions in the Cascades. The verification of the model posed many unusual problems and unique methods were required to obtain prototype information. However, all these problems were successfully solved, and when finally verified, the model reproduced faithfully the known performance of the river and Falls over the full flow and diversion range. The model then became a most valuable and remarkable design tool with the ability to produce accurately any combination of river flow and diversion required.

As described in the paper "Niagara Remedial Works" the effects without remedial works on the river and Falls of the new power diversions authorized by the 1950 Treaty were first determined. Then the remedial works were developed which were necessary to preserve and enhance the beauty of the Falls and enable full use to be made of the additional diversions for power. The model has been found to be of continuing value as the construction of these works proceed. Cofferdam plans have been developed and tested to determine conditions to be met during construction, and to ensure that the work will proceed with a minimum disturbance to river levels. When flank excavations are completed, their performance "as constructed" is double-checked. It might be noted that the model predicted that the first stage cofferdam for the control structure would be self-clearing of ice, and this was completely verified during the heavy ice run this winter.

A similar model, but to different scales (1:360; 1:60) was constructed by the Corps of Engineers, United States Army, at Vicksburg, Mississippi, and yielded very similar solutions and performance. It is felt that this demonstrates the ability of such models to solve problems of this type. It is also believed that only by such model studies could a problem of this nature be solved with any reasonable degree of reliability. Although it is considered that economy was achieved in the solutions obtained, as minimum works were developed to effect the desired results, it is not possible to evaluate the savings attributable to model analysis, as equivalent solutions by other methods did not exist.

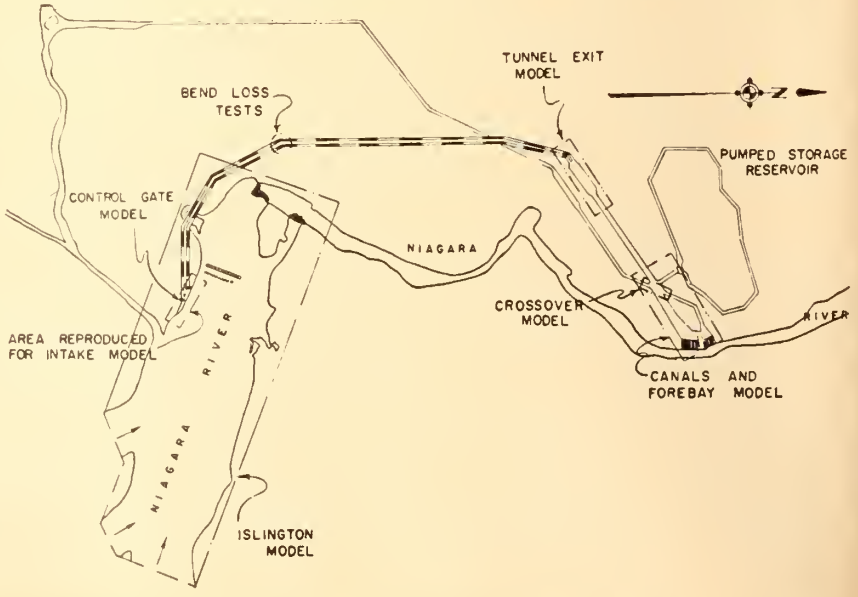
Intake Type and Location

The large Niagara river model referred to in the previous section was also used in determining the best type, location, and overall dimensions of the new Niagara river intakes which would abstract a considerable portion of the river's flow, about 20 per cent on the average, and discharge it into the two tunnels leading to the Sir Adam Beck-Niagara Generating Station No. 2.

In determining the type of intake to be used, the main requirement was that the intake should be able to abstract a large volume of flow from the relatively shallow river, with minimum head loss, and without attracting the ice floes which at times cover the entire surface of the river in this area. Several conventional types of intakes were tested, and also a form of the Johnson - Wahlman tube type of intake, adapted to the special conditions existing at this part of the river. It was proved conclusively that two tube-type intakes, each 500 feet in length, at and parallel to the shore were the most efficient in satisfying the requirements. With the submerged slot through which the flow entered the tube located on the vertical riverward face of the tube, Fig. 4, it was found that the flow entered the tube from below while the surface water and ice proceeded unimpeded downstream.

After testing numerous loca-

Fig. 2. General plan showing situation of features tested by models.



tions, that shown on Fig. 4 was found to be the best. After intensive testing, the river bed excavation shown was also developed to ensure that minimum head losses occurred in the river approaching the intakes, and also to ensure that at least 50 per cent more flow would be attracted toward the intakes than would be drawn into the tubes. This ensured that a sufficient current past the intakes would always exist to carry ice downstream.

Before testing the intake tubes in the model, it was considered that each tube should be about 1000 feet in length and that the river excavation should be considerably more extensive. The model tests indicated, however, that a length of 500 feet was quite sufficient to prevent concentrations of flow which would attract ice and increase head losses, and therefore a considerable saving was achieved as a result of the tests. In round figures this saving is estimated to be:

Savings in intakes tube costs	$1.5 million
Saving in river excavation	0.3 million
Total saving.	$1.8 million

Intake Model Tests

(*a*) *Reason for Large Scale Model.*—Although the large Niagara river model was suitable for determining the type and location of the intake tubes, its distorted scale, horizontal 1:250, vertical 1:50, made it unsuitable for determining the detailed hydraulic design of the tubes themselves. Consequently, a much larger 1:36 natural scale model was constructed at the hydraulic laboratory of the University of Toronto, the model including both tubes and that portion of the Niagara river as indicated in Fig. 2. As the action of the river adjacent to the tubes was most important in the tube design, measurements were made in the large Niagara river model of the flow distribution, velocities, and levels in this portion of the river and these were carefully reproduced in the intake model.

(*b*) *Design Requirements and Scope of Tests.*—The fundamental design requirements of the intake tubes were:

(i) An approximately uniform draught should exist along the full length of each tube under all flow conditions thus preventing concentrations of flow which would attract ice.

(ii) A minimum head loss consistent with other requirements.

(iii) A submergence and action such that the surface flow conditions would carry ice downstream past the intake.

(*c*) *Description of Model and Scope of Tests.*—Tube No. 1 was first constructed and tested in the model, followed later by tube No. 2. In each case the tubes were so constructed that interior dimensions, slot height and position, and pier angle and spacing could all be readily varied to ensure the optimum design of these elements. A theoretical design was first constructed and tested, but it became immediately apparent that the distribution of flow and the relatively high velocity in the Niagara river approaching the tube would require extensive revisions to the design to satisfy the requirements. All the elements of the tube were then systematically varied until a final design was achieved which satisfied the criteria.

The detailed findings in connection with the development of optimum tube details will be found in another paper.* In the present paper, the remarks will be con-

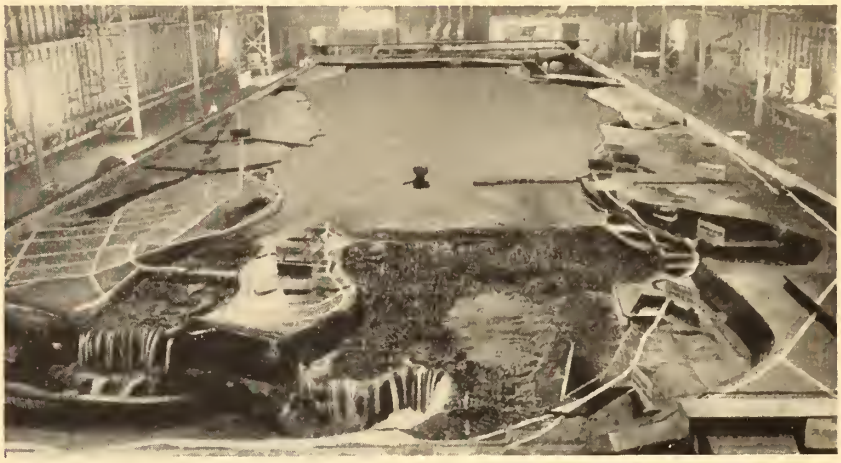


Fig. 3. General view of Niagara River model at Islington.

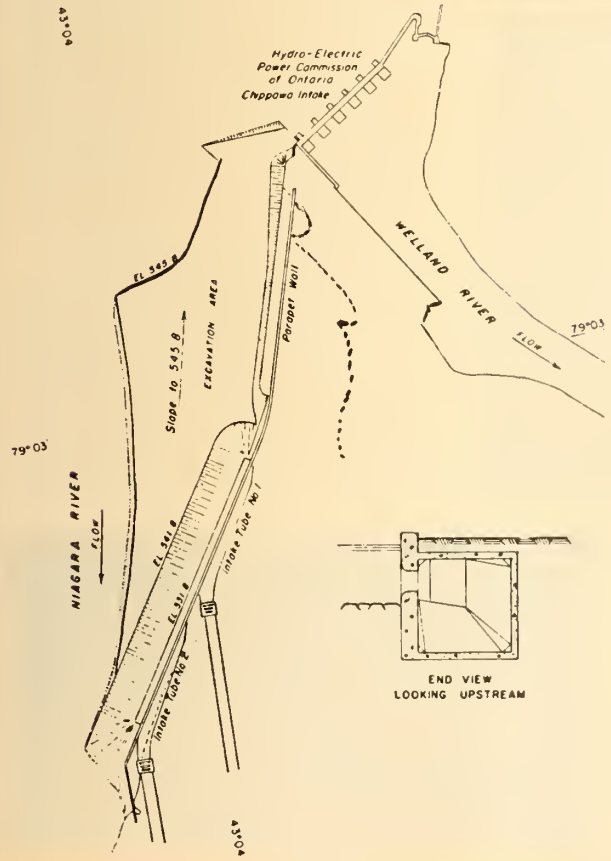


Fig. 4. Sir Adam Beck Niagara G.S. No. 2: location of intake tubes and river dredging.

* "The Intakes for Sir Adam Beck-Niagara Generating Station No. 2" by O. E. Johnston and D. G. Harkness, *The Engineering Journal*, Oct. 1955.

Fig. 5. Vortex in original intake design photographed through transparent plastic top.

fined to a discussion of some of the particular findings which may be of general interest.

(*d*) *Effect of Tube Shape on Performance.*—The effect of the shape of the tube on its performance was found to be very important. The original design tested had a 45-foot square cross-section throughout. As the invert of the tube was considerably below river bed level, the slot of necessity was located in the upper half of the vertical face, as indicated in the sketch in Fig. 4. This, combined with the high approach velocities, produced a remarkable condition inside the tube. The flow entering the tube produced spiral flow which set up a high-speed air-filled vortex extending the length of the tube. In Fig. 5 is shown the vortex in action through the plexiglass top of the model tube, its limits being outlined by colour injection. It is of interest to note that colour or light objects injected into the vortex worked their way upstream against the flow of the tube.

After many tests, it was found that by progressively reducing the size of the tube from the downstream end to the upstream end, the vortex action was eliminated and only a very slow spiral remained. Figure 6 shows the final model design in operation. It is of interest to note that the reduction in tube area to this degree did not increase the head loss in the tube, but any further reduction could not be made without an increase in loss. As is usually the case, the best design was also the most economical, and in this case the final design resulted in a saving in construction cost of some $400,000 over the original design tested, by the elimination of tube volume which was not only unnecessary but actually troublesome.

(*e*) *Effect of Approach Flow Conditions on Slot and Pier Design.*—It was found that the theoretical design of the slot shape and angle of the piers had to be greatly modified by the approach flow conditions encountered in the Niagara river. The distribution, velocity, and direction of the approach flow varied along each tube and this required a special combination of slot shape and pier angle to ensure uniform draught distribution. In tube No. 1 it was found that all piers could be kept at 45 degrees and the slope tapered uniformly from upstream to downstream. In tube No. 2, to keep the slot height within required limits, pier angles of 55 degrees, 45 degrees, and 40 degrees with the front face were required.

Figure 7 shows the final model designs for tube 2. Here conditions more nearly approach those of a lake, and it is probable that under a true lake condition a continuous change of pier angle would be necessary. A minimum submergence of 8 ft. in tube No. 1 and 6.3 ft. in tube No. 2 was found satisfactory in preventing any surface disturbance. As the slot decreased in height and the entering velocity increased proceeding downstream, the reduction in slot height was made by lowering the slot top, thus increasing the submergence as the entering velocity increased.

(*f*) *Comparative Performance, Prototype and Model.*—Although full scale prototype tests have not yet been made (Apr. 1955), certain observations are of interest in comparing the model and prototype performance. In the model, the flow entering the tube all came from below the surface, while the surface current continued downstream parallel to the intake. Observation of the prototype tubes indicates the same action, floating objects and ice, of which a heavy run occurred this winter (1954/55), all proceed downstream parallel with the intake and with no tendency to be stopped or be drawn into the intake. Although construction conditions in the river have as yet prevented precise head loss comparisons to be made, one comparative observation of head loss between gauge No. 5 at the original Queenston intake, and the energy level in the No. 1 intake tube at its downstream end, indicate good agreement. These head losses for a No. 1 intake tube flow of 20,000 c.f.s. were: model 1.1 ft.; prototype 1.2 ft.

Fig. 6. Final design of intake tube No. 1, in operation.

Fig. 7. Final slot and pier design: intake tube No. 2.

Tunnel Control Gate Tests

Some interesting results were obtained from tests of a model of the very large control gate, 48 ft. 4 in. wide and 58 ft. high, which is installed immediately downstream from each intake in the 45-ft. square covered conduit connecting the intakes with the tun-

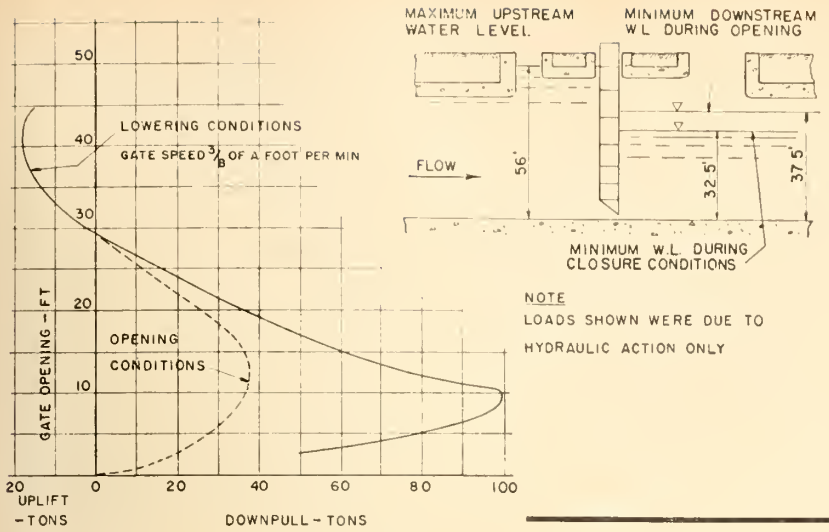


Fig. 8. Tunnel control gate model. Vertical hydraulic loads under operating conditions.

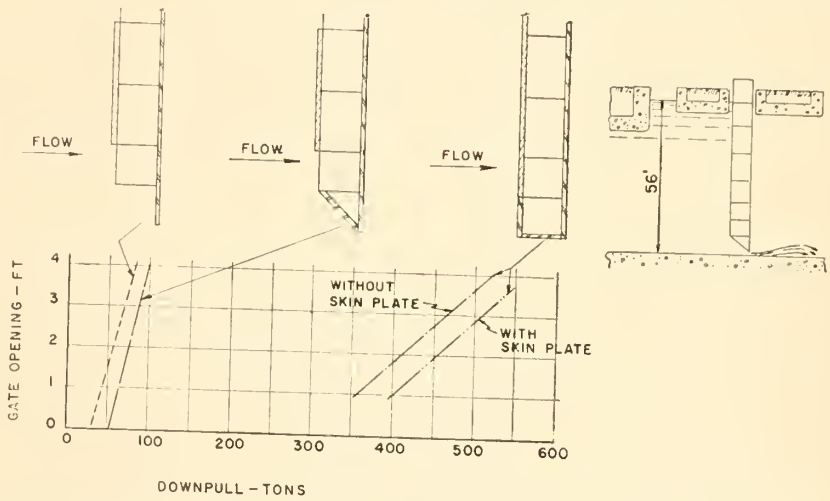


Fig. 9. Tunnel control gate model. Comparative vertical loads for various gate bottom designs.

nels proper. A transition from the 45-ft. square conduit to the 45-ft. diameter tunnel takes place immediately below the gate. The gate is designed for the following duties: (1) to close under full load tunnel flow; (2) to open under full upstream head and forebay level downstream; (3) to open under full upstream head and no tailwater level, i.e., empty tunnel. The speed of travel of the gate is set at ⅜ ft. per min. as the result of other studies where surge and water hammer effects in the tunnels were investigated.

The gates were designed and constructed by the Dominion Bridge Company but in view of the size of the gates and the magnitude of the tunnel velocities, about 10 ft. per sec. at the gate under design flow, it was decided that a model would be constructed by Ontario Hydro of the gate to determine the actual hydraulic forces that would exist under design conditions. An extension was made to the 1:36 scale intake model, and a model of the gate installed with the general arrangement of the model gate and measuring apparatus. The hydraulic load measurements were made by electrically indicating strain gauges mounted in the wheel supports and in the hoisting apparatus. These gauges indicated loading by the amount of change in surface strain which took place in their mountings and were connected by wires to an electrical bridge circuit which indicated the movement in micro-inches.

The forces to be investigated and measured in the model were:

(1) The horizontal hydraulic thrust on the gate as it lowered into the full load tunnel flow.

(2) The vertical hydraulic loads, i.e., uplift or downpull, when the gate: (*a*) lowered into the full load tunnel flow; (*b*) opened with forebay pressure back of the gate; and (*c*) opened up to 4 ft. under full upstream pressure and with an empty tunnel downstream, i.e., in order to fill the tunnel.

With regard to the horizontal thrust under lowering conditions, it was found that at all times it was less than the static thrust with the gate closed with no tailwater, which was a further design condition. The results of the vertical loading tests are shown in Fig. 8 and 9. In Fig. 8 is shown the variation and magnitude of the hydraulic downpull and uplift as the gate is lowered and raised under operating conditions. In Fig. 9 is shown the observed downpull when the gate is raised up to 4 ft. with an empty tunnel downstream. As downpull forces were large, a number of modifications were made to the gate bottom to determine how the shape affected the downpull. Three such shapes are shown in Fig. 9 and their resulting downpull. The great increase in downpull with a square bottom may be noted. As a result of these tests, a satisfactory gate bottom design was chosen and the hoisting apparatus designed for the loads to be encountered.

Tunnel Bend Loss Tests

The alignment of the 45-ft. diameter tunnels required eleven bends in tunnel No. 1, and ten bends in tunnel No. 2, the majority having a deflection angle of about 30 degrees. In view of the size of the tunnels, the number of bends, the scarcity of information on bend losses other than 90 degrees, and the great value of minimum head loss, it was decided to make laboratory tests of bend loss to determine the optimum R/D ratio, bend radius to pipe diameter, for a bend, and the actual bend loss coefficient.

A very intensive series of tests were made using 6-in. pipe and bends of 30, 60, and 90 degree deflection angles. Bends of five different radii were used producing ratios of R/D from 1.42 to 41.37.

In Fig. 10 is shown the results of these tests, the bend loss coefficients being plotted in relation to the R/D ratio. From these results, R/D ratios were chosen for the tunnel bends which would give minimum bend losses, and the bend losses coefficients were used in estimating the total losses from the bends. While it is fully recognized that the 6-in. pipe produced

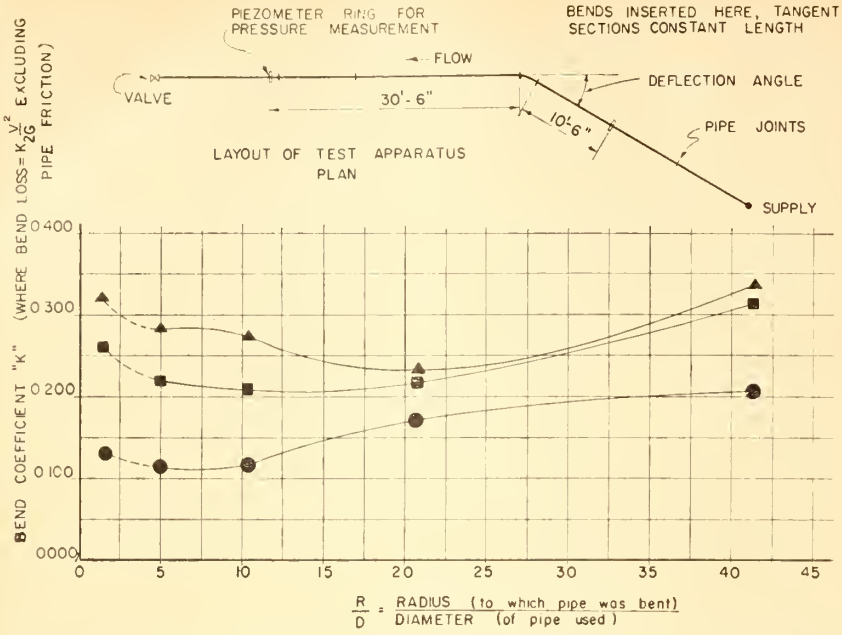


Fig. 10. Bend loss coefficient curves obtained from tests on 6-in. dia. steel pipe (actual dia. 0.4835 ft.). Effect of friction in pipe forming the bend is not included in bend loss coefficient. Deflection angle: ● 30°; ■ 60°; ▲ 90°. Reynolds No. range 200,000 to 450,000. Velocity range 4.5 to 11.0 f.p.s.

Reynolds numbers much below the 45-ft. tunnel, it is felt that the R/D ratio giving the minimum bend loss would remain virtually unchanged and the bend loss coefficient would be conservative, as the larger tunnel would probably produce lower bend losses. In the writer's opinion, these results are a valuable addition to bend loss literature, as they indicate the relative effect on bend loss of a good range in R/D ratio and a deflection angle range of from 30 degrees to 90 degrees, using precisely the same pipe in each case.

Tunnel Outlet Model

At the downstream end of the tunnels, the problem arose as to the most efficient manner in which the relatively high velocity tunnel flow should be brought to the surface and introduced into the trapezoidal canal leading to the plant. The transition from the trapezoidal canal to the rectangular canal, which took place some distance downstream was also to be investigated.

A 1:60 scale model was constructed at the University of Toronto for this investigation, the model including both tunnels and bends approaching the outlet portal, the outlet portal itself, the transition from portal to trapezoidal canal, the trapezoidal canal and the transition from trapezoidal to rectangular canal.

To bring each tunnel to the surface and into alignment with the canal, three bends were required, one horizontal and two vertical. Preliminary designs had the tunnel bends arranged as shown in Fig 11, with the horizontal bend some distance upstream from the vertical bends. The model tests showed, however, that the overall head loss could be redueed if the horizontal bends were moved downstream to immediately before the vertical bends. It was found

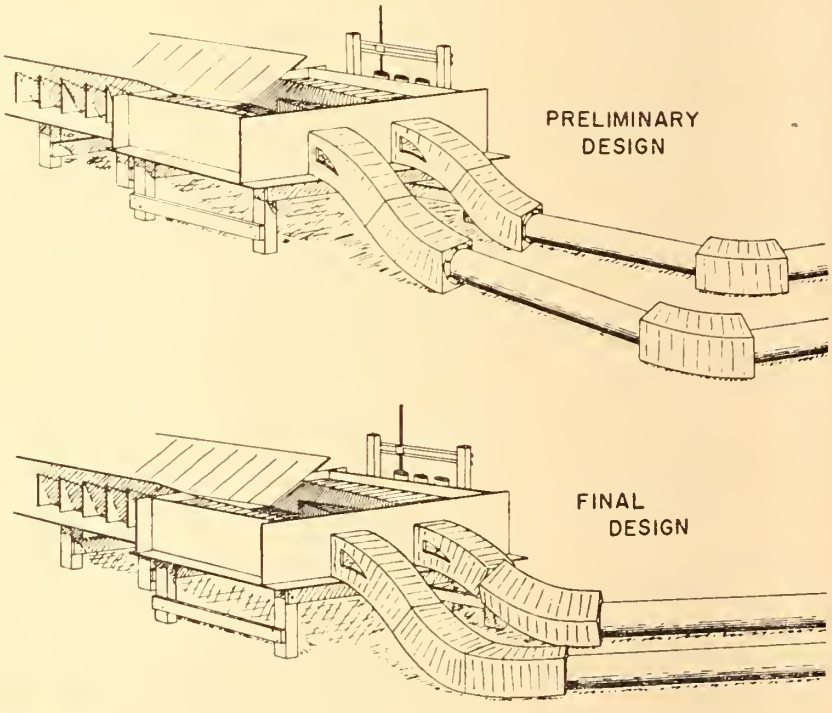


Fig. 11. Niagara tunnel outlet model. Preliminary and final design of tunnel bends.

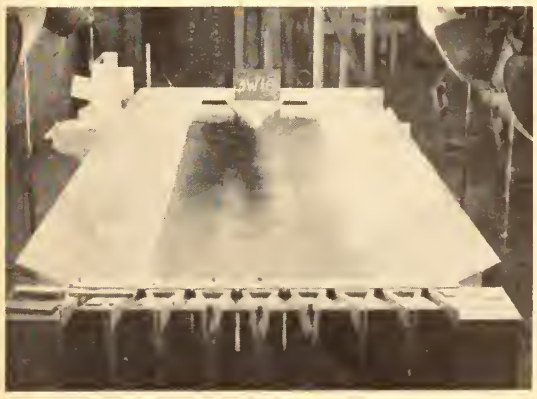


Fig. 12. Tunnel outlet transition in operation; No. 2 tunnel flow coloured.

even more effieient to merge one horizontal bend with one vertical bend into one inclined bend, and this was done in tunnel No. 2 as shown in Fig. 11, final design. Tunnel No. 1 could not be treated in this manner because of minimum clearance requirements between the tunnels. As indicated in Fig. 11 the bends in the model were built up from tapered laminations of plywood which explains the square outward appearanee, the interior water passage being,

Fig. 13. Model of canal cross-over in operation.

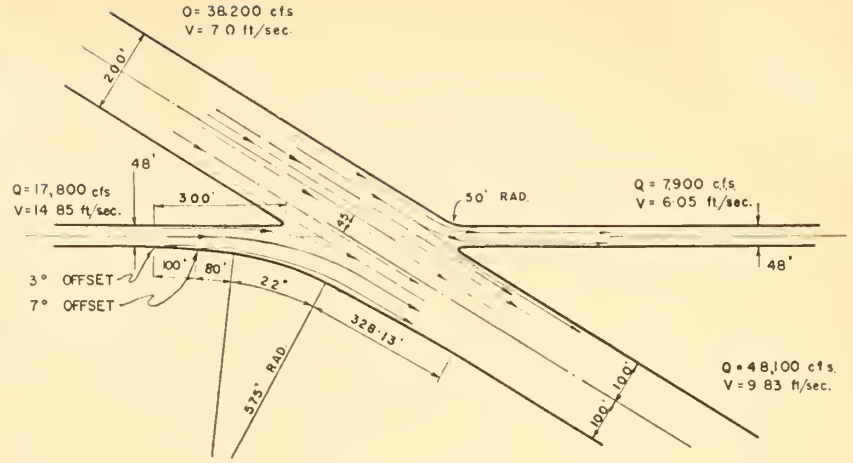


Fig. 14. (Right). Canal crossover model: design conditions and plan developed.

of course, of circular cross-section.

Many tests were made on the transition between the portal and the trapezoidal canal and a design was developed which produced a very smooth reduction in velocity with almost no eddies, turbulence, or dead areas. The transition in operation is shown in Fig. 12, where both tunnels are discharging their maximum flow, with that from No. 2 being coloured to show its action. A similar performance was achieved in the transition downstream between trapezoidal and rectangular canals.

As a result of these tests, a reduction in head loss at the outlet of the tunnels of 1.3 ft. was achieved, which in capital terms would represent a saving of well over one million dollars.

Canal Cross-over Model

The canal cross-over model was perhaps the most interesting and most productive of savings in construction cost and effort of all the models tested. The location of the new Sir Adam Beck-Niagara Generating Station No. 2 was upstream from the No. 1 plant, and a direct line from the tunnel outlet to the new plant crossed the old power canal at an angle of about 32 degrees. If the new canal could proceed on this line and cross the old canal at the same grade and water level, then very substantial savings would result, as the alternative would be a costly inverted syphon under the old canal, or a costly circuitous route for the new canal via the old No. 1 plant forebay.

The crossing of the old canal, 48 feet wide, and with velocities up to about 15 feet per second, with the new canal 200 feet wide with velocities up to about 7 feet per second, at the same grade and water level, and without a large energy loss, appeared to be a most formidable design problem. However, when tested in a model, a very simple and effective solution was found.

A 1:60 scale model of the canal intersection was constructed at the University of Toronto and the intersection conditions studied, the model being shown in action in Fig. 13. In Fig. 14 are shown the elements of the crossing and the solution obtained. Originally it was the intention to have the old canal carry the same flow from, as well as to, the intersection, and a solution was obtained on this basis. However, later studies indicated that an interconnecting canal between the two forebays would produce less total head loss and be more efficient in distributing the flow, and this permitted the flow from the cross-over in each canal to be on the basis of its carrying capacity for the same head drop. The design flows entering and leaving the cross-over thus became as shown in Fig. 14.

It soon became apparent in the model that the crossing or intersection was actually a merging and redistribution area. A simple solution was found to achieve this distribution efficiently. First the old canal was gradually widened approaching the crossing so that its velocity was efficiently reduced to about that of the new canal where they merged. Next, the centre line of the new canal was offset 45 feet as shown in Fig. 14. By this offset, area was provided for the old canal flow to proceed smoothly into the new canal, and at the same time a portion of the flow approaching in the new canal was deflected into the old canal upon leaving. This merging and redistribution of flow is indicated graphically by stream lines in Fig. 14. Offsetting the centre line was the major discovery of the tests.

Fig. 15. Prototype canal cross-over in operation. Note flow interchange visible due to water discoloration.

If more flow was to be defleeted into the old eanal, then the offset would be proportionally increased. The required amount of offset was found to be proportional to the amount of flow interchange.

Careful observations in the model predicted is obtained in Fig. ciable energy loss beyond that of normal channel friction occurred in the cross-over.

An indication that the prototype cross-over will perform as the model predicted is obtained in Fig. 15, which shows the flow in the old canal, discoloured by a storm, entering the new canal. Although at the time the photograph was taken the cross-over construetion was not complete and design conditions not realized, the aetion appears identical to the model performanee.

Comparative estimates of alternatives indicated that the canal cross-over scheme enabled savings of some $2.25 million in construction cost to be made and enabled a much simpler construction plan to be followed. An appreciable reduction in overall head loss was also achieved.

As noted in the next section, a pump-storage canal was later added near the cross-over, but this addition did not affect the basic design deseribed in this seetion.

Canals and Forebay Model

To investigate the optimum dimensions of the forebay for the Sir Adam Beck-Niagara Generating Station No. 2, the approach canals, and the canal interconnecting the forebays of the Nos. 1 and 2 plants, a 1:90 scale model was constructed at the University of Toronto. As shown in Fig. 16, this model reprodueed both forebays and both the new and old canals to points well upstream from the eross-over.

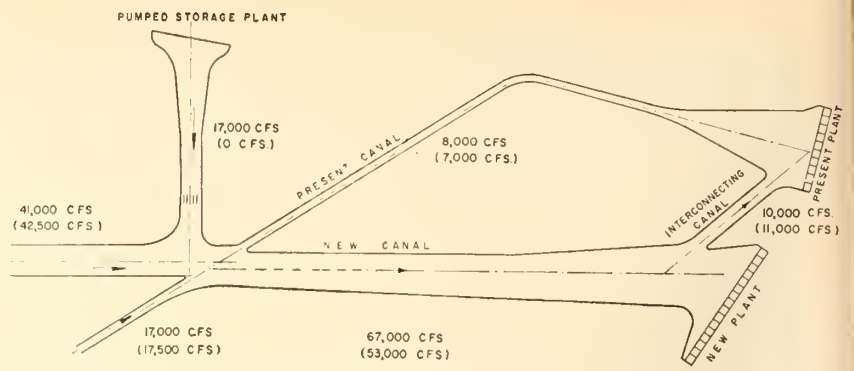


Fig. 16. Canals and forebay model: final design. Flows shown for average river levels; figures in parentheses indieate no pump storage flow.

Tests on the original No. 2 forebay design indicated that the flow would not expand at the rate provided, and serious back eddies occurred. After intensive tests, the original design was modified to provide the maximum expansion that the water would follow, and the walls of the forebay actually trace the streamline for maximum expansion. In Fig. 17 is shown the final design of the forebay. The interconnecting canal was placed such that all its area would be effective, and it was found that its width could be reduced from that originally planned. The design of the forebay and interconnecting canal eliminated all back eddies and all area was effective. In so doing, a saving of some $800,000 was made possible compared to the original design.

When it was decided to proceed with the pump-storage plant, another series of tests were made on this model to determine the best location and design of the pump-storage canal. This is a reversible flow canal which withdraws water from the main canal during the filling of the reservoir, and discharges water back when the storage is being withdrawn. In Fig. 16 is shown the location found by the model to be best for this canal. This location produced the minimum energy loss in the system and gave the best flow distribution for the storage water. The tests also indieated the best canal entrance dimension to give least loss under either inflow or outflow eonditions.

Summary of Advantages Obtained

As indieated in this paper, many design advantages resulted from the Niagara models. The Niagara river remedial works and the eanal cross-over posed design problems, which in the writer's opinion, could only be solved by model tests. Without model tests, the intakes would not have functioned efficiently due to the special velocity eonditions eneountered in the Niagara river. Tests on the other features—the control gates, the tunnel bends, the tunnel outlet structure, and the forebay and conneeting eanals, enabled much more efficient designs to be produced.

The essence of efficient design is economy, and it is considered to be of interest to summarize the known savings in construction cost attributable to the models. These are:

	$ Millions
Niagara river intake models	2.20
Canal cross-over model	2.25
Canals and forebay model	0.80
Total	5.25

In addition to these savings in construction eost, the models also reduced head losses between the Niagara river and the forebay, equivalent to a capital saving of several million dollars. It should be pointed out, however, that these figures do not represent the total economy of the models. In cases such as the Niagara remedial

(*Continued on page 1674*)

Fig. 17. Model of forebay and canal: final design of new forebay with colour showing adherenee of flow to walls.

The Tide and the Crisis

by

Dr. G. E. Hall, F.R.S.C.,

President and Vice-Chancellor,
The University of Western Ontario.

Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, May 1955.

The subject of future education in Canada is of particular significance to the engineer. The whole progressive world is concerned about the source of men trained for future developments in technology; the rapid growth of Canada accentuates this problem, which is boldly presented by one of Canada's leading educators.

From one end of Canada to the other, throughout the United States, in Great Britain and in every part of the Commonwealth, the universities and colleges have been examining their place in the changing modern society. They have been singularly self-critical. They recognize that they are far from being perfect. They admit that they are seriously worried. They are extremely conscious of their responsibilities and at the same time are aware of the difficulties of meeting obligations in the face of almost general misunderstanding on the part of the public of the purposes of education, of the place of education relative to society, of what a university is and of what a university must always be.

Not only have university people been worrying about these ever-growing problems within their own faculty meetings, over the luncheon table and in general discussions, but they have also been worrying about them out loud—on the public platform, in the press and on the radio. And in the face of these near-insurmountable problems, and at a time when their solution is so vital, there are now more worries and more problems which have been heaped upon the shoulders of the universities. These new problems, unlike the basic problems which are fundamental, are concrete problems — problems of a material, substantive nature — simple problems of economics coincident with a growing nation.

The new major forces influencing the future of higher education in this country are so significant, I feel, and the changes to be wrought so far-reaching, that they should be thoroughly understood by all of us within the universities and appreciated by all citizens who believe in education and educational opportunities. A few facts will, I think, serve to introduce the problems of student enrollment and finances. These are the new modern problems facing the universities today and so serious are they that they are even pushing aside the deeper and more fundamental problems which must be solved if universities are to remain universities.

Stated bluntly, perhaps, the new problems have arisen because Canada's population has doubled in the past forty-five years — from 7.6 to 15 millions of people. Periodic immigration has been a factor in this increase, but of more significance has been the actual number of births. During the depression years (1930-38) the number of births per annum was approximately 220,000. By 1945 this figure had increased to 350,000 and by 1953 to 380,000.

Today, the universities of Canada are serving some 55,000 students. These students represent the "depression babies" of the low birth period. But since that time the birth rate has been increasing. Even in the past ten years the birth rate in Canada has increased from 20.5 to 27.2 per thousand. In Ontario there was even a greater increase in rate—from 17.5 to 25 per thousand. This increase in births in Ontario, especially since 1938, has resulted in an unprecedented influx of students into our primary and secondary schools, creating problems of staff and facilities and costs with which we are all familiar.

It is not necessary to do much speculating in connection with the numbers to be provided for in our secondary schools in 1960 and in 1965. Neither does it require a telescope to see the impending tidal wave of students rushing forward to engulf the seats of higher learning. The storm signals have been raised by all of us in the educational field. What is happening in the secondary schools today is passed on to the universities tomorrow.

There is no mystery about this problem. Those who will be seeking higher education in 1960 and 1965 are already born; we can count them now; they are already in our schools.

Inevitably, those who are 13 years old this year will be 18 years old in five years. If there are 25 per cent more in Grade 9 this year than there were 5 years ago, there will be proportionately that many more in Grade 13 five years from now. It is just that simple to calculate. But take this one step further to the university level. If the percentage of students graduating from secondary school and going on to universities and colleges remained the same in 1960 as it was in the fall of 1954, and if the total number of students in Grade 13 doubled by 1960, then the number seeking higher education would be twice the present number.

Actually there are 8,000 more students in provincially supported schools in Ontario this year (1954-55) than there were last year (1953-54). In Canada in 1953 there were 310,000 students in the secondary schools and by 1964 there will be 600,000 of them.

It can be said, with considerable accuracy, that we do know the time of the coming of students from the secondary schools to the universities. And the numbers are increasingly large.

It may be said, and I have heard it in discussion, that the universities, since they "handled" so well the large influx of veteran students from 1945 to 1950, should

find this new surge of prospective students no serious challenge. For those who may think in this way, may I remind them that too few teachers, lack of space, too little equipment, large classes and even double classes are not the answers to this new problem as they were for our 50,000 veteran students. If it had not been for the great incentive, the experience and the maturity of these young men and women, that great experiment in higher education might well have been a colossal failure. We do not wish to repeat it. But the oncoming situation, unless effective measures are taken now, will be not just as serious. It will be worse. It will be worse because the students will be considerably younger than the veterans were, and the incentive will be less marked. It will be worse too, because the numbers will not be a three, four or five year "peak"—they will be continuous and they will be greater.

More and permanent facilities will have to be provided; more university teachers will have to be prepared and appointed. Higher salaries will have to be provided for the members of the staffs—so that they too may share in the material benefits of an increasing standard of living experienced already by most groups in Canada but largely denied to university teachers.

Why the University?

It is not unreasonable, I feel, to have people ask where the universities "fit in" with our total Canadian economy. At the same time, many people ask the apparently easy question, "why go to University?" The answers to these questions are not easy nor can they be specific. And I feel sure that no one of us would ever hold that to be successful, even in the limited material sense, one has to be a university graduate. Far from it. But I will say that in keeping with Canada's economic, technological and scientific development, the university graduate is indispensable. When we recall that our gross national product of goods and services is 25 billions of dollars, we should remember the place of the engineer, the chemist, the physicist, the geologist, the mathematician, the botanist, the agricultural scientist and the zoologist in the production of those goods and services. And to these add the teachers, the clergy, the doctors, the dentists, the public health nurses and to an ever-increasing extent, the historians, the economists, the philosophers—those in the humanities and social sciences who, one day, will solve the great social problems of our industrial civilization. Only in the universities can these men and women receive the education and the professional and social skills so urgently required in our total economy.

There are not enough engineers to meet the increasing demands for them. There are far too few graduates in the natural sciences to meet the needs of science let alone a fraction of the needs of the secondary schools. There are insufficient numbers of doctors, of nurses, of clergy. There are not enough university graduates in the honours and professional courses to go around. But the picture can start to change in 1960 with the influx from our secondary schools—if we are ready for them.

It can be argued, it can be proved, that the universities of Canada are important to Canada. They should not be taken for granted.

I do not think that it is necessary to argue the point as to whether universities are provincial or national. That, in essence, is beside the point. They certainly are national assets. They certainly enroll students from provinces other than those in which they are situated. They send out their graduates to every province in the Dominion. They conduct nationally sponsored research in the national interest. They supply graduates to federal government departments and agencies as they do to provincial government departments and agencies. They are integral parts of our economy and vital parts of our total society.

At this point perhaps we can, in general, agree that there is no myth about the impending wave of increased student numbers which will strike at the doors of the universities in a few short years. We can agree, too, I am sure, that Canada is a land of promise, of plenty, and of fine people. It is a country where the university graduates stay and play their part. I think we are of one mind in describing our universities as national assets. I am sure that we recognize that the universities have very great and equally as grave responsibilities as the only institutions in our land where the doctors, the engineers, the lawyers, the physicists and those many other highly qualified men and women can be educated.

Money the Problem

If we agree to those premises, either wholly or in part, then why all the shouting? What is the problem? The problem is money!

Strange as it may seem in a materialistic world, with inflation all about us, the universities do not sell their products. In business, if the production costs of an article increase, the increase is passed on to the consumer. And the producer is still in the black. But too few people take the time to think about what is happening to the poor universities which have no such opportunities of passing on its increased costs.

Here, in brief, is the picture. In 1927, in the midst of the roaring twenties when money was flowing freely, the average revenue available for the education of a university student in Canada was $483. In 1951 the figure was $741! And in that fiscal year (1951) when the total revenue of all universities in Canada was 40.5 million, the Canadian people spent 90.5 million on carbonated beverages, 66 million on hosiery and 113.7 million on liquor. And in the next year when universities, with inflation pounding at their sides, had a total revenue of 48.4 millions, the people of this country spent 59.9 million caring for the patients in our mental institutions.

So $741.00 was the average revenue available for the education of the university students in 1951—for the education of the engineers, the chemists, the economists, the teachers — those students upon whose minds and hands and souls the people of Canada are to a large extent placing the future of their country: $741.00! But those same people of Canada, in the same year, spent $1670 to keep each convict in our federal penitentiaries. And the people of Ontario expended $1500 to maintain each inmate in the jails and reformatories of this province. Are those in our jails, in our mental hospitals, in our reformatories and in our penitentiaries likely to be as productive for Canada? Are they likely to be as creative? Are they likely to be as responsible as the graduates of our universities?

I do not believe that the Canadian public realizes the financial plight of the universities and the unfortunate comparative fiscal position of their institutions of higher learning. The public's respect for higher education and its place in our civilization is too great for me to believe that they know of the crisis.

Perhaps there are solutions to the problems of money and numbers which would not cost more general money, but I doubt if too many people would accept the solutions—raise still higher the entrance requirements and raise still higher the fees. Both would be mutually restrictive. I do not, personally, subscribe to either course. I believe that every young man and woman in the Dominion of Canada who has the desire and the ability to take advantage of the opportunities of higher education should be afforded those opportunities. Canada will otherwise be the eventual loser.

Where can the extra money so urgently needed by the Universities come from? We recognize that the taxpayers' dollars are in great demand. Roads, public works, agriculture, primary schools, secondary schools, etc., etc., must be financed. Actually the Provincial Governments are doing much—with Nova Scotia, Ontario, Newfoundland, New Brunswick and Alberta spending 20% or more of their total revenue for education at all levels. The action of the Government of the Province of Ontario this year in giving added sums to the support of the universities in the province, has been virtually a life-saver. Here is Mr. Frost's relevant statement, made in his budget address of March 10th:

> "Special grants are also being paid to the universities for construction and deferred maintenance. We are deeply conscious of the role of the universities in advancing research and science and of affording opportunities for continuing intellectual and spiritual development. The sustained economic growth of our whole Province, and indeed of the whole nation, will depend to a large extent upon how we contribute to and utilize the multitude of new advances made possible by modern science. To assist the universities in meeting the impending sharp increase in enrolment, we, therefore, propose to pay to them this year special grants totalling $5,600,000."

More is needed—but there are limits to the taxpayer's dollar.

The philanthropist's dollar is the subject of extremely keen competition, keener since succession duties and other taxes have reduced net income and estates so markedly. Although an extremely important but rather specific source, it can hardly be a constant nor a general one.

What then about student fees? It is to be freely and frankly admitted that there are and should be limits to which students fees may be raised to help pay for higher education. I believe, personally, that the proportion of university current revenue derived from students fees is already at an exclusive level.

The Federal Government, recognizing the national scope of the

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". . . for the Universities to do the job of which they are capable and to meet their responsibilities to Canada and its people."

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universities, and realizing their financial plight, commenced in 1952 to make grants to the universities on a provincial population basis of fifty cents per head. The total of some 7½ million dollars so arrived at has since been distributed *pro rata* to the universities annually. This assistance "bailed out" the universities in 1952 and has helped materially to maintain the *status quo*. Assistance from the Federal Government, I believe, should be greatly increased in order that the universities may be permitted to meet, in part at least, the problems of providing facilities and staff for the near future. But government grants and student fees should not be the only major sources of total revenue.

Another very significant source of income for the work of the universities is from Canadian corporations, including Canadian subsidiaries of United States corporations. A study of corporate giving in Canada was made in 1952. It is interesting to note that in 1946 Community Chests, Hospitals, the Red Cross, Salvation Army and other health and welfare agencies received 55 per cent of the total gifts from corporations, and the universities and colleges received 14 per cent of the $2,326,000 total. In 1951, on the other hand, the health and welfare agencies received 70 per cent of the total corporate giving while the colleges and universities were the recipients of less than 11 per cent of the 6 million dollar total.

Although business corporations may deduct for income tax purposes up to 5 per cent of their taxable income with respect to gifts to charitable and educational institutions, such corporations, on the average, are making corporate gifts of less than 1 per cent of their taxable income. There is a strong and growing feeling within the business community that every corporation in Canada, using Canadian resources of material and man-power has an increasing responsibility to the welfare and future of this country—a responsibility which goes beyond the actual taxes which are paid. They know that the universities are indispensable to Canadian corporations. They are realizing that the universities must receive their financial assistance not alone in support of specific things, but in a bigger, broader and more far-reaching manner—support for the university as a university.

Although the problems of each university or college are, to some extent, specific and individual, yet no one university can solve these problems alone. They are problems coincident with our increasing population and our rising economic level. They are, too, problems of inflation. I am sure, as others are too, that if the people of Canada realize the impending educational crises, a solution to the problems will be found. In any event, a decision, if not a solution, will have to be made. That decision may or may not be an intelligent one. We do know that the right decision can be made and the solution to the problems effected if adequate finances are available — in time. The decision eventually rests in the hands of the people.

Governments and the people, governments and industry—together — hand in hand — with understanding and with determination, should combine to make it possible for the universities, on which so much of our present and our future depends, to do the job of which they are capable and to meet their responsibilities to Canada and to its people.

DISCUSSION

of Technical Papers

Low Frequency Radio Communications and Engineering

By R. S. Thain, Defence Research Board, Ottawa.

The Engineering Journal, October 1955 issue, page 1373

Capt. (L) J. Deane, M.E.I.C.[1]

I would like to compliment Mr. Thain on his most interesting paper. It is timely that we should recognize that the LF band is of particular importance to Canada, and it is indeed appropriate that Defence Research Board is studying the special problems peculiar to this band.

When the R.C.N. first went into frequency shift radio teletype about seven years ago we ran into plenty of stability problems. Our experience fully supports Mr. Thain's contention that the wider the band over which a transmitter or recorder is tunable, the more difficult is the stability problem. Although I have not personally been closely associated with radio communications in the R.C.N., I do know that manufacturers have made great strides in improving frequency shift equipment and Mr. Thain's paper should help to direct more of their attention to the LF field.

When trying to decide the relative size of the aerial system versus the transmitter, there is one factor which I consider important which I do not believe Mr. Thain mentioned. In the operation of a large LF transmitter, the cost of electric power becomes significant. This may justify a larger aerial and smaller transmitter than would otherwise be the case.

[1] Royal Canadian Navy, Department of National Defence, Ottawa.

The Author

I must agree with Captain Deane that I did not mention the specific factor of cost of electrical power when discussing design factors in transmitting installations, and I wish to thank him for pointing out the significance of this factor. The cost of electrical power for such installations is, indeed, a very important consideration, in particular when considering the electrical power requirement of transmitting installations in Northern Canada. The economy of electrical power is essential to alleviate the problems of transportation and supply in such remote areas. The engineer must realize that any improvements in system design, receiver design, and transmitting antenna efficiency, to lessen the radiated power requirement of the transmitting installation, will result in a saving in operating costs in addition to a saving in the initial investment.

DISCUSSION

The editor invites discussion of papers appearing in the *Journal*.

Readers may contribute to this section by sending appropriate comments to the *Journal* office.

Niagara Hydraulic Models

(*Continued from page 1670*)

works, the savings could not be estimated as alternative designs did not exist. The savings from the detailed design knowledge supplied by the models is also difficult to estimate. From the known savings, however, it may safely be concluded that hydraulic models are indeed efficient tools of hydraulic design.

Acknowledgments

The engineering management of this Commission, by their appreciation and full support of model testing, have been responsible to a large degree for the development of staff and techniques necessary for the model testing programme described in this paper. Successful model testing is largely teamwork, and while the hydraulic section is responsible for the tests, the assistance of many others is necessary in the collection of field data, construction of the models, and correlation with the design programme. With reference to the Niagara model tests, special mention should be made of the very able and resourceful team of Commission engineers who carried on the work in the laboratories, in particular: D. G. Harkness, R. E. Johnson, K. A. Henry, D. M. Foulds, H. M. McFarlane, C. E. Davidge, and T. B. Reynolds.

Appreciation is also expressed to the Department of Mechanical Engineering of the University of Toronto for making available their river flow laboratory which greatly facilitated the model testing. √

ABSTRACTS . . .

OF RECENTLY PUBLISHED ENGINEERING LITERATURE

ASSESSING ENGINEERING PROBLEMS BY OPERATIONAL RESEARCH METHODS

M. D. J. Brisby, *The Engineer*, v. 199, n. 5185, June 10, 1955, pp. 803/805.

The term operational research was originally coined to describe the activities of a small section of the Air Ministry Research Station at Bawdsey. It has since been adopted to denote the scientific approach to the solution of problems involving complex operations.

Essentially, the aims of operational research are practical—to sum up a situation and to provide a course of action based on the correct appraisal of all available data. Where the complexity of a problem precludes a clear-cut answer, operational research will find the *best bet* using available knowledge.

Lowering Production Costs

Unnecessary delays, breakdowns or off-quality products are obvious points to watch if production costs are to be kept to a minimum.

There are cases where wastage may be unnecessarily high without anyone knowing it. An example is the case of a works that was buying coils of strip nominally 37 in. wide to slit into six 6 in. strips for processing. To play safe, the works ordered the coils on the wide side and wasted 3.5 per cent of the total coil weight in "edge scrap." By examining the distribution of a hundred coil widths it was found that to order a nominal width of 36½ in. would minimise the total amount of scrap which would then amount to 2.5 per cent.

The classic example of this sort of study was done by R. F. Passano on steel works recirculated scrap. He was able to show how the lengths of rolled product could be related to ingot weights and to bloom and billet sizes. By greater control in the initial stages of production he was able to reduce the tonnage of *home* scrap by as much as 25 per cent.

Congestion arises because the rate at which events occur is greater than that at which they can be dealt with. In the most general terms there must be matching of capacities at all stages in the production line.

It is obviously both undesirable and uneconomical to have sidings or blast-furnace bunkers large enough to hold a shipment of iron ore. The solution must be to have sidings large enough to absorb the temporary impact of train arrivals while surplus materials are being discharged to stockyard.

The need for storage sidings is obvious, but how big should these be? The answer demands a knowledge of the pattern of train arrivals, of the real cost of holding materials in wagons, and of unloading and reloading costs. Only then is it possible to find the most economical size of sidings, based on the cost balance between holding materials in wagons and discharging these to ground.

Operational research can be of great assistance in helping to solve problems which involve an element of chance. Generally, these can be classed into two groups; (i) those involving straight forecasts based on probability theory, and (ii) those involving a forecast of events when basic conditions change, such as forecasting the equipment required to cope with an increase in production.

Production Control

Production control fulfils two important functions — it makes it possible to keep a close check on all operations in a production line and it provides a basis on which to plan future production.

The work so far undertaken has concentrated on the organisational aspects of improving control on operations and on reducing paperwork — a rewarding line of study, particularly in some of the older works. There is obviously nothing new in this, but it can be claimed that the methods of operational research are particularly well-fitted to analyse production and planning data, to find inefficiencies and to establish the best course of action to be taken in the light of facts — technical, organisational and economic.

FROST CLOSURE OF ROOF VENTS IN PLUMBING SYSTEMS

Air Conditioning, Heating and Ventilating, v. 52, n. 4, April 1955, p. 98

The principal objection to frost closure of plumbing vents is the fact that air flow into the vent cannot completely replace the air that is carried down the drainage stack and out of the plumbing system when water is discharged from the fixtures. If the roof vent is nearly or completely closed, the discharge of a single water closet will often suffice to siphon the water seals from one or more fixture traps on the system, thereby making it possible for sewer atmosphere to enter the rooms of the building in which the plumbing system is located.

Frost closure occurs naturally in two forms: (1) a cylindrical layer of frost on the inside of the exposed portion of the vent pipe extending above the roof, and (2) a frost cap at the top of the vent. The two forms may occur simultaneously.

It has been commonly believed that if the weather is cold enough to initiate the process of frost closure in a vent of any diameter and that if these conditions persist

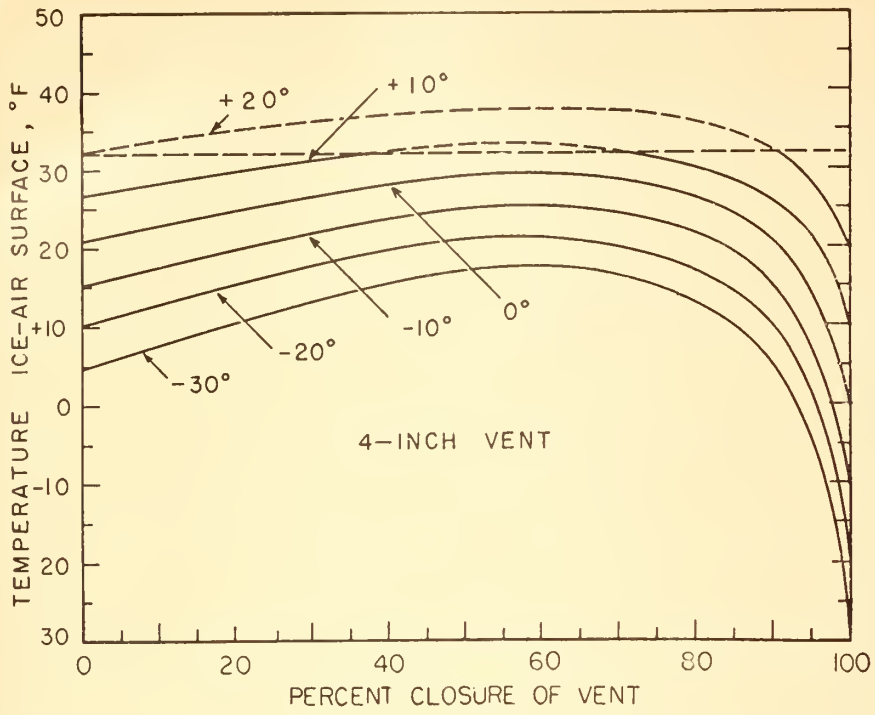


Fig. 1. By means of a heat transfer analysis it is possible to compute the temperature of the ice-air surface as the vent freezes up for any assumed conditions. This graph shows the results of this computation for a 4-inch metal vent, when the wind velocity is 10 fps across the roof and the air stream temperature in the vent is 60°F.

for a sufficiently long period, the vent will become completely closed, but this is not always true. Actually, under some conditions a layer of ice or frost forms on the wall of the vent and increases in thickness up to a certain maximum value, depending on the diameter of the vent and on the rate at which heat is extracted from the air stream through the wall of the vent. This thickness may or may not be sufficient to close the vent.

By applying heat transfer analysis to a set of assumed conditions, it is possible to compute the temperature of the ice-air surface as the vent freezes. As shown in Fig. 1, for a 4-inch metal vent, a wind velocity of 10 ft. per sec. across the roof, an air stream temperature in the vent of 60° F., and an outside air temperature of less than 7° F., the vent will freeze solid, but for outside temperatures greater than about 7° F. it will not. For example, if the outside temperature is 10° F., the computations indicate that freezing will stop when the diameter of the opening is reduced to about 0.63 of its original value, while for an outside air temperature of 20° F. no reduction whatever will take place. Although the analysis indicates the controlling conditions and the extent of frost closure, it does not show the length of time required to close the vent opening to any particular size.

IMPROVING RUBBER FOR INDUSTRY

The Times Review of Industry, v. 9, n. 101. June 1955, p. 11.

Situated at Welwyn Garden City are the laboratories of the British Rubber Producers' Research Association which, since 1938, have been the centre, in Britain, for investigations into the fundamental properties of natural rubber and for the development and improvement of rubber as a raw material of industry.

Throughout its existence there has been an emphasis on the need for undertaking research on the broadest fundamental lines. It is felt that the great technical advances of the past two or three decades coupled with the challenge presented by recent synthetic rubber developments made it imperative to provide an expanding scientific framework on which further technological advances can be built.

One of the most interesting of recent projects has been the introduction of modified rubbers in which the natural rubber is reinforced with a plastic material. These modified rubbers combine certain basic properties of natural rubber with the versatility of the synthetic materials they incorporate. One type promises to be of value for some engineering applications such as vibration mountings for machinery. In this new range, too, hard mouldable rubbers can be produced in clear, bright colours, in white, or may even be transparent.

It will serve to indicate the wide range of activities at the B.R.P.R.A. laboratories to list some of the other work which is being undertaken there for the benefit of industry.

Rail Pads. — British Railways is at present conducting experiments with grooved rubber rail pads. The pads are inserted between rail and sleeper with the object of absorbing vibration, reducing maintenance costs and lengthening the life of the track.

Cyclised Rubber. — This material, made directly from Latex by treatment with sulphuric acid, has properties akin to leather.

Rubber in Roads. — Highway engineers in several parts of Britain are surfacing roads experimentally with compounds of rubber, tar and bitumen. The main advantage of this kind of treatment is that it is possible to get a good surface which is more resistant to traffic and climatic deterioration under greater extremes than with conventional road binders.

Arctic Rubbers. — Methods have been developed to produce natural rubber compounds capable of retaining flexibility in 140 degrees of frost—an important consideration when rubber is to be used in high-altitude flying.

Another advanee has been the introduction of Positex, a natural latex which has been processed to change the eharge of the rubber particles, normally negative, to positive. The positively charged particles have an affinity for fibres to provide greater wear and resistance to shrinking. The possibility of Positex-treated yarns for carpet manufaeture is also under consideration.

One most interesting activity is the production of latex-bonded fabrics. Particles of rubber are deposited on a web of textile fibres and, after water has been removed and drying and vuleanizing processes undergone, a fabrie is obtained in whieh the fibres are bonded together by the latex. This fabric is flexible, has exceptional resilienee and is permeable by air.

Another activity eoncerns the preparation of fluid rubber eompositions whieh eonsist of partially depolymerized rubber in a nonvolatile low-viseosity solvent such as mineral oil with subsequent vuleanization. Among the applications for these compositions are printing rollers, textile machinery components, surgical supports and moulds for casting plaster of Paris and eold-setting materials.

HUMAN RESOURCES IN THE TECHNOLOGICAL FUTURE

C. H. Linder, *Electrical Engineering*, v. 74, n. 6, June, 1955, pp. 482/485.

The fundamental foree acting to put a premium on technically trained manpower is the tremendous rate at which teehnology is growing.

Examine, first, some of the impact of teehnology; it is eonvenient to do so in terms of the resources, other than manpower, required to run a business. Consider the resouree of materials. Today, in sharp eontrast with yesterday, the principal limitation in many products is a roadbloek in the performance characteristics of materials. All are being worked, in the most advanced products, at or near one or another of their physical limits. This means that progress in sueh products as jet engines, prime movers, generation and distribution equipment, and most of the glamorous semiconductor applications, will depend on the improvement of materials.

Consider the business resources of time and money. The expense levels which nowadays must be factored into any change of product design or method of manufacture are so high as to be, on occasion, an effective bar to progress. Interpreted technologically, this means that technical work must have a mueh lower degree of empiricism than in the past.

The growth of new technology, starting with the impetus of World War II and continuing since, has been almost geometrically explosive. There is a good description of this situation in a 4-line stanza, of which the first two lines were written by Alexander Pope in honor of Sir Isaac Newton. The last two lines were added by an exasperated modern poet.

"Nature and Nature's laws lay hid in night.
God said "Let Newton be," and all was light!
It did not last. The Devil, howling 'Ho!'
'Let Einstein be!' restored the status quo."

The first implieation in this situation is that eomplexity may have infiltrated further than has been suspeeted and is a consideration in many present problems, not to mention further ones.

A seeond implieation is that, in view of the inereasing volume and complexity of teehnology, the great number of younger recruits who eome to industry from the technical schools are best prepared for the work awaiting them if they are trained broadly rather than specifically.

The third implication is that for engineers, as well as others, *no man is an island*. The engineer must understand his fellow men and be able to make himself understood by them.

Finally, there is the quantity aspeet of the manpower situation. When the total population is ranked according to native ability, as measured by intelligence test techniques, an alarming number of the top 10 per eent do not go on to, or complete, college work. Only 42 per eent of this upper tenth are graduated from college; in other words, 58 per eent of the best potential talent is lost to those fields where a college degree is generally necessary for entrance.

Of course, the rising birth rate is due to flood the primary and seeondary school systems, and this will mean that, in due time, a eorresponding increase can be expected in the total number of engineering graduates. However, a eorresponding expansion also ean be expeeted in total manpower requirements; the need for a high proportion of technically trained people will not be satisfied by a mere increase in totals. In short, the country is heading toward not only an expanded eeonomy, but toward an everyday life in whieh teehnology is an inereasingly important factor.

The Technological Future

New technology is destined to have a predominant influenee on all the resources required to run a business; on time and money, on materials, on facilities, and most of all upon manpower. The industry must eoneern itself with the quality and the quantity of that manpower in the immediate present, and it will also be a eontinuing eoneern. Mueh will be required of the engineer in his work to build the future he wants and knows is possible. On a day-today basis, first one ehallenge and then another will be flung at the engineering profession; ehallenges which will need statesmanship, managerial ability, and great teehnical skills. The fact should never be lost sight of that, even with all these qualities of men, if teehnical skill is lacking, there will be need of little else.

EFFECTS OF NUCLEAR ENERGY ON THE ENGINEER

M. C. Leverett, *Chemical Engineering Progress*, v. 51, n. 4, April, 1955, p. 162

Those members of the engineering profession who have become a part of the growing nuclear energy industry would agree that engineering as a profession has both gained and broadened by sueh experienee but at the same time the profession has lost something. On the side of gain I would put the increased technieal seope of engineering, the inereased opportunity for advaneement.

One of the obvious eonsequences of the advent of nuclear energy to the engineering profession is the broadened technieal area whieh the engineer is expected to eover. In a professional sense one

of the most important effects of nuclear energy developments on engineers is that it has brought about an increasing awareness of the value of good fundamental training .

Another striking feature of the position of the engineer in nuclear energy is his opportunity for advancement. One person in six in the nuclear energy industry is primarily technical in background or function. The industry is at present dominated by considerations of technical feasibility, and this tends to give the technically trained person an unusually large share in the direction and management of the overall enterprise.

Another new characteristic introduced into the engineering profession by nuclear energy is that of mobility of the individual. Many have moved from one employer to another as contracts are cancelled or change hands. This has had a very broadening effect upon the technical component of the industry, which certainly is beneficial.

One noticeable characteristic of the nuclear energy industry is its growing similarity to the aircraft industry. If the nuclear engineer can expect that his professional experience will parallel that of the aeronautic engineer, he has indeed an exciting and productive future to envision.

EFCO-VIRGO SALT DESCALING OF TITANIUM AND ITS ALLOYS

Machinery, v. 86, n. 2214, April 22, 1955, pp. 882/3.

One of the major difficulties that must be overcome in the working of titanium-based materials is the removal of the scale formed during forging operations and heat-treatment. If this scale is not removed, the corrosion resistance of these materials is decreased, ductility is substantially reduced and welding is rendered difficult. The scale formed consists principally of titanium dioxide.

The solubility of the oxides of titanium in both mineral acids and molten alkali salts depends to a large extent on the temperature of formation. Scale formed at a temperature above approximately 760 deg. C. is practically insoluble in most common acid and alkali descaling media.

Two important factors that must be taken into account when considering the descaling of titanium materials are the effect of the descaling medium on the ductility of the metal, and the proportion of basic metal that may be lost during the treatment.

The Efco-Virgo process involves the use of a mixture of caustic soda and activated agents, and the action of the molten salts, at a temperature ranging from 480 to 540 deg. C., modifies the scale chemically and physically. The scale is converted into a flocculent compound which is soluble in a weak acid, and the increase in volume that accompanies this change is such that the greater portion of the modified scale can be dislodged by the rupturing effect of the steam generated by quenching in cold water, leaving only a loosely adhering deposit. For inter-process pickling, cold-water quenching only is necessary, the deposit appearing to act as a lubricant during subsequent operations. When a bright finish is desirable, however, the water quench is followed by flash pickling in warm, dilute acid, with a subsequent water wash. Alternatively, the acid dip can be carried out in two stages, namely, immersion in 10 per cent hydrochloric acid in water at 75 to 80 deg. C., and in 10 per cent nitric acid in water at the same temperature. The duration of the acid dip is of the order of 1 min., so that the possibility of hydrogen generation, and consequent embrittlement, is negligible.

The time of immersion in the molten salt varies from 2 to 20 min., depending on the condition of the material, and the total cycle time, therefore, ranges from 5 to 25 min. Such a cycle time represents a substantial reduction as compared with that required for descaling stainless steel by the methods employed hitherto.

The descaling procedures adopted for titanium and its alloys vary, and depend to a large extent on the form in which the material is handled, careful control being necessary in certain instances. Hot rolled and annealed titanium requires to be handled with caution, particularly in the lighter gauges. Thin materials may ignite in baths that are maintained at the temperatures normally employed for descaling stainless and alloy steels.

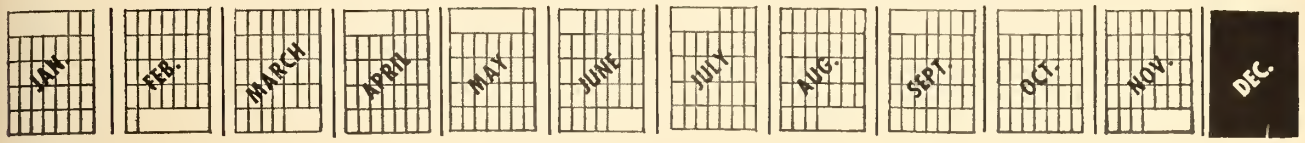
After the salt-bath treatment, the sheets should be water quenched and then pickled. In certain instances, an initial pickle in 10 per cent sulphuric acid is beneficial, but final pickling is always carried out in a mixture of nitric and hydrofluoric acids. Immersion times in the acid baths vary in accordance with the scale condition, but a period from 1 to 5 min. is usually allowed. Care is necessary since the final acid mixture can readily etch the base metal if the vat temperature is excessively high or if an unduly large proportion of hydrofluoric acid is used.

WET SANDBLASTING

Engineering, v. 179, n. 4662, June 3, 1955, p. 689

For many years, wet sandblasting had been in universal use in United States Navy yards, and it proved invaluable during the war. The equipment was also used by the Canadian and Australian navies and apparently no difficulties arose from silicosis. During the war in the Pacific, the use of that equipment, together with hot plastic anti-fouling paints, enabled ships of the U.S. Navy to remain out of dock, and operationally available, for periods far in excess of anything known by British standards. Had the war in the Pacific continued a few months longer, the inadequacies of the British Navy in that respect would have been glaringly apparent. The special feature of importance about wet sandblasting was that it was a time and labour saver; and time and labour were both scarce commodities in war time. It was a modern mechanized method of doing a hard and dirty job effectively, and means of overcoming the handicap of labour shortage and inefficient labour. With such equipment the hull of a ship could be cleaned to bare metal quickly, using a small labour force; without it, the job could not be done at all, unless a very large labour force was available for a long time and was rigorously supervised.

Month To Month



Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Ontario Committee Studies Water Problems

The Ontario Water Resources and Supply Committee has been holding public hearings during the past few months at centres in Ontario to obtain information on local water problems and on the steps to be taken to correct them.

The committee will report to the provincial government on the vital problem of water in the cities, towns and rural communities in South Western Ontario. A. M. Snider of Waterloo, Ont., is chairman, and the members of the committee are B. L. Bedford, Q.C., Chatham, W. D. Conklin, Q.C., Kingsville, Dr. C. H. Reason, London, and J. A. Vance, M.E.I.C., Woodstock.

Water supply is critical. In South Western Ontario there is a long shore line on the Great Lakes where there is an abundant supply of fresh water. This can readily be made available for domestic and industrial uses but complications, under the International Joint Commission agreements, arise when excessive amounts for irrigation are requested. Evidence, so far, would indicate that adequate supply of water can be provided through pipe lines from the Great Lakes and conservation and storage of water in head waters of our streams. The elevation of the interior of Western Ontario varies from two hundred to six hundred feet above the levels of Lake Huron and Lake Erie.

By means of newspaper announcement of public meetings, briefs have been invited from municipal bodies, industries, organizations and individuals. Details are requested of water consumption, present capacity and estimated future requirements, quality of water, extent and effect of pollution, local irrigation problems and the present and future requirements of water for irrigation.

The Toronto Office of the Institute has cooperated with the committee by calling the attention of engineers in the area to the work being done. Engineers were encouraged in the public interest to present briefs, and branches of the Institute were urged to send representatives to the meetings.

The problem of water supply in this part of Canada has become an increasingly troublesome one in recent years, and it is to be hoped that the work of this special committee may point out some solutions. All concerned within the Institute should lend their encouragement and active support in any way they can.

Cover Picture

Our cover picture is a view of the Jacques Cartier bridge at Montreal, taken from under the north approach. This is one of the structures in the news at present because of the necessity of raising its south end to accommodate the needs of the St. Lawrence Seaway ship channel, which passes below it. Photo by our associate editor.

Energy Resources and the Royal Commission

We feel that readers might appreciate some clarification of the relationship between the proposed Institute study of energy resources and the Royal Commission on Canada's Economic Prospects.

This matter was considered by E.I.C. Council on July 29, and a preliminary report was read. The discussion brought out the opinion that a great deal of this energy information is already available, and further that it might properly fall within the field of the Royal Commission. A study of energy resources is included in the commission's terms of reference.

While mindful of the Institute's responsibility, and desire, to be of assistance to the Royal Commission in any way possible, Council at the same time decided that there should be no further action for the moment, so far as the Institute as a whole is concerned. It was suggested however that the Publication Committee might consider ways of being helpful.

Subsequent investigation has shown that a task such as this one

is much too big for the Publication Committee, or in fact for any standing committee of the Institute. For the present, therefore, it has been decided that the columns of the *Journal* will be made available to anyone who has something of value to contribute on Canadian energy resources, which in turn may be of use to the Royal Commission. Any reader having worthwhile material of this kind is invited to submit it to Institute headquarters in the usual way.

Canadian Committee Meets at Ottawa

The Canadian Committee on Counselling in Engineering and Science had its thirteenth meeting in the Chateau Laurier, Ottawa on November 9 under the chairmanship of R. F. Shaw, M.E.I.C.

As is usual the agenda covered quite a variety of subjects including the availability of film strips for guidance meetings, the circulation of the revised list of councillors, a film on recruiting at the high school level, a request from Affiliated Engineering Institutions of South Africa for permission to reproduce the committee's pamphlet "After High School, What?", and a discussion on the shortage of high school pupils going on to university to study engineering and science.

Considerable time was spent on the consideration of methods by which more high school pupils could be encouraged to take up the study of engineering and science. To explore the matter further a sub-committee was set up consisting of Garnet Page, Chemical Institute of Canada, T. Medland, Ontario Association of Professional Engineers, and L. Austin Wright, Engineering Institute of Canada.

This subcommittee is to discuss various proposals with officers of the organizations and then is to meet not later than January in order to put together all the ideas for presentation to a subsequent meeting of the main committee.

ECPD Meeting in Toronto

Scenes from the annual meeting of the Engineers' Council for Professional Development in Toronto, which was reported in last month's 'Journal'.

Shown at the head table for the annual dinner are Mrs. Grant, Dr. C. T. Bissell, the speaker, M. D. Hooven, ECPD vice-president, Col. L. F. Grant, retiring president, Mrs. R. E. Heartz, Wm. Roy Glidden, past president of ASCE, and Mrs. Bissell.

Canadian deans of engineering were head table guests for an ECPD luncheon. Left to right, W. S. Wilson, A. E. MacDonald, Rev. W. P. Fogarty, M. D. Hooven, P. R. Gendron, W. R. Sawyer, S. J. Carew, M. L. Baker.

President of Civil Engineers

Enoch R. Needles of New York, senior partner of Howard, Needles, Tammen & Bergendoff, took office as president of the American Society of Civil Engineers on October 26, during the national convention of the Society in New York. He succeeds William Roy Glidden, of Richmond, assistant chief engineer of the Virginia Department of Highways.

Mr. Needles, who was born in Brookfield, Missouri, received the degree of B.S. in civil engineering from the Missouri School of Mines in 1914, and in 1937 the honorary degree of doctor of engineering from his Alma Mater. In World War II he served as a colonel in the corps of engineers, receiving the Legion of Merit.

His firm has engaged in many notable projects, including a number of famous bridges, expressways and turnpikes. Mr. Needles is past-president of the Metropolitan Section of ASCE, of the American Institute of Consulting Engineers, and the American Road Builders' Association.

Two vice-presidents of ASCE and seven members of the board of direction also took office on October 26, and will serve with others continuing in office. Vice-presidents elected for two years are Frank A. Marston, of Boston, consulting engineer with the firm of Metcalf & Eddy, and Glenn W. Holcomb, of Corvallis, professor and chairman of the department of civil engineering, Oregon State College. The new directors, who will serve for three years, are Carey H. Brown, of Scottsville, N.Y., an executive of Eastman Kodak Co., Rochester; Clarence E. Eckel, of Boulder, dean of the college of engineering, University of Colorado; Mason C. Prichard, of Washington, D.C., executive vice-president of The Foundation Company of New York; John P. Riley, director of development, New York City Housing Authority; R. Robinson Rowe, of Sacramento, supervising bridge engineer, California State Division of Highways; Louis E. Rydell, chief engineer, planning branch, Corps of Engineers, Walla Walla, Wash.; and Prof. Robert H. Sherlock, of Ann Arbor, of the department of civil engineering, University of Michigan.

The President's Tour

Dr. R. E Heartz, president of the Engineering Institute, is greeted by members during his annual visit to the branches in the East.

The president visits the dumper house of the Iron Ore Company of Canada in Seven Islands. Left to right: Gerry Lepage, town manager, R. L. Dunsmore, Montreal branch chairman, E. E. Bode, terminal engineer, Dr. Heartz, and A. Moss, dumper foreman.

The Lower St. Lawrence branch honours the president at dinner in Rimouski. Left to right: Marcel Lanouette, Mrs. Lanouette, Georges Santerre, Mrs. Santerre, Mrs. St-Hilaire, Claude St-Hilaire, Leopold Caron, R. L. Dunsmore, and J. C. Hurtubise.

At Bathurst the Northern New Brunswick branch welcomes the president. Left to right: E. C. Bannerman, Mrs. J. Leo Hachey, J. G. Chalmers, Mrs. R. E. Heartz, W. S. Hosking, chairman, Mrs. Chalmers, Dr. Heartz, Mrs. Hosking, J. Leo Hachey, and Mrs. Bannerman.

Lower right, from left: G. P. Milton, Mrs. Milton, W. R. MacLachlan, Mrs. MacLachlan, H. L. Archibald and Mrs. Archibald.

Left to right: T. Turgeon, Jules Picot, Miss Carol Creaghan and Thomas Creaghan.

Amherst branch members are greeted by the president and Mrs. Heartz. Left to right: A. G. Baxter, Dr. Heartz, Mrs. Heartz, Dr. H. W. McKiel, and F. C. Wightman.

At the Amherst branch dinner. Left to right: G. M. Josephson, Mrs. Josephson, Mayor M. J. Kaufman, Mrs. Heartz, and Dr. Heartz.

The president chairs the regional council meeting of the Institute in Charlottetown. Left to right: Grant R. Jack, E. Lee Cameron, L. E. Burrill, A. E. Flynn, M. L. Baker, E. V. Gage, N. B. Eagles, and Dr. Heartz.

The North Nova Scotia branch luncheon in New Glasgow. Left to right: J. L. Cavanagh, Dr. D. J. MacNeil, Dr. Heartz, Mrs. Heartz, F. C. Morrison, chairman, D. G. Dunbar, and R. S. Morrow.

The president views the practical aspects of the work in New Glasgow. Left to right: F. C. Morrison, chairman, Walter Monck, Dr. Heartz, William Flemming, Robert Logan, and Dr. D. J. MacNeil.

The Cape Breton branch entertains the president in Sydney. Left to right: Mrs. C. M. Anson, Dr. Heartz, M. R. Campbell, chairman, and W. S. Wilson. (Lower left.)

The president pays a visit to the mayor of St. John's. Left to right: L. Austin Wright, E. V. Gage, Dr. Heartz, His Worship Mayor H. G. R. Mews, and E. Dickinson, chairman of the Newfoundland branch.

Branch members and their wives attend a dinner in honour of the president's visit to Corner Brook. Left to right: Mrs. M. G. Green, Mr. Green, Mrs. E. Leja and Mr. Leja.

Left to right: Mrs. F. H. Clark, E. V. Gage, Mrs. A. Martin, Dr. Heartz, F. H. Clark, chairman of the Corner Brook branch, Mrs. Heartz, and A. Martin.

The president visits the Nova Scotia Technical College during his visit to Halifax. Left to right: Clair Joseph Callaghan, E.I.C. Prize winner; W. A. Devereaux, chairman, Dr. Heartz, and Dr. Alan Cameron, Nova Scotia Technical College president.

A chat with the Doanes. Left to right: Harvey Doane, F. W. W. Doane, still practising at the age of 92, and Dr. Heartz.

Frank Bennett, the president, and J. E. Clarke relax in the sun. (Lower left.)

The president has luncheon with the Association of Professional Engineers of Nova Scotia. Left to right: Dr. Ira P. Maenab, Dr. Heartz, M. L. Baker, president of the Association, and Dr. Allan Cameron.

◀ Dining with the Saint John branch members and their wives. Left to right: Dr. Heartz, T. C. Higginson, chairman, Mrs. Heartz, F. L. Doty, Mrs. A. G. Watt, and A. W. Purdy.

Left to right: A. G. Watt, Mrs. Glenn Scott, N. B. Eagles, Mrs. F. L. Doty, Mrs. T. C. Higginson, and Dr. Heartz. ▶

R. H. B. McLaughlin, Lt. Col. W. B. Akerley, and T. C. Higginson (centre three) attend the luncheon meeting in Fredericton. ▶

In Fredericton the president meets Colin B. Mackay, president of the University of New Brunswick.

Dr. Heartz awards E.I.C. Prizes to University of New Brunswick students Charles Alexander Ponder and Walter Dana Wasson.

The 70th Annual Meeting of the Engineering Institute of Canada

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May 23 to 25, 1956

Sheraton-Mount Royal Hotel

MONTREAL

Community Planning Meeting

The annual conference of the American Society of Planning Officials and the Community Planning Association of Canada, September 25 to 29, 1955, attracted 1300 people to Montreal.

The CPAC is the active centralizing body in Canada for community planning information and for promoting public participation. This was an occasion for cooperation with the ASPO in a Canadian conference, affording an unusual opportunity for Canadians to benefit from so large a gathering. Delegates came from the ten provinces, and from 38 of the 48 United States, Hawaii and Puerto Rico. Australia was represented, and South Africa, England, India, Israel, Jamaica and Japan. The Engineering Institute was one of the Canadian sponsors for the meeting. In a very concrete way the future occupies the community planners, so that speakers were able to present studies of the way of life which may prevail at the end of the century, in a session on "Planning for Tomorrow's World".

Other topics discussed by American and Canadian speakers were Visual Design of Cities, Churches in the City, Urban Renewal, Public Opinion Surveys, Planning in Print, Planning Education, Subdivision and Zoning, Surburban Development Problems, Traffic, Metropolitan Government, The St. Lawrence Seaway.

The Hon. Robert H. Winters, M.E.I.C., minister of public works of Canada, gave a luncheon address during the meeting in which he said that "in this country and in the United States we have, since the Second World War, been involved in—and indeed have helped to bring about—what approaches a social revolution in the field of housing, which has become an economic force of dynamic and momentous character". Being concerned with housing, he is interested in city planning, and he told of four main points of concern to those occupied with housing at the federal level. They are:

First—The city planner cannot control the factors underlying city growth.

Second—His field is in reality one large problem which tends, often unfortunately, to get broken down into parts—and dealt with in parts. Undue concern with the detailed and technical aspects of the variety of problems diverts attention from their essential unity.

Third—Planners may be apt to forget that a city's livelihood must come first. Too much concern with civic beautification and social reform is all too likely to divert attention from those economic processes which form the very basis of a city's existence.

Fourth—The Canadian public is facing major decisions in the planning field—and it needs expert help in making them. Yet the Canadian public has not been sold on the merits and values of city planning as a major force.

New Chemical Engineering Building at University of Ottawa

As a further step toward the development of a school of applied science, the University of Ottawa has opened a new chemical engineering laboratory not far from their new medical building. The formal opening of this laboratory building took place on Saturday afternoon, October 29.

At this modest but important ceremony representatives of scientific groups and professional associations including the Engineering Institute of Canada, were present.

After the ceremony of blessing the new building had been performed by Msgr. N. Gélineau, P.D., V.G., and those present had made an inspection of its equipment, the party went over to the new medical building where the official opening address was given in the auditorium by Dr. E. W. R. Steacie, president of the National Research Council. The bilingual program also included addresses by the Very Reverend Rodrigue Normandin, O.M.I., rector of the university, and Dr. Pierre R. Gendron, dean of the faculty.

Dr. Steacie mentioned the increasing demand for engineers that is evident everywhere.

He was glad to see that French-speaking Canadians were recognizing this fact and taking steps to meet it in a practical way. He briefly referred to the rise in scientific development that had taken place in the University of Ottawa during the past few years and congratulated those in charge on what they had accomplished and the speed with which this development had come about.

The Very Reverend Father Rodrigue Normandin, O.M.I., rector of the university, explained that much effort had lately been put into the building up of the faculty of medicine. "Now that this faculty has settled down in a building that fully satisfies its present needs," he said, "our care can more freely turn towards another field of action that we had long hoped to enter; that of applied science."

The opening of the new chemical engineering laboratory marks a real step in this direction, following the setting up in 1946 "in embryonic form of a school of applied science offering the first three years of a five-year course".

Father Normandin explained that as early as 1901 the university erected a spacious building reserved entirely for the natural sciences

Even before that, attention was given to scientific studies. "Let us recall that in 1873 the University of Ottawa introduced a course in civil engineering, which survived a few years only; it was in fact abandoned in 1880, but re-established five years later when mining and mechanical engineering were added. Once again, the newly-born failed to conquer the rigours of time."

In spite of these failures, certain accomplishments gave eloquent testimony of the excellence of the professors of the time and of the equipment used, much of which was designed and made by them. They had a hand, for instance, in the design of what was probably the first installation of electric lighting in an educational institution in America.

Nominees for Office

A list of nominees for office, as reported by the Nominating Committee, appeared on Page 1397 of the October, 1955 issue of the *Journal*. Since that time the committee has reported the selection for president as follows:

President.....Vernon Archibald McKillop.....London, Ont.

REGISTRATION IN ENGINEERING AT CANADIAN UNIVERSITIES

University	Year	General Course	Aeronautical Engineering	Agricultural Engineering	Petroleum Engineering	Chemical Engineering	Civil Engineering	Electrical Engineering	Engineering and Business Administration	Mechanical and Electrical Engineering	Forest Engineering	Geology and Mineralogy Engineering	Mechanical Engineering	Metallurgical Engineering	Mining Engineering	Engineering Physics	Total
Memorial	1st	55															55
	2nd	37															37
	3rd	9															9
Total		101															101
Dalhousie	1st	81															81
	2nd	55															55
	3rd	25															25
Total		161															161
St. Mary's	1st	45															45
	2nd	27															27
	3rd	30															30
Total		102															102
St. Francis Xavier	1st	73															73
	2nd	102															102
	3rd	80															80
Total		255															255
N.S. Tech. College	4th					12	44	50					47	3	4		160
	5th					4	25	21					20	2	4		76
Total						16	69	71					67	5	8		236
Acadia	1st	63															63
	2nd	46															46
	3rd	31															31
Total		140															140
Mount Allison	1st	53															53
	2nd	87															87
	3rd	39															39
Total		179															179
New Brunswick	1st					6	54	43					21		3		127
	2nd					3	61	25					15		1		105
	3rd					3	35	25					16		3		82
	4th						45	16					19				80
	5th						17	8					12				37
Total						12	212	117					83		7		431
Laval	1st	166															166
	2nd	194															194
	3rd					13	38	31				6	15	8	7		118
	4th					11	41	22				4	8	9	6		101
	5th					8	29	14				2	9	5	4		71
Total		360				32	108	67				12	32	22	17		650
Ecole Polytechnique	1st	191															191
	2nd	179															179
	3rd	143															143
	4th					10	44			53		2		10	2		121
	5th					5	45			40				5	2		97
Total		513				15	89			93		2		15	4		731
McGill	1st	242															242
	2nd	273															273
	3rd					56	42	62					72	12	11	26	281
	4th					39	76	78					73	12	13	17	308
	5th					34	63	59					74	12	5	6	253
Total		515				129	181	199					219	36	29	49	1357
Ottawa	1st					5	18	6					6	1			36
	2nd					15	14	13					11				53
	3rd					2	6	8					4	1	1		22
	4th					5											5
	5th					3											3
	6th					1											1
Total						31	38	27					21	2	1		120
Carleton College	1st	31															31
	2nd	35															35
Total		66															66
Queen's	1st	297															297
	2nd					48	56	39				16	58	7	17	12	253
	3rd					38	41	34				7	37	6	16	21	200
	4th					47	52	38				11	40	7	4	6	205
Total		297				133	149	111				34	135	20	37	39	955

REGISTRATION IN ENGINEERING AT CANADIAN UNIVERSITIES—*Continued*

University	Year	General Course	Aeronautical Engineering	Agricultural Engineering	Petroleum Engineering	Chemical Engineering	Civil Engineering	Electrical Engineering	Engineering and Business Administration	Mechanical and Electrical Engineering	Forest Engineering	Geology and Mineralogy Engineering	Mechanical Engineering	Metallurgical Engineering	Mining Engineering	Engineering Physics	Total
Toronto	1st					94	102	102	64			37	110	13	25	110	657
	2nd		20			84	79	69	66			12	90	11	20	54	505
	3rd		12			66	59	61	45			18	80	12	6	32	391
	4th		13			65	71	60	35			10	88	8	9	30	389
Total			45			309	311	292	210			77	368	44	60	226	1942
Ontario Agricultural College	3rd												*11				11
Total													11				11
Western Ontario	1st	25															25
	2nd	17															17
Total		42															42
Manitoba	1st	260															260
	2nd	165										2				3	170
	3rd						46	31					53			3	133
	4th						28	25				10	40			3	106
Total		425					74	56				12	93			9	669
Saskatchewan	1st	305															305
	2nd	166				28										17	211
	3rd			2		17	37	22				8	43			14	143
	4th			6	5	12	35	15				15	30			13	131
Total		471		8	5	57	72	37				23	73			44	790
Alberta	1st	328															328
	2nd				9	66	79	48							16		218
	3rd				8	36	64	26							12		146
	4th				21	37	56	25							7		146
Total		328			38	139	199	99							35		838
British Columbia	1st	326									11						337
	2nd	225									4						229
	3rd			1		17	29	51			2	11	38	8	7	11	175
	4th			1		15	22	40			2	11	47	9	5	10	162
Total		551		2		32	51	91			19	22	85	17	12	21	903
Canadian Services Colleges																	
Royal Military College (Kingston)	1st	80															80
	2nd	67															67
	3rd					5	44	22					26			12	109
	4th					12	31	12					12			4	71
Total		147				17	75	34					38			16	327
Royal Roads	1st	91															91
	2nd	53															53
Total		144															144
Collège Militaire Royal de St-Jean	1st	109															109
	2nd	82															82
Total		191															191
Grand Total		4988	45	10	43	922	1628	1201	210	93	19	182	1225	161	210	404	11341
Prospective 1956 Graduates			13	7	26	227	443	305	35	40	2	61	360	48	40	68	1675

*Students in agricultural engineering who will proceed to their final year in Mechanical Engineering at the University of Toronto on completion of their studies at Guelph.

The increase in registration of engineering students at Canadian universities in the fall of 1955 has been almost exactly 10 per cent over that of one year ago. The actual increase was 1,049 as compared with approximately 1,250 in the previous year.

It will be noted that the Ontario Agricultural College at Guelph, Ontario is included in our returns this year for the first time. An arrangement has been made whereby students studying agricultural engineering may proceed to the faculty of applied science and engineering at the University of Toronto on completion of their fourth year at Guelph and enter the final year in mechanical engineering at Toronto.

The total enrolment of first year students this year has been 3,652. This represents an increase of 211 or 6 per cent, compared with 10 per cent in 1954. Apart from the Universities of British Columbia, Saskatchewan and Manitoba, where the freshman classes increased by 25, 22 and 22 respectively over last year, the classes entering the larger degree granting schools remained almost unchanged. On the other hand, the entering classes at the non-degree granting colleges were lower in every case, except at Dalhousie University where there was an increase of 25.

The total registration for all graduating classes, as indicated in last year's commentary, is 1,675 as compared with 1,392 in 1954, an increase of almost exactly 20 per cent. A further increase in the graduating class of 1957 of slightly over 20 per cent is likewise indicated.

Contrary to recent years, the pattern of registration in different courses has proved to be radically different than formerly. Apart from engineering physics, where the total registration has increased by 50 per cent, the trend has been strongly toward the basic courses. Chemical, metallurgical and mining registrations have increased by approximately 20 per cent in each case. Students in electrical engineering increased by 25 per cent; mechanical engineering by 15 per cent, and civil engineering by 12 per cent. These may be related to the total overall increase of 10 per cent.

St. Lawrence Seaway and Power Project

The *Journal* reviews the news and progress of the St. Lawrence project.

Progress by Ontario Hydro

Work was started on the Cornwall dyke closure and diversion of Cornwall canal during October by C. A. Pitts General Contractor Limited. Excavation work began on a large scale before the end of the month. About 8 per cent of the adjoining section of Cornwall dyke has been completed by Atlas Construction Company. Approximately 60,000 cubic-yards of till were placed and compacted on section 3, and extensive stripping was carried out on section 2.

At the powerhouse site, excavation continued despite unfavourable rainy weather. Some 250,000 cubic-yards of overburden was removed. Since the start of the job in mid-July, approximately 680,000 yards of excavation material had been taken out by the month end. Drilling and grouting operations in the foundation area proceeded favourably, about 70 per cent of the drilling having been completed and 60 per cent of the grouting. Meanwhile excavation of the diversion canal access tunnel was virtually finished. Assembly of the Armco tunnel liners had advanced so that installation was ready to begin.

Wet weather interfered somewhat with Canadian National Railways relocation progress, but excavation was continued at most work points. In the month, road construction for the relocation of No. 2 highway went forward so that this section between Cornwall and Moulinette soon would be ready for traffic.

Excellent progress was made in channel improvement work throughout October. About 50 per cent of the Galop Island clearing had been done and the total of all excavation to the month end was about 600,000 cubic yards. In the Chimney Island contract, removal of Spencer Island pier was virtually completed. About 170,000 cubic yards of material had been removed by the end of October.

Some 70 medical doctors from Cornwall and neighbouring communities attended the official opening on November 9 of the Commission's project hospital. Built by Hydro to provide on-the-job medical service and surgical treatment for construction workers and staff members, the two storey frame building with single storey wings has a 30-bed capacity and incorporates many of the latest facilities of larger institutions. The official opening of the hospital coincides with the increasing tempo of construction work on the St. Lawrence power project.

Looking downstream upon the site of the canal and lock being built at Iroquois Point, Ont., in the international section of the seaway. The Galop canal at left.

St. Lawrence Seaway Authority photo.

Progress by NYSPA

October was marked by a major progress milestone, the placing of the first concrete in Long Sault dam on the tenth of the month. Erection of the construction plant and excavation of cut "F" continued concurrently with excavation and grouting of the Long Sault dam foundation.

Excavation for the power house neared the half-way mark, while construction of access roads, railroads, dyke and construction plant progressed. A total of 70,000 cubic feet of grout had been placed for foundation treatment, preparatory to rock excavation. Placement of earthfill in the upstream toe fill at cofferdam C-1 was started.

Earth excavation at Iroquois dam was continued and rock excavation started. Hauling of aggregates and construction plant erection was continued. Channel excavation at Red Mills Point and on Lalone Island progressed, in spite of muddy conditions. Approximately 900,000 cubic yards of channel excavation had been moved to end of October.

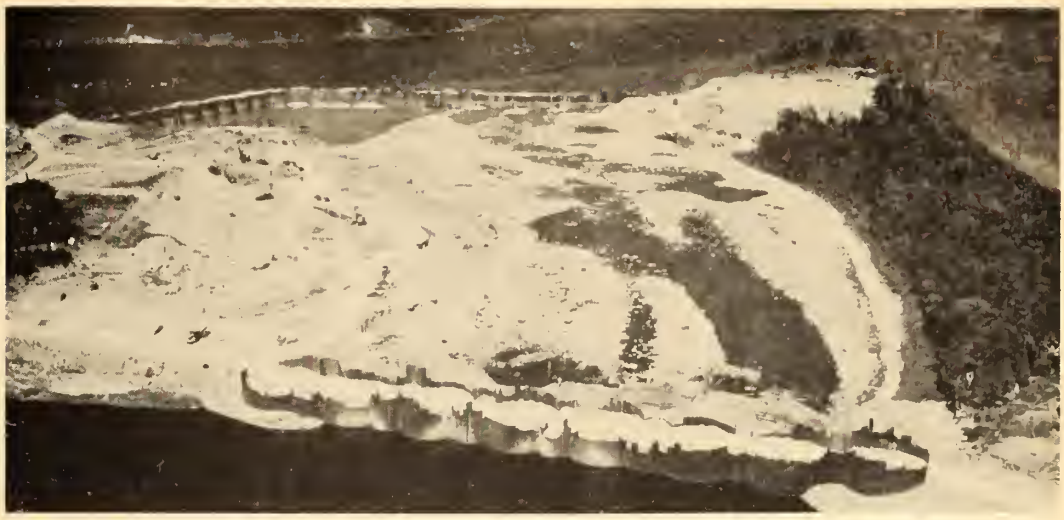
Stage 1 excavation for the Massena intake structure was continued and the material was hauled to stock piles, dyke embankment or in spoil area. The access railroad to Barnhart Island bridge was completed. Paving was also completed on the Barnhart extension highway. Superstructure steel for the south pier of Barnhart Island bridge was being cantilevered out near midstream to meet steel being erected from the north pier.

Construction of the substructure of the Grass River bridge was nearing completion and preparation was being made for erection of the superstructure. Clearing for the construction of the Long Sault canal construction power line was started.

Work on engineering drawings and specifications continued on schedule. Inspection and expediting of major items of essential equipment and materials received top priority. Fifty-one major supply and construction contracts were in progress.

St. Lawrence Seaway Authority

Tenders were called on October 27 for excavation of some three miles of overland channel and the construction of 3½ miles of dyke



Long Sault dam cofferdam "A" (at top) holds back Long Sault rapids. Cofferdam "B" (foreground) blocks off south channel.
Ontario Hydro photo.

in the Lachine section of the seaway, between Côte Ste. Catherine and Caughnawaga on the south shore. The work includes 4,600,000 yards of earth excavation, 2,900,000 yards of rock excavation, as well as cofferdams and unwatering. It will require a temporary diversion of part of highway 9C in the western end of the area, but highway traffic will be maintained. Completion is called for by August 31, 1958.

Tenders have been called for enlarging the Welland ship canal channel, between lock 1 and lock 2, between lock 2 and lock 3 and between lock 3 and lock 4. The area of the first contract is near Port Weller and the areas of the other two are between Port Weller and Merriton, Ontario.

The work as advertised is to be carried out during the non-navigation seasons of 1955-56, 1956-57 and 1957-58, with completion by June 30, 1958. This season the canal north of the flight lock at Thorold, Ontario, is to be unwatered December 20 and will remain so until midnight, March 28, 1956.

Enlargement of channel between lock 1 and lock 2 will entail the excavation of some 71,000 cubic yards of earth. Enlargement of the channel from lock 2 to lock 3, will involve some 482,000 cubic yards of earth, while enlargement of the channel from lock 3 to lock 4 requires removal of some 41,000 cubic yards of earth. Some 750 cubic yards of concrete slabs and the placing of some 400 cubic yards of stone protection are also involved in the three contracts.

Canadian and American seaway officials, meeting at Washington October 20, agreed on principles to govern the division of cost and responsibility for new bridges and roadways necessitated by seaway construction near Cornwall. The south channel bridge over the river in the international section near Cornwall and Massena must be dismantled. It now carries both the New York Central Railway and highway traffic, and must be removed to provide headroom for shipping in the new channel along the south side of Cornwall Island.

Also discussed were problems relating to construction of a new rail-highway bridge over Polleys Gut between Massena and Cornwall Island; relocation of 5 miles of the New York Central Railway and relocation of the highway now operated as part of the toll system of the Cornwall International Bridge Co.; and construction of a fixed rail-highway bridge across the Grasse River on the American side of the St. Lawrence.

Pursuant to an exchange of notes between the two governments, an arrangement has been made with the SLSDC whereby the Canadian Authority will build the substructure of the new bridge, while the SLSDC will build the superstructure. The Canadian Seaway Authority will also relocate the facilities in Canada owned by the New York Central Railway Company, the Cornwall International Bridge Company and re-establish the Canadian customs and immigration offices at a point near Polleys Gut.

St. Lawrence Seaway Development Corporation

According to Edward R. Place, information director, SLSDC, contracts for the United States' share of the cost of navigation facilities, have been awarded at prices lower than engineers' estimates. The United States' share, originally estimated at some $90 million, may now be done for about $87 million. SLSDC traffic studies indicate that the waterway will handle about 36½ million tons yearly, he stated, or about 1½ million tons less than the most recent Canadian traffic estimate.

The Jack and Jim Maser Corporation, contractors under SLSDC for the excavation of the Robinson Bay lock in the 10 mile Long Sault canal near Massena, defaulted on their contract early in October. The Tecon Corporation of Dallas was assigned to complete the work, with the bonding company paying the difference between the new contract price of $1,063,095 and the original low bid of $991,000.

The Masers had about half finished the excavation, handling the heavy boulder strewn till as a scraper operation. The heavy till was taking its toll on the scraping equipment. The firm had bid about 34 cents a yard and was reportedly claiming an actual cost of 54 cents. They "did not have the funds with which to defray the cost of further construction operations".

The Tecon Corporation, whose bid was the lowest of four for completion of the job, is already the operator of the aggregate plant supplying all the sand and stone for NYSPA. They will complete the lock excavation as a shovel and dragline operation. Jack and Jim Maser Inc. was not the only contractor having troubles moving the heavy glacial till of the area, which is like glue when wet and weighs 140 lb. per cubic foot.

Design by Corps of Engineers at the Buffalo district office, of an emergency 46 ft. vertical lift 50 ft. wide seaway lock gate for the Rob-

inson Bay lock on the new Long Sault canal, raised a number of interesting hydraulic problems. What were the hydraulic forces to be considered in the design of a gate to be raised into flowing water?

Model studies were carried out by the Corps' St. Paul district of the University of Minnesota. These showed that (1) overflow aerates without vents, and (2) free overfall would start when gate crest height reached about 22 feet above channel bottom.

The resulting design is a horizontally framed gate with a sheet steel skin on the upstream side only. It will weigh 350 tons and will be lifted by two hydraulic cylinders. Two 75-hp. motors will drive pumps for the cylinders, raising the gate at a speed of 2 ft. per minute. The gate will be built in place, with stoplogs upstream to permit dewatering for future painting and maintenance.

Seaways Effect on B.C. Economy

In an address at Vancouver during his recent tour of the western provinces, seaway president Lionel Chevrier commented on the probable effects of the seaway on British Columbia's economy. He did not believe the B.C. fishing industry would benefit directly, although industrial development in the Montreal-Toronto area would increase the market for canned fish.

Regarding the fruit industry, most rail shipments of B.C. apples terminate in the Prairie Provinces and Ontario. The proportion that goes to Quebec might reap some benefit, although through rail shipments were more likely. Large east-west movements of paper products do not occur, he pointed out. However, the seaway should help B.C. lumber shipments consigned to Great Lakes points.

Wheat exports from Pacific Coast outlets were destined for three main areas, he stated; namely the Near East including Japan, the west coast of South America, and Western Europe. Prince Rupert and Vancouver were the logical outlets to the Near-East. Argentine grain to South American points has to be bagged, he said. Canada has a large bagging plant on the west coast, which will maintain the shipping route for grain via the west coast.

There were also numerous shipping lines operating from west coast points to South America, while more than 60 per cent of the grain moving through Montreal moves by liner service. The shipping pattern of grain was mostly the direct result of availability of spot cargo on the west coast. Partial loads of wheat out of west coast ports helped solve shipping companies' problems. The Alberta Wheat Pool had recently decided to enlarge the capacity of its Vancouver elevator by 50 per cent, he added. This was evidence that there was no fear of the seaway drying up the flow of wheat through Canada's west coast ports.

Commission on Coastal Trade

During the public hearings before the Royal Commission on coasting trade in Canada in some 14 cities from St. John's to Victoria, about 115 briefs will have been dealt with. Any number of arguments both for and against restrictions have been submitted in briefs and oral representations; some of them involve decisions on a good many aspects other than the strictly coasting trade.

In summary, the proponents of restrictive legislation point in the main to national security reasons for maintaining the shipyards, if necessary with subsidies. But they emphasize almost equally strongly that this country should retain control of its water transportation facilities in any case. Without such control, they maintain, we might in short order become dependent on other nations for services which are vital to our whole economy as well as to defense.

The opposition to the proposed changes in the Canada shipping act is somewhat more diversified. The grain growers' fear of being priced still further out of possible markets abroad is matched by Newfoundland's apprehension with regard to export sales of the primary products there. With specific reference to the seaway, it is claimed that it would not be logical to remove a natural barrier to shipping, only to replace it with an "artificial," legislative obstacle in the form of restrictions.

Throughout many opposing briefs runs the idea that Canada must continue to buy such services as shipping and products like ships from United Kingdom in order to provide dollar earnings. If we don't, they say, we will only still further worsen a situation already precarious in the U.K.-Canada trade balance.

Few, if any, of the restriction opponents deny that both shipyards and ships may be needed for defence. But if that is so, they suggest, let the whole country pay for it equally, through direct subsidies. One thing seems certain: it will be a long time, probably several months, before the evidence taken can be sorted, evaluated and compressed into a report with recommendations. Even then there may be further delay while the government makes up its mind about the action it will take

No Excess Transportation Being Developed

Addressing members of the New England Railroad Club at Boston, Mass., on November 9, President Lionel Chevrier of Canada's Seaway Authority stressed the economic growth of North America from 1932, when a treaty calling for construction of the seaway had been first negotiated between the United States and Canada.

"Twenty-three years ago it was perhaps not unreasonable for certain groups to have taken the view that in building the seaway we would be equipping ourselves with excess facilities, whether in electric power, in navigation, or in both. Today, or at least three years hence when the seaway is completed, I submit that we will find we are going to have no more than a comforable margin," he declared.

Quoting leaders of the steel industry in the United States as foreseeing a probable 60,000,000-ton increase in steel-making capacity within the next 15 years Mr. Chevrier said "the additional ore requirements to utilize such an increase in capacity dwarfs the expected normal output of present Quebec-Labrador mines and this is expected to be the most important single item of traffic on the seaway. It is not easy to visualize the scale of ancillary economic developments that would spring from the vast increase in steel output and the additional demands for transportation therefrom."

"One of the anticipated consequences of the seaway is the growth of industrial areas along both sides of the St. Lawrence Valley based on the power and navigation advantages," the St. Lawrence Seaway Authority president stated. The area above Montreal is now only moderately industrialized, he said, "the presence of a strong new industrial nucleus in this area is bound to have repercussions on surrounding areas such as New England. The traffic potential, par-

ticularly in general merchandise traffic, between two industrialized areas is much greater than that between industrial and non-industrial areas."

Pointing out that non-industrial areas tend to be the hinterlands of the nearest manufacturing and distributing centres, he said he did not believe the present traffic between the Upper St. Lawrence Valley and the industrialized areas of lower New England could be considered heavy by any standard. Industrial areas however, Mr. Chevrier pointed out, exchange traffic readily with other industrial areas, and where the distances are not great the volumes may become very large.

"It would therefore appear altogether probable that a greatly increased flow of traffic between the seaway area and New England would result from the expansion of industry and population in the seaway area. This would be to the advantage of both areas and to the transportation lines that connect them," he believed.

"Two other factors should of course be mentioned as tending toward the same result; he added:— "The greatly improved efficiency of land transport during the last 25 years, and the fact that traffic on the seaway will be subject to tolls designed to make it a self-supporting enterprise. In my opinion we are building the seaway at a most opportune time both from the point of view of its necessity and the relative ease with which it promises to be integrated into the transportation systems of our two countries."

Other Seaway News

Representatives of NYSPA and the New York State Department of Commerce met in New York City October 11, to set up a close working arrangement for the purpose of attracting industry to Northern New York. It was determined as a general principle that companies that will provide maximum additional employment for residents would be given priority in the drive to attract new industries. The sites will be available on the St. Lawrence between Massena and Ogdensburg.

President Lionel Chevrier, addressing civic officials and prominent citizens of metropolitan Montreal on October 10, assured them that their fears that water levels in Lakes St. Francis and St. Louis would be affected by the seaway were groundless. There might be an ensuing variation of a few inches, he said, but no more.

At its meeting on November 12, the majority of members of the New York State Power Authority approved contracts for the sale of power to the Public Service Commission of the State of Vermont, the city of Plattsburgh and the Plattsburgh air base. New transmission facilities are required between Massena and the Plattsburgh area. Two methods of providing these facilities are under consideration by the Authority.

In the event that an agreement with these companies for these back-up facilities can be settled promptly, the second method will be the one adopted. On the other hand, if such an agreement is not reached within thirty days, the Authority will follow the first method and will take the necessary steps to provide facilities for the delivery of all power, including back-up to Vermont.

The Authority also approved a resolution granting an easement to the Aluminum Company of America in the Massena intake works to construct permanent pumps to provide a potable water supply for the village of Massena and to care for the water needs in Alcoa. The Authority will construct the necessary pipe lines. The Authority also approved a program for the relocation of cottages and houses on the St. Lawrence project.

Technical Sections in Branches

Not long ago the general secretary asked C. E. Frost, M.E.I.C., chairman of the Montreal Branch, to set down on paper some notes on the experience of this branch with technical sections, it having had the widest experience of any branch. It was thought that such an account might be of value to other branches which might be thinking of establishing them.

Mr. Frost's report gives a detailed history of the creation of branch sections and offers some comment on successful and unsuccessful methods of integrating them into the general framework of the branch. As those parts of the report which apply to the Montreal Branch's special problems are not of widespread interest, this abstract is confined to matters which affect all branches alike.

The first point to be made is that a technical section is likely to be successful only when it is organized in response to a demand from a sufficient number of members to guarantee that it will not die of malnutrition. And there must be a reasonable probability that the accession of new members from year to year will at least balance the natural loss of senior members from deaths, retirements, changes of residence or of interest and the like.

Second, each technical section must always include among its members some who are able and willing to work to keep it going. Perhaps its program committee is its most important one. This committee must not only provide a suitable program for its own section, but must avoid overlapping or duplicating any part of the programs of other sections or of its parent branch. To this end it should be represented on the branch's main program committee and its representative should take his job seriously—attend meetings and not try to conduct business by telephone calls and by casual conversations. No section should attempt too ambitious a program; some have died of a surfeit.

Third, having established a technical section, the branch should not leave it wholly to its own devices, but should maintain an interest in it and always be ready with sympathy, advice and help. An ignored section will have a hard time existing, and even if it does succeed in keeping going, will be less effective than it would be under happier conditions.

Fourth, it is suggested that a technical section should be assigned an appropriate sum from the branch budget, money that it can spend of its own volition. The branch treasurer can control the section's financial affairs by requiring regular audited reports from it. Having a little money of its own gives a section a useful sense of independence and does not necessarily lead to extravagance.

Fifth and last, no branch should hesitate to close down any technical section which is obviously failing to carry on as it should. Such a section can sometimes be consolidated with another to their mutual advantage.

To sum up:

Active technical sections are assets to any branch.

They should not be established

unless there are reasonable guarantees that they will flourish.

They should have a reasonable amount of independence, consistent with proper control by the branch.

They should be closed down or consolidated before actual failure, if they show signs of impending death.

There are other points which could be covered by this memorandum, but we believe they are minor ones.

Technical sections, properly organized and properly administered, are a source of strength, as branches which have them well know. For example, they may enlist the interest of the member with the one-track mind, the one who is really interested only in his own specialty, and who would otherwise attend meetings but seldom.

Perhaps one of the most important usefulnesses of a technical section is that it brings more members into committee work. The Montreal Branch questionnaire showed that a high percentage of those replying were prepared to act on committees. The more members of a branch there are working on committees the stronger the branch will be, and it is the members serving on committees who themselves will profit most from this additional activity.

The Montreal Branch has seven different technical sections as follows:

Chemical, Civil, Electrical, Industrial and Management, Transportation, Mechanical, Radio and Communications.

It must not be thought that a branch has to enter into such a large program in the beginning. For instance the Winnipeg Branch had an electrical section for about eight years before they set up their second section, civil engineering. There is no reason why a branch might not readily set up a single section to meet the special demands of any group that is particularly active in their area. Then later if a need is shown for other sections they, too, can be organized in due course.

The general secretary's office has in its files considerable material relating to technical sections and several members of headquarters' staff have some knowledge of or experience with them. They will be happy to assist, so far as possible, any branch considering organizing a technical section.

Officers of the Institute and the Branches

The familiar "Officers Pages" will appear again in full in the January 1956 issue. Meanwhile the following corrections are offered as a means of bringing up to date pages 1442 to 1444 of the October issue, 1955, which listed officers of the Institute and of the Branches.

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Cochrane, Ont.

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Executive, T. C. ROBERTSON
J. W. SMITH — J. F. McCALLUM
(Ex-Officio), F. A. ORANGE
R. H. MOORE
Sec.-Treas., H. M. WHITTLES,
10 Wembley Drive,
Sudbury, Ont.

IATA Meets in New York

The tenth annual meeting of the International Air Transport Association was held at the Waldorf Astoria Hotel, New York City, October 17 to 21, 1955. Some 250 delegates from the 75 member airlines of 40 countries, and observers, were in attendance. Juan T. Trippe, president, Pan American World Airways, was elected president of the Association for 1956, succeeding Max Hymans, of Air-France.

Director General Sir William Hildred, in his annual report, said airline traffic for the last year had shown "definitely healthy though not spectacular" increases (passengers 14 per cent, cargo 8 per cent, and mail 18 per cent) over 1953. "Prospects for continued increase lie in the maximum possible extension of tourist operations," he observed, "and in intensified efforts to tap the mass market for air cargo".

Equipment modernization programs by IATA members of $200 million had provided 15 per cent more capacity with an increase of only 1 per cent of total fleet. But net operating profit of all scheduled airlines was only 3 per cent, or $70 million, last year. "It becomes self evident we must look to government aid to help us out in one way or another," he declared.

Incoming president Juan Trippe told delegates that "the two greatest impediments to economic advancement of air transportation have been 'fear' and 'fare'. The fear of flight has been very largely dissipated. . . ." Referring to President Eisenhower's report on the results of the Geneva Conference, he pointed out that "international airlines are the instruments best equipped to implement this Spirit of Geneva".

Technical Committee Report

Raymond Dupré, vice-president and operations director, Air France, and chairman of the IATA technical committee, warned that the state of navigation aids and ground organization on which aircraft are wholly dependent is currently lagging behind the state of our aircraft by about five years.

"The need to carry excessive fuel loads, delays in departure, slow handling due to inadequate terminal facilities, inefficient routing or assignment to uneconomic alti-

tudes, excessive flight time resulting from inadequate and delayed weather information and inefficient communications — all these are problems we are forced to live with today. Although able to survive economically with today's aircraft, in the future this will be increasingly difficult because of much higher operating costs when considered on an aircraft-mile basis," he predicted.

Reviewing IATA efforts to attain lower safe operating limits for approach and landing as an imperative objective, Mr. Dupré said his committee had found electronic developments have progressed to such an extent that, with existing aircraft, any immediate development can only come from improvements on the visual side. "The urgent and pre-eminent need," it had declared, "is to see what can be done to improve threshold and runway lighting".

Turning to the need for revision of the criteria which determine whether a pilot must fly under visual flight rules or under instrument conditions, the committee had concluded that "the ultimate solution can only lie in the full control of all air traffic at all times," he stated. They had recommended an increase in the criteria separating instrument from visual flight rules as a step in the right direction.

The airlines had now succeeded in gaining increasing recognition by governments of the need for operational control of scheduled flights by the carrier, the committee's report said. The report also warned that concepts on which procedures for feeding weather data to aircraft in flight are based are becoming outmoded, due to the appearance of very long range aircraft.

In air-to-ground communications, IATA is attempting to attain universal standardization of radiotelephony procedures in all regions. This was important because in aviation the preferred medium was now the spoken word of radio telephony. The systems of selective calling (SELCAL) of aircraft now in use in some parts of the world permits pilot and ground to call each other on what amounts to a dialing system.

The committee reiterated the airlines' view that 10 to 20 years will elapse before international operational requirements will necessitate replacement of VOR, and urged that governments fulfil the ICAO regional plans for VOR networks at the earliest possible moment. While it considered the current TACAN/VOR dispute as primarily a domestic matter, they pointed out that TACAN is as yet operationally unproven.

In long distance navigation, airlines are watching a new system known as "inertial navigation," which is self-contained in the aircraft.

Conclusion

Summarizing the results of the meeting at its conclusion, President-elect Trippe commented that IATA's first policy target was better facilities. Present aircraft were already carrying greater loads than their terminals can handle, and outrunning present aids and facilities. With new generations of aircraft on order these matters had become serious and pressing. He emphasized that this was *not* a safety problem, but airlines were operating uneconomically. If long continued, these extra costs would be passed on to the public in the form of higher tariffs.

Elections and Tranfers

At the meeting of Council held at Winnipeg, Manitoba, on Saturday, November 19, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

R. H. Aspinall, *Peterborough*
F. W. Bainborough, *Espanola, Ont.*
L. G. Bangs, *London*
L. Baskin, *Niagara Falls*
T. A. Bowles, *Toronto*
N. P. Bruce, *Toronto*
T. H. Chapman, *North Bay*
C. L. Cosser, *Montreal*
D. S. Cotterill, *Hamilton*
W. B. Drowley, *Toronto*
S. M. Finlayson, *Montreal*
J. J. A. Hall, *Brantford*
R. K. Hesse, *Waterloo, Que.*
F. Jackson, *Falconbridge*
L. E. Jones, *Toronto*
E. A. Koivula, *Arvida*
B. C. Lewall, *Prince George*
Z. J. N. Li, *Montreal*
R. G. Mason, *Calgary*
D. McNeill, *Montreal*
C. W. Parsons, *Toronto*
C. A. Peter, *Montreal*
P. R. Purcell, *Ottawa*
W. K. Rybczynski, *St. Johns, Que.*
W. F. Sharon, *Toronto*
E. W. O. Snikeris, *St. John's*
F. K. Stone, *Whitehorse*
M. Tirkanits, *Toronto*
W. A. Trow,
H. J. F. Vandernoot, *Montreal*
J. M. F. Vickers, *Lincoln, Neb.*
S. S. Vozoris, *Toronto*
A. A. Walker, *Kitchener*
M. S. Ward, *Montreal*
J. E. Wright, *Toronto*
A. Zsolt, *Toronto*

Juniors:

O. Y. Barde, *Montreal*
B. W. Cosman, *Kingshurst*
J. A. Dake, *Montreal*
E. D'Souza, *Quebec*
H. E. Ford, *Montreal*
K. R. Langille, *Halifax*
W. W. Lutek, *S. Ste. Marie*
J. P. Mulvin, *Seven Islands*
A. D. North, *Montreal*
W. M. Rea, *Calgary*
L. N. Savoie, *Windsor*
H. D. Stevenson, *Hamilton*
I. E. Suchoversky, *Kingston*
P. R. Thompson, *North Bay*
W. I. M. Turner, *Montreal*
K. H. Wu, *Winnipeg*

For Admission as Affiliate:

M. Corriveau, *Chicoutimi*

Transferred from the class of Junior to that of Member:

H. M. Lapp, *Winnipeg*
D. G. McKay, *St. John's, Que.*
J. L. Motherwell, *Whitehorse*
E. J. Penrose, *Montreal*
J. H. Turner, *Montreal*
M. G. Spankie, *Montreal*
N. M. Warner, *London*

Transferred from the class of Student to that of Junior:

T. D. Ray, *Windsor*
S. E. Steeves, *Grand Falls*

The following Students were admitted:

University of Ottawa

R. J. R. Amyot	F. Milotte
J. G. Beaudoin	P. Mulas
R. Belasky	J. D. A. Pelletier
B. J. T. Berrigan	M. O. Pelletier
M. Bilodeau	J. E. Porter
P. R. G. Boucher	J. M. Poulin
J. W. Brennan	D. Pover
D. M. Cameron	A. Proulx
X. H. Chu	R. J. L. Quesnel
J. A. Daoust	R. Ranger
M. E. Dugas	R. Raymond
G. Fung	A. P. Rivard
V. Gauthier	J. J. Robinson
J. C. Gervais	J. W. Rooney
C. A. Giguere	P. M. Roy
M. Gratton	A. P. Seguin
C. K. Ho	J. E. Stanton
B. C. H. Kwan	R. Surprenant
K. H. Kwan	W. B. Sutherland
A. Lafleur	K. F. Tam
H. D. Lajeunesse	J. Therrien
J. A. M. Lalancette	R. Thibaudeau
H. C. L. Lam	A. H. L. Tong
J. P. Landolt	R. Trudel
B. Larose	J. G. Vachon
V. A. Levers, Jr.	C. J. Vibert
M. D. Mahoney	E. Vincent
N. Maniatis	G. Vinette
R. Masse	W. T. C. Wu

University of Alberta

J. F. Adam	N. Oneschuk
D. E. Bateman	G. W. Richards
G. L. Brown	C. Skene
W. H. Curtis	G. Sveinunggaard
J. S. Graham	R. K. Ulveland
A. W. Hagen	C. E. Wilson
D. A. Hodgkinson	S. W. Wilson
J. G. MacGregor	

University of New Brunswick

L. A. Brewer, H. R. Friars, T. E. Bursey, R. C. Hale, G. R. Campbell, G. C. Harper, Miss S. E. Caughey, M. E. Joseph, W. J. Dohaney, R. A. Ouellette, D. B. Douglas, E. D. Stephenson, H. Foerstel, G. B. Watson

University of Toronto

N. Alexeichenko, J. E. Hurst, T. J. Bradshaw, R. W. Piggott

Memorial University

R. R. Andrews, R. E. Whitten, D. J. Squires

Nova Scotia Technical College

C. J. A. DeLory, G. R. V. Goad, J. W. Earle, E. M. Wright, A. E. Garrett

Ecole Polytechnique

J. J. Rivest, C. A. Roberge

McGill University

J. A. A. Dupuis, A. Maloney, T. V. Evangelatos, K. Niland, I. Granich, A. R. Thimens, J. A. Hatzidakis, I. Wajs, G. Kowalski

University of Manitoba

W. E. Blore, J. E. Konrad

Queen's University

J. H. Graham

Carleton College

R. Rai

St. Francis Xavier University

F. H. Vanzutphen

Royal Military College

J. M. Cote

Graduates

J. E. Karpa, B.Sc. (Mech.) 1955, Manitoba.

A. D. Derry, B Eng. (Civil) 1955, McGill.

W. B. Chown, B.A.Sc. (Civil) 1955, Toronto.

H. N. Dixon, B.Sc. (Elect.) 1955, New Brunswick.

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Association of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members:

L. S. Dartnell, R. Shortreed, W. G. Palmer, D. A. Smith, G. Westra

Junior:

D. Harvey-Smith

Junior to Member:

H. A. Bowman

SASKATCHEWAN

Members:

J. Bazuin, J. L. Lee, H. Kaldor, R. J. Wilson

Junior to Member:

K. R. Craig, G. M. McKay, M. R. Gunderson, M. N. Tivy, J. H. Kearney

NEW BRUNSWICK

Junior to Member:

D. R. Robidoux

Thirty-five Years Ago

Comment on the *JOURNAL* of December 1920

Following the late war, it is noticeable that the number of "foreign" engineers joining the Institute increased sharply. By "foreign" we mean those who had recently come to Canada and who had received their educations abroad. Perhaps this is a phenomenon which follows every great war, for the same trend showed itself after the 1914-18 struggle, as even a casual inspection of the *Journal* for December, 1920, shows. There we find candidates for membership from many engineering schools of the Old World — from London, from the Royal of Ireland, from Glasgow, from Le College de Dieppe, from Dublin, from the City and Guilds, from Liverpool, from the Federal of Zurich, from Geneva and from the Vienna Technik, to mention only a few.

There are those who feel strongly that engineering in Canada should be done exclusively by native-born Canadian engineers, a thesis with which the writer cannot agree. The test of whether a commission should be entrusted to this or to that engineer ought to be wholly a matter of which one has the greater ability. By all means let us use the talents of Canadian engineers to their greatest extent, but let us not play dog in the manger and try to exclude from Canada those who are perhaps more competent in some ways than we. And do not let us forget that some of our most brilliant engineers and best citizens were once fairly recent immigrants.

We believe we have in Canada a pool of engineering talent at least equal to that existing elsewhere and we deprecate the attitude of those who feel that the only competent engineer for a really big job must necessarily come from New York or London, an attitude which we think is unfortunately too common, but we have no sympathy with the ultranationalists in our profession.

Engineering Standards

Four to five pages were devoted in this *Journal* to an account of a meeting of the Canadian Engineering Standards Association, by far the most publicity the *Journal* had ever given it. Rail and track, wire rope, steel bridges, electrical equipment, steel, cement and concrete, machine parts, mining drill chucks and aircraft were the topics under consideration. The secretary of the C.E.S.A. was then R. J. Durley, M.E.I.C., who later became the Institute's general secretary and served it faithfully and well until his retirement.

Dr. A. L. Clark, professor of physics at Queen's University wrote the editor to say that it had set up a course in engineering physics two years before McGill's, which we referred to in last month's notes. The editor's riposte was that the McGill course was the first to lead to an M.Sc. degree.

This *Journal* congratulates P. L. Pratley, M.E.I.C., on being awarded the Telford gold medal of the Institution of Civil Engineers for his paper on the "Design and Construction of the Saint John Arch". Incidentally, there is a scale model of this bridge at McGill University, made by one of the engineers who worked on it as a junior.

Technical Papers

G. A. Walkem, M.E.I.C., leads off the technical papers with "Railway Construction with the Royal Engineers in Palestine," as readable today as when it was written. Col. Walkem early ran into army procedure: ". . . I told them I was a mechanical engineer, presuming that they would put me in the mechanical department, but that is not the British army's way, and they gave me charge of maintenance . . . then of construction . . ." Some of the work was a nightmare, but there were compensations, e.g., with no right of way to stay within, No. 7 frogs were used throughout. The rolling stock was not of the best: "There were no brakes on the trucks. They used three links for coupling. . . . When you rode . . . at the end of a train . . . and the locomotive would take up the slack, the jerk . . . was tremendous. . . . Often the train pulled apart, when the back part would run down the grade until it came to an upgrade, when it . . . came to rest."

F. P. Vaughan, M.E.I.C., had a paper on "Practical Applications of

Electric Welding," in this *Journal*, notable perhaps because it described the first automatic welder, which had just been put on the market. The illustration showed it putting a layer of metal on an undersized shaft.

The Nova Scotia Power Commission was getting ready to start its Sheet Harbour project, which was described by H. S. Johnston, A.M.E.I.C. The author quoted figures for the cost of electric power from a number of steam plants in the area, 7½ to over 15 cents per kilowatt hour, and this where coal was practically at one's front door. In contrast, it was estimated that power could be delivered from Sheet Harbour for 1¼ cents per kilowatt hour at the consumer's premises.

Public Service for Engineers

At the end of 1920, the *Journal's* editor was still trying to get more Institute members into some form of public life. One, Reid McManus, A.M.E.I.C., of Moncton, had just been elected to the provincial legislature of New Brunswick, but there were other things the editor thought engineers might do: "There are . . . men in the . . . Institute capable of writing . . . editorials on the . . . phases of the profession's activities (whereby) the general public is affected, which would be quoted by the daily press." Well, maybe, but the experience of the present editors of this periodical is that, while the engineer's opinions may be sound and even brilliant, not many are skilful at getting them down on paper.

The Branches

The Peterborough Branch celebrated its first anniversary; the Toronto Branch was a little worried because a shortage of coal imported from the United States might develop sometime in the next hundred years and suggested "an embargo on the use of coal in Ontario for purposes for which electrical power could be used"; the Moncton Branch gave C. B. Brown, M.E.I.C., now retired, a send-off on his being appointed engineering assistant to the vice-president of the Canadian National Railways in Toronto; the Saint John Branch set up an entertainment committee to enliven its meetings; the Vancouver Branch learned from one of its speakers that even a first-class commercial air pilot could expect to be involved in a crash about once in every 700 flying hours; the Hamilton Branch envisioned an era of great prosperity following the opening of the St. Lawrence Seaway "in the near future"; and the Winnipeg Branch worked up considerable enthusiasm over the prospects of high voltage, direct current transmission, as presented by the inventor of a new system of commutation for generators. All these activities were covered in considerable detail in the issue of the *Journal* we are reviewing here.

1920 may be put down as a year in which the Institute, so far as its affairs were reported in the *Journal*, made considerable advances, not only in numbers, but in arousing the interest of its members and in its prestige with the public at large.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

David Hutchison, M.E.I.C., retired development engineer with the Power Corporation of Canada in Montreal, died on September 17, 1955, in Owen Sound, Ont., after a brief illness.

Mr. Hutchinson was born in Owen Sound, Ont., on July 31, 1892, and received his general education at Lindenwood School and Owen Sound Collegiate. After teaching school for a short time at Shouldice and Presqu'Isle he entered Queen's University, graduating in 1924 with a B.Sc. (honours) degree in engineering.

Before his graduation he was with Foundation Company of Canada Ltd., working as a diver during the summer months, and after obtaining his degree Mr. Hutchinson remained with Foundation as an engineer and diver engaged on underwater inspection until 1926. That year he became field engineer for the company on the Gatineau Storage Baskatong Reservoir. He became associated with the Power Corporation of Canada in December, 1926, as construction superintendent.

He left Power Corporation in 1938 to become manager of Mackenzie River Transport for the Hudson Bay Company in Winnipeg, Man., and was transferred by the company to Edmonton in 1946 as manager of the transport department. Then, in 1948, Mr. Hutchinson rejoined the Power Corporation as superintendent in Montreal, subsequently becoming development engineer until his retirement in May, 1955.

Mr. Hutchinson had been an active member of the Engineering Institute, having joined in 1932 as an Associate Member, transferring to Member in 1940. He was chairman of the Edmonton Branch of the Institute in 1943.

David Hutchison, M.E.I.C.

Paul Joncas, M.E.I.C., professor emeritus of Laval University, died in Quebec City on October 24, 1955, following a lengthy illness.

Mr. Joncas was born at Grande Rivière, Que., on July 6, 1883, and received his early education at the Quebec Seminary. In 1908 he graduated from Ecole Polytechnique in Montreal with a B.A.Sc. degree in civil engineering, working during the summers of his course as a rodman and instrumentman with the Quebec Atlantic and Western Railway.

After graduation Mr. Joncas was appointed professor of the newly founded School of Surveying and Forestry Engineering at Laval University. In 1910 he was named director of studies at the university, a position he held for forty years until his retirement in 1950.

Mr. Joncas was also a partner in the firm of Joncas and Malouin in Quebec City, engaged in municipal works for neighbouring towns and corporations.

He was a member of the Corporation of Land Surveyors, serving as president from 1941 to 1945. He was also a member of the Corporation of Professional Engineers of Quebec, the Association of Forestry Engineers of Quebec, and of the Canadian Institute of Surveying and Photographic Surveying.

Mr. Joncas became an Associate Member of the Engineering Institute in 1913 and transferred to Member in 1940.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

News of Members

H. B. Dulmage has accepted a position as project engineer with Collins Radio Company of Canada Ltd., 11 Bermondsey Road, Toronto 16. Before making this change he was in the electronics department of Canadian General Electric Co. Ltd., Toronto.

J. Jablonsky has left Wallace Carruthers and Associates Ltd., Toronto, to join the engineering staff of Farkas and Barron of Canada Ltd., of 7 Adelaide St. West, Toronto.

C. Rhodes is presently employed as a development engineer with Atomic Energy of Canada Ltd., at Chalk River, Ont. Before moving he was employed by Cockshutt Farm Equipment Ltd., of Brantford, Ont.

Glenn H. Curtis has joined Stone & Webster Canada Ltd., as engineering representative with headquarters in Toronto.

Following his graduation from the University of Toronto in 1948 he attended Harvard University and graduated in business administration in 1950. Since then he has been employed by a prominent construction company in Montreal.

D. H. W. Allan has left the position of metallurgical statistician at the Steel Company of Canada to join the American Iron and Steel Institute in New York City as a permanent staff member working on technical statistics for the steel industry.

Mr. Allan has recently been elected a Fellow of the American Society for Quality Control and appointed chairman of that Society's Metals Technical Committee. He has been active as an officer of the Toronto Section of A.S.Q.C. and is well known as a lecturer in statistical quality control at the Universities of Toronto and McMaster.

George Glinski, president of Data Processing Associates Ltd., Toronto, recently addressed the Comunications Technical Group of the Toronto Section, A.I.E.E., on the subject "Numerical Control—A New Concept in Machine Tool Automation". His talk covered a discussion of the meaning and importance of the automation concept and in particular one important method of automation, numerical control and its application to the control of machine tools.

Geoffrey P. Webb is joining the staff of Kennedy and Donkin, consulting engineers of London, S. W. 1, England. He will be engaged in design and contract work in the firm's hydro-electric division and later transferred to Caracas, Venezuela, as their representative for the Caroni hydro-electric scheme.

Mr. Webb is an engineering graduate of the University of London and served as a captain in the Royal Engineers in India and Burma from 1942 to 1946. On coming to Canada three years ago he completed the Canadian General Electric test course and spent a year in power transformer and switchgear sales. Prior to his move to England he was with the Aluminum Company of Canada Limited as an electrical engineer on the Saguenay hydro-electric system at Shipshaw, Que.

Canadian General Electric Changes

Announcement has been made recently of the appointment of **J. Herbert Smith,** a vice-president of Canadian General Electric Co. Ltd., as general manager of the company's apparatus department. He will make his headquarters at the company's heavy apparatus plant in Peterborough, Ont.

Mr. Smith succeeds **Archie M. Doyle,** who has been assigned to conduct a special study of the relations of the Canadian company with the apparatus sales division of General Electric Company. Mr. Doyle will report directly to the president of the Canadian General Electric Company and will make New York his headquarters.

Mr. Smith, who was for a number of years a member of Council of the Association and president in 1953, was named general manager of the C.G.E. wholesale department in 1951. In 1953 he was elected a vice-president and earlier this year was appointed general manager of the appliance department. He will retain this responsibility temporarily in addition to his function as general manager of the apparatus department.

Major J. H. Gillett, formerly of the Directorate of Electrical and Communications Development, Army Headquarters, Ottawa, has been posted to the Vancouver Wireless Section, Ladner, B.C.

Garth A. McDowell, who held the post of assistant to the Warden of Hart House, University of Toronto, has moved to Saskatoon, Sask., to become director of the Memorial Union Building of the University of Saskatchewan. Mr. McDowell graduated in electrical engineering from the University of Toronto in 1951.

With Saskatchewan Power Corporation

David N. Cass-Beggs, formerly associate professor of electrical engineering at the University of Toronto, has recently assumed his duties as general manager of the Saskatchewan Power Corporation. For almost nine years prior to his appointment he served as a consultant to the Corporation in several fields relative to Corporation development in hydro-electric power and natural gas.

Mr. Cass-Beggs was born in England and graduated from Manchester University in 1929. In 1939 he came to Canada and joined the engineering faculty of the University of Toronto. For the past three years he has been in charge of electrical engineering at the University College, Swansea, Wales, resigning this post last spring to join the Saskatchewan Power Corporation.

During World War II, while in Canada, he developed, for the R.C.A.F., the first automatically controlled human centrifuge or accelerator, important in the study of pilot and aircrew blackout reaction under high accelerations. This was later used extensively by the Allies.

Packard Directors

W. L. Hetherington and **Irving Lorenzen** have been appointed directors of Packard Electric Company Ltd., St. Catharines, Ont., to fill vacancies created by the death of **Arthur G. Herr,** and the retirement of **Frank Malloy.**

A graduate of the University of British Columbia, Mr. Hetherington joined Packard in 1941. During the war years he was on loan to The Steel Company of Canada as engineer in charge of installation and maintenance of all electrical equipment at its Montreal plants. Returning to Packard he specialized in the design of power and distribution transformers from 1946 to 1952, when he was appointed as engineer-in-charge of power and distribution transformers.

Mr. Lorenzen, who is a Toronto graduate, has been with Packard since 1927 and from 1929 to 1934 was in charge of

the design of distribution transformers. From 1934 to 1952 he specialized in the design and development of watthour meters, relays and instrument transformers. In 1952 he was appointed engineer-in-charge of instrument transformers.

Eric G. Jorgensen has moved from Hamilton, Ont., to Toronto, where he is supervising engineer with H. A. Babcock, consulting engineer, 119 Isabella Street, Toronto.

Prior to this change, Mr. Jorgensen was sales engineer with Union Screen plate Company of Canada Ltd., of Lennoxville, Que.

Eldon G. Yundt is county engineer of the County of Bruce with headquarters in Walkerton, Ont.

A graduate of civil engineering of the University of Toronto, 1945, Mr. Yundt was formerly assistant to the district municipal engineer of Ontario Hydro at Stratford, Ont.

F. P. J. Rimrott of Toronto has joined the staff of the Pennsylvania State University, University Park, Pa., as instructor in engineering mechanics.

For the past two years Mr. Rimrott has been on the staff of the Faculty of Applied Science and Engineering of the University of Toronto, where he obtained his M.A.Sc. in May of this year.

D. A. Pirtinnen has moved to Sarnia, Ont., where he is with Catalytic of Canada Construction Co. Ltd., as a project engineer. Mr. Pirtinnen is an engineering graduate of the University of British Columbia and previously was employed in the process department of Foundation of Canada Engineering Corporation Ltd., in Toronto.

M. F. McGrath has left the staff of Armstrong, Kingston, Hanson & Associates Ltd., Toronto and is employed by Onway Construction Ltd., Don Mills Road, Toronto.

E. G. Taylor has become associated with R. J. Cave & Associates, 1770 West Georgia Street, Vancouver, B.C., and is head of the municipal and civil engineering department. A graduate in engineering of Belfast University. Mr. Taylor was earlier with engineering consultants in Ontario before moving to British Columbia.

Clifford G. M. Eland is now with Abitibi Power & Paper Co. Ltd., as a design engineer in the Toronto engineering office of the company. Mr. Eland, who graduated from the University of Toronto in 1949, was formerly a design engineer with Provincial Paper Limited, in Thorold, Ont.

Norman Moysa is employed by the Shell Oil of Canada Ltd., and is located at the Shelburn Refinery, Vancouver, B.C. Prior to his move to Vancouver from Niagara Falls, Mr. Moysa was with Ontario Hydro.

V. D. Horvat has moved to Camden, N.J., where he is a transformer design engineer with RCA Victor division of the Radio Corporation of America.

Prior to this move, which took place in August, Mr. Horvat was in charge of engineering with the Acme Electric Corporation Ltd., of Toronto.

Frank Belshaw, of the Imperial Oil Ltd., has been transferred from the company's engineering division in the manufacturing department in Sarnia, Ont., to the head office in Toronto where he is project engineer in the construction and maintenance division of the marketing department.

Alberta

The Engineering Professions Act

On April 6 of this year the Lieutenant-Governor assented to "The Engineering Professions Act, 1955" being an Act to regulate the professions of engineering and geology. This Act replaced the previous one and reaffirmed and outlined the responsibilities which the Association assumes, to both the general public and its members. Its responsibilities are fundamentally the same as they always have been, but the methods of carrying them out have been changed and some of the procedures have been clarified and made more specific.

Major Responsibilities

Two major responsibilities are those of discipline and enforcement. The composition of the Discipline Committee and procedures for the discipline of members for conduct unbecoming a Professional Engineer, are very definitely set down and your Council has appointed the Committee, which is already functioning. Obviously this Committee cannot work effectively unless it receives information respecting any allegation of conduct unbecoming a Professional Engineer. Complaints to the Discipline Committee may be originated by any member or visitor, by the Council or by the Discipline Committee itself. Whereas the Council and Discipline Committee will do all in their power to ascertain any situation which should be investigated. it cannot work effectively if the membership at large does not bring such cases to its attentoin. It, therefore, is the responsibility of the membership at large to advise the Council or Discipline Committee of any matters which might be detrimental to the engineering profession.

Membership and Enforcement Committee

The function of the Discipline Committee is internal and deals with members and visitors of the Association. It is distinct from enforcement, which pertains to those who are not members of the Association. As enforcement and new membership are very akin, the Council has set up a new committee, known as the Membership and Enforcement Committee. Here again, the Committee and Council will do all in their power to carry on this function with the information at hand, but they must of necessity, appeal again to the membership at large to keep them advised of any case of infringements of the Act by those who are either not qualified or who have neglected to take out their membership.

Whereas the Council are willing to do everything they can to make the work of the Association effective, they cannot do so without the support of the membership at large because it is fundamentally "Your Association" and unless each and every member is willing to take his part in the affairs of the Association we cannot successfully carry out the responsibilities placed upon us as Professional Engineers.

(Reprinted from *The Alberta Professional Engineer,* Nov. 1955.)

Engineering Registration Rises 835 Students in 55-56 Faculty

Registration in engineering at the University of Alberta increased this year to the highest figure since the record veterans' registration of 970, making Alberta one of the largest engineering schools in Canada.

Dean Hardy in an interview stated that the Faculty was now well equipped to handle these numbers although some shortage of general classroom space was being experienced. He felt, however, that this was being remedied by reallocation of space made possible through completion of the Biological building and that when this changeover had been completed engineering would have satisfactory accommodation.

With an industrial development and building program unequalled in the western provinces it would appear that there will be no lack of opportunities in Alberta for these graduates.

Association Outgrows Office

Due to continued growth of membership and increase in services to the members, the Association office will be moved to new and larger quarters at 120 Commercial Building, 10120 Jasper Ave., Edmonton, about the end of the year.

We invite the members to drop in to visit us in our new quarters any time after the middle of January.

British Columbia

Engineers in the News

W. Choukalos has left Stolberg Construction Ltd. to go into partnership with Woodburn, Hooley and Partners. The firm has now changed its name to Choukalos, Woodburn and Hooley and has moved to a larger office at 435 W. Broadway.

W. J. Lund has accepted a position with Westminster Iron Works Ltd. in New Westminster. Mr. Lund, a 1953 mechanical graduate, had been with MacMillan and Bloedel Ltd. at the Harmac plant.

G. C. Tanner, a '51 civil engineering graduate of University of British Columbia, reports that he will be spending the next two years in Pakistan, where he will be working on dam and powerhouse construction for Angus Robertson Ltd. The work is being done under the Colombo Plan.

J. H. A. Forrester, a '52 University of British Columbia electrical graduate, at present with Canadian Westinghouse in Eastern Canada, has accepted a position with Sandwell and Co. Ltd., of Vancouver.

J. T. Turner was recently appointed vice-chairman of the Canadian Transit Association. The appointment is for a two-year period and carries with it the

(*Continued on page 1750*)

Personals

News of the Personal Activities of Members of the Institute

R. Harvey Self, M.E.I.C., has been named to the newly created position of assistant business administrator for the Toronto Board of Education. This new position will involve planning and supervision of all new buildings of the Board. Prior to this appointment Mr. Self had been with the Ontario Hydro Electric Power Commission as rehabilitation engineer on the St. Lawrence Power Project, in charge of the Hydro's program of moving people and industry from the path of the seaway project in the Iroquois area.

Mr. Self received his general education in Toronto and graduated from the University of Toronto in 1938 with a B.A.Sc. degree in civil engineering. Following graduation he joined the engineering department of Canada Packers Company Ltd. Until 1940, when he joined the construction department of the Ontario Hydro as construction engineer, Mr. Self was reinforced concrete design engineer with Canadian Kodak, Weston, Ont.; resident engineer with Brunner-Mond Ltd., Amherstburg, Ont.; design engineer with Canadian Industries Limited, Montreal; and estimator and superintendent with Bennett-Pratt Limited, Toronto.

R. Harvey Self, M.E.I.C.

For two years during the War—1943 to 1945—he was on loan to the Department of National Defence, Ottawa, as executive assistant to the chief engineer, Works and Building, Naval Service, and later as a special research engineer in the Directorate of Operational Research —Army.

Returning to the Ontario Hydro in 1945, Mr. Self was named construction project engineer, and generation construction engineer and department head in 1950.

Mr. Self, who joined the Institute in 1939 as an Associate Member and transferred to Member in 1940, has taken an active part in Institute affairs. He was instrumental in forming the junior section of the Toronto Branch early in the war, and after the war helped to organize Students' Night meetings. In 1953 he served on the executive of the Toronto Branch. Mr. Self was also on the committee for studying confederation of the Institute and the Associations.

W. L. Hetherington, M.E.I.C., has been named a director of Packard Electric Company Ltd. in St. Catharines, Ont.

Mr. Hetherington, a graduate of the University of British Columbia in electrical engineering, joined Packard in 1941. During the war years he was on loan to the Steel Company of Canada as engineer-in-charge of the installation and maintenance of all electrical equipment at their Montreal plant. He specialized in the design of power and distribution transformers from 1946 until his appointment as engineer-in-charge of power and distribution transformers in 1952.

W. L. Hetherington, M.E.I.C.

Mr. Hetherington is a member of the Association of Professional Engineers of Ontario, and of the American Institute of Electrical Engineers.

R. R. Colpitts, M.E.I.C.

Rolfe R. Colpitts, M.E.I.C., has joined the staff of the engineer-in-chief's department of Naval Technical Services of the Department of National Defence at Ottawa, as combustion engineer. He was formerly supervisor of station steam plants with the Canadian National Railways, Atlantic region, at Moncton, N.B, having joined the C.N.R. in 1947 as assistant mechanical engineer in Moncton.

Mr. Colpitts graduated from Nova Scotia Technical College in 1944 with a B.Eng. degree. After graduation he spent two years with the Canadian Army and then joined the Canadian International Paper Company at Dalhousie, N.B.

G. R. McMillin, M.E.I.C., has been transferred to Sarnia, Ont., as manager of the Imperial Oil Limited refinery there. He was previously in Dartmouth, N.S., as superintendent for the company.

Mr. McMillin graduated in 1933 from the University of Toronto with a B.A.Sc. degree in chemical engineering and joined Imperial Oil that same year as assistant in the inspection department at the Sarnia refinery. In 1938 he was transferred to the Toronto office as assistant in the manufacturing department and later that year was moved

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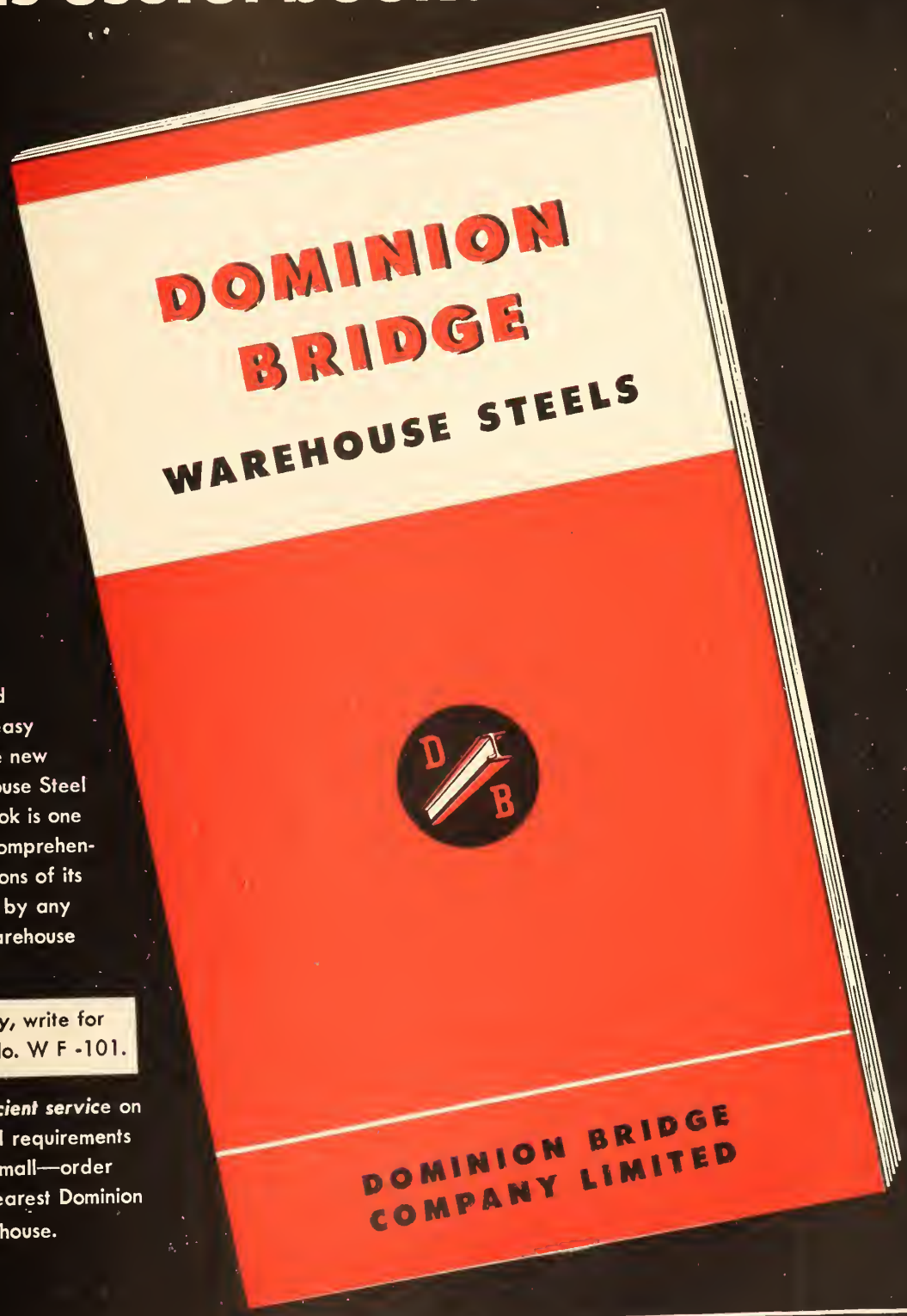

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• Personals

to Talara, Peru, where he became acting chief engineer in the inspection department of the International Petroleum Company. In 1939 he returned to Canada as chief engineer for the company's inspection department at the Imperial refinery at Dartmouth, N.S. In 1953 he was supervisor of the production control section of the company's engineering and development branch at Sarnia.

John C. Hamilton, M.E.I.C., has been appointed works manager for Canadian Resins and Chemicals Ltd., whose plants are located at Shawinigan Falls and Ste. Therese, Que.

Mr. Hamilton, general superintendent of plants since December 1953, joined the company in 1943. Previous to being named general superintendent, he was successively plant production supervisor and production superintendent for the company.

He graduated in 1942 from Queen's University with a degree in chemical engineering and spent some time with Canadian International Paper Company Ltd. at Three Rivers, Que., before joining Canadian Resins and Chemicals Ltd.

John Joseph Miller, M.E.I.C., has been named assistant chief engineer of the Aluminum Company of Canada Ltd. in

G. R. MeMillin, M.E.I.C.

Montreal. He was previously in Arvida with the company.

Mr. Miller spent some time as works manager for the Indian Aluminum Company in Bihar, India, in 1948-1949. Before going to India he was assistant superintendent of ore plants in Arvida with the Aluminum Company.

He graduated from the University of Toronto in 1939 with a B.A.Sc. degree.

Major R. B. Jennings, M.E.I.C., formerly claims and contract engineer of the Trans-Canada Highways Division of the Department of Public Works, is now associated with the department of planning and works of the City of Ottawa.

W. H. Cameron, M.E.I.C., has been named assistant manager of the Quality Construction Company at Calgary, Alta. He was previously in Winnipeg, Man. with Vulcan Iron and Engineering as estimator, and as municipal engineer at St. Vital, Man.

A 1951 civil engineering graduate of the University of Manitoba, Mr. Cameron has also been associated with the Central Mortgage and Housing Corporation as assistant resident engineer at Cold Lake, Alta.; with the Fraser Brace Company at St. Joseph d'Alma, Que.; and with the Pentagon Construction Company at Parent, Que.

T. T. Anderson, M.E.I.C., is now general superintendent of the reduction division for Aluminum Company of Canada Ltd. in Arvida, Que. He was previously assistant chief engineer in Montreal for the company.

Mr. Anderson graduated in 1942 from the University of British Columbia with a B.A.Sc. degree in chemical engineering. He joined Powell River Company Ltd. but later in the same year became associated with the Aluminum Company as assistant supervisor of the hydrate department of the Bayer Ore Plant in Arvida. In 1945 he was named superintendent of plant development at Arvida and came to Montreal for the company in 1949.

He served as secretary-treasurer of the Saguenay Branch of the Engineering Institute in 1948.

V. T. B. Williams, M.E.I.C., has been appointed sales manager of Alexander Fleck Ltd. in Ottawa. For the past three years Mr. Williams has been plant engineer for Columbia Cellulose Company Ltd. at Prince Rupert, B.C.

FOR TEMPERATURE CONTROL

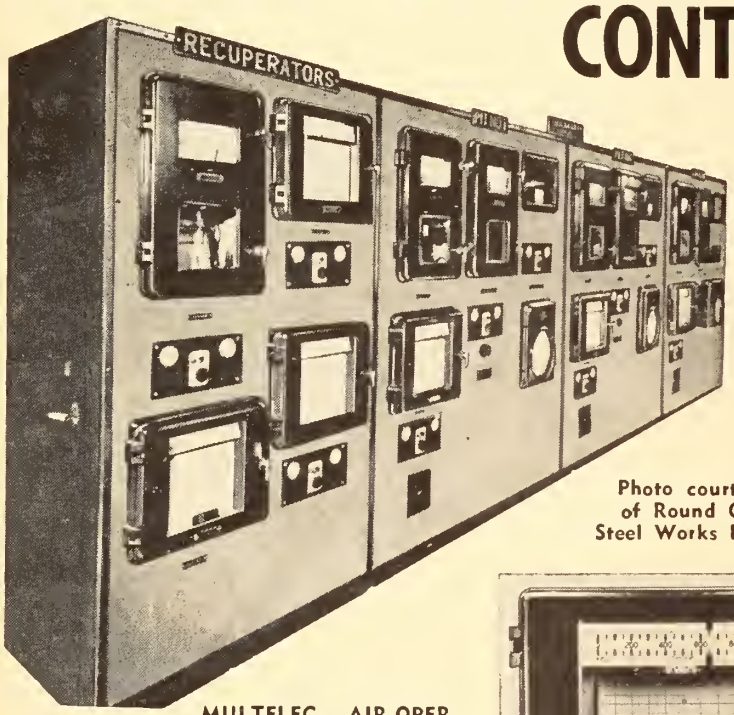
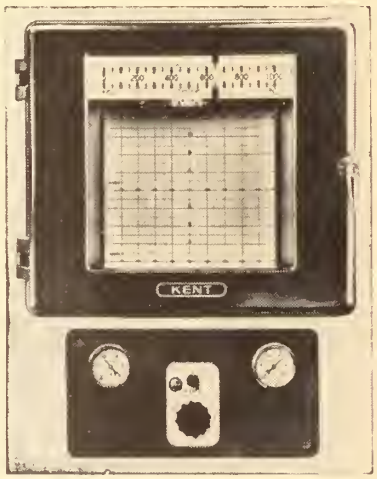


Photo courtesy of Round Oak Steel Works Ltd.



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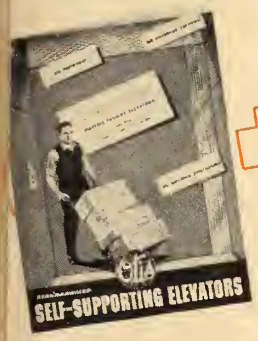

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• Personals

He graduated in 1938 from Nova Scotia Technical College in mechanical engineering and spent ten years with Canadian Ingersoll-Rand Company Ltd. as district engineer of both their Sydney, N.S. and Montreal branches, and was for a time in charge of the Sherbrooke, Que. sales branch. He has also been plant engineer of Saint John Sulphite Ltd. at Saint John, N.B., and was with Irving Pulp and Paper Company Ltd. in Fairville, N.B. for a time.

Mr. Williams has been chairman of the northern branch of the Association of Professional Engineers of British Columbia.

Charles W. Henry, M.E.I.C., transmission and distribution engineer with Newfoundland Light and Power Company Ltd. in St. John's, is secretary-treasurer of the Newfoundland Branch of the Engineering Institute.

Mr. Henry received his general education in New Brunswick and, after two years with the T. Eaton Company and with E. B. Eddy Company Ltd., he entered the University of New Brunswick, graduating in 1946 with a B.Sc. degree in electrical engineering.

In 1947 he became assistant distribution superintendent for C. A. Energia Electrica de Venezuela in Maracaibo, Venezuela, a position he held until 1950. Returning to Canada Mr. Henry became associated with the Newfoundland Light and Power Company at St. John's.

Mr. Henry joined the Engineering Institute in 1944 as a Student, transferring to Junior in 1948 and to Member in 1955. He is also a member of the Association of Professional Engineers of Newfoundland.

V. T. B. Williams, M.E.I.C.

A. E. Sibbick, M.E.I.C., is now in Hornepayne, Ont. where he was transferred by the Canadian National Railways as division engineer.

A civil engineering graduate of Queen's University, Mr. Sibbick was previously assistant division engineer in London, Ont. for the C.N.R.

Olav Mykleby, M.E.I.C., has taken a position as design engineer with the Ontario Hydro-Electric Power Commission in Toronto. He was formerly inspection engineer with Canadian Inspection and Testing Company Ltd., also in Toronto.

C. C. Simpson, M.E.I.C., has been transferred from the Vancouver office of Northern Electric Company Ltd. to the company's head office in Montreal as assistant power apparatus marketing manager. In Vancouver Mr. Simpson was manager of power apparatus sales in British Columbia.

Mr. Simpson has been with Northern Electric since his graduation in 1937 from the University of Alberta in electrical engineering. He was first in Edmonton with the company and in 1942 he came to Montreal in the general sales department, power apparatus division. He was transferred to Vancouver in 1948 to the position he held until his present appointment.

D. L. McGillivray, M.E.I.C., has been named assistant manager of the technical division of the marketing department of Imperial Oil Limited in Toronto. He has been with the company in Sarnia, Ont., and in Winnipeg, Man., as manager of industrial sales.

During the Second World War Mr. McGillivray obtained a leave of absence from Imperial Oil and served as technical advisor on petroleum products to the Royal Canadian Navy, with the rank of lieutenant commander.

He is a 1937 graduate of Queen's University with a degree in chemical engineering.

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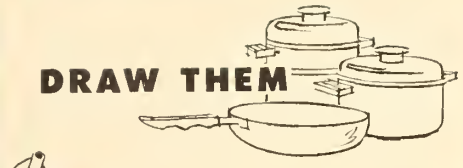

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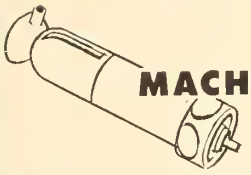

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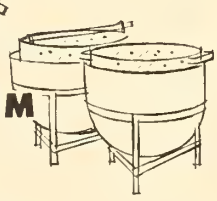

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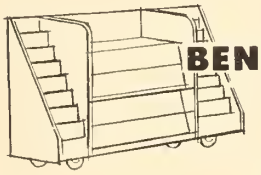

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• Personals

Jean R. Menard, M.E.I.C., senior engineer in the district engineer's office of the Department of Public Works in Rimouski, Que., is the new chairman of the Lower St. Lawrence Branch of the Engineering Institute.

A native of Beloeil, Que., Mr. Menard received a B.A. degree in 1938 from Ecole Polytechnique and later returned to receive a bachelor of engineering from the same institution in 1943. Upon graduation he enlisted in the Canadian Army and served overseas with the R.C.E.M.E. during the war, being discharged in 1946 with the rank of captain.

After a short period with Canadair Limited in Montreal he joined the Department of Public Works of Canada in the Quebec district. In 1948 he was transferred to Rimouski as assistant engineer.

Mr. Menard joined the Engineering Institute in 1941 as a Student, transferred to Junior in 1946 and to Member in 1951. He is also acting secretary-treasurer of the Lower St. Lawrence Branch of the Institute.

J. R. Menard, M.E.I.C.

A. D. Hamilton, M.E.I.C., is now general superintendent of the Quebec North Shore Paper Company at Baie Comeau, Que. He was previously with the Ontario Paper Company at Thorold, Ont., as control superintendent.

Mr. Hamilton graduated in 1940 from McGill University with a chemical engineering degree and joined Dominion Rubber Company Ltd. in Montreal. During the war he served overseas as a squadron leader with the R.C.A.F., returning to Dominion Rubber at the end of the war. He became associated with the Ontario Paper Company in July, 1946.

Robin R. Jackson, M.E.I.C., has accepted a position in the semi-conductor department of the Westinghouse Electric Corporation at Pittsburgh, Pa. Prior to his move to the United States, Mr. Jackson was with the radio and electrical engineering division of the National Research Council in Ottawa.

Mr. Jackson graduated from the University of Alberta in electrical engineering in 1944, and also completed a course at the Graduate School of Engineering of the Carnegie Institute of Technology.

T. K. Fowler, M.E.I.C., is now employed as mechanical engineer with Canadian Bechtel Limited of Vancouver, B.C., working in the design section of the Westcoast Pipeline Project.

Mr. Fowler, who graduated in 1950 from London University in mechanical engineering, was previously with the Interprovincial Pipeline Company in Edmonton, Alta.

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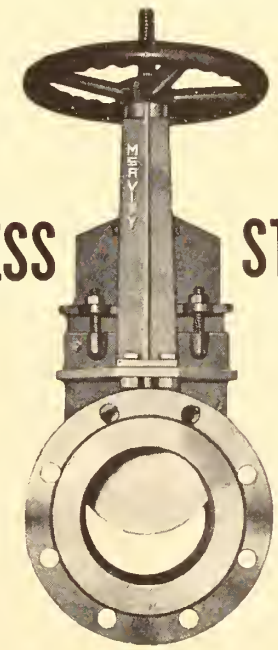

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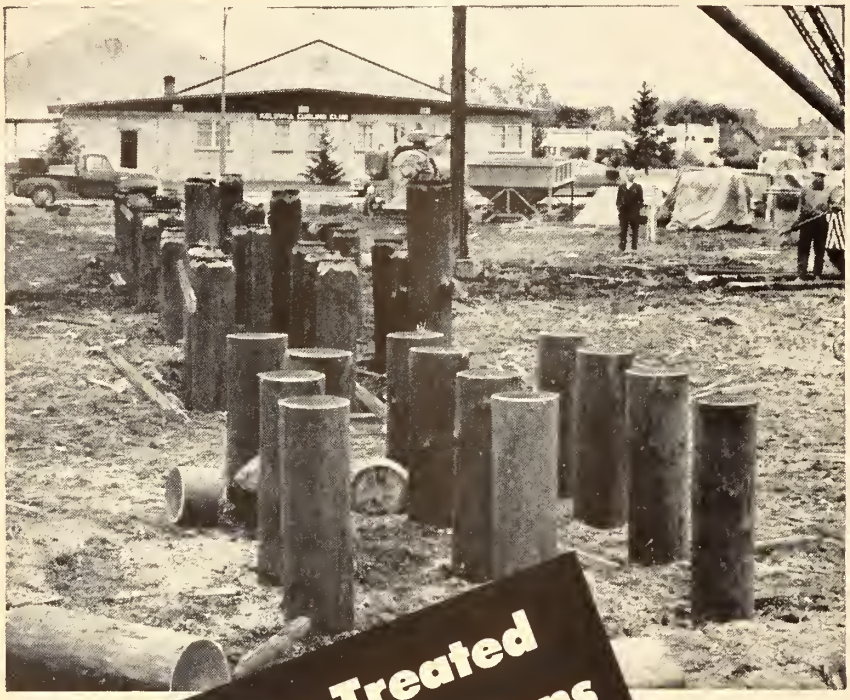

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• *Personals*

William O. Findlay, M.E.I.C., has been named project engineer for the Central Mortgage and Housing Corporation at the Petawawa military camp, Ont. He was formerly assistant engineer with H. G. Acres and Company Ltd. in Niagara Falls, Ont.

Mr. Findlay is a civil engineering graduate of St. Andrews University.

Eric G. Jorgensen, M.E.I.C., has been appointed supervising engineer with H. A. Babcock, consulting engineer of Toronto. Mr. Jorgensen was formerly sales engineer with Union Screen Plate Company of Canada Ltd. in Lennoxville, Que.

A 1949 civil engineering graduate of Queen's University, he has also been associated with Irvington Varnish and Insulator Company of Canada Ltd. in Hamilton, Ont., as plant engineer.

A. M. Kerr, M.E.I.C., is manager of production and construction for Davie Shipbuilding Limited at Lauzon, Levis, Que. Mr. Kerr was previously assistant manager for the company, also at Levis.

J. R. Johnston, M.E.I.C., is now chief petroleum engineer with Husky Oil & Refining Ltd. at Calgary, Alta.

Mr. Johnston received his B.A.Sc. and M.A.Sc. degrees from the University of British Columbia in 1933 and 1934, respectively.

He was previously a geologist with Husky Oil at Calgary and at Lloydminster, Sask.

K. M. Mote, M.E.I.C., is now associated with the Procter and Gamble Company and has been appointed their London, England, construction engineer, with headquarters at H. K. Ferguson Company of Great Britain Ltd.

Mr. Mote was formerly with British Cellophane Ltd. in Bridgewater, England, and spent last year in Mexico for that company. In Mexico he was associated with Celorey, S.A. in Monterrey.

He is a graduate of Birmingham Central Technical College, class of 1949.

G. E. Knight, M.E.I.C., has been named district engineer for the Newfoundland Department of Public Works. As district engineer he will be in charge of most federal construction projects in Newfoundland, including all wharves and other marine works.

Mr. Knight joined the Department in 1950, having previously served with various government departments in Newfoundland and with the Nova Scotia Department of Highways.

He graduated in 1947 from Nova Scotia Technical College with a B.Eng. degree in civil engineering.

D. K. Penfold, M.E.I.C., has retired from the Public Utilities Commission as commissioner in Victoria, B.C. Mr. Penfold had been named a member of that Commission and of the Coal and Petroleum Board of British Columbia in 1949.

He was previously chief engineer of the Water Rights Branch of the Department of Lands of British Columbia, having joined the government service in 1928, becoming district engineer at Kelowna in 1931 and chief engineer in 1941.

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1. **Water and anti-freeze.** Now available either air-pressurized or cartridge-operated, in either brass or stainless steel, 2½ gallon capacity.

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• Personals

E. G. Taylor, M.E.I.C., has been named head of the municipal and civil engineering departments of R. J. Cave & Associates, consulting engineers in Vancouver, B.C.

Mr. Taylor was previously in Ottawa where he was deputy to the engineer in charge of sanitation and roads section, design division of the Department of National Defence (Army).

A 1948 graduate of Queen's University in Belfast with a civil engineering degree, Mr. Taylor has also been with C. A. Meadows & Associates Ltd. in Toronto as senior engineer.

Elemer Visan, M.E.I.C., has been named design engineer for refinery and blast furnaces with McKee & Company, engineers and contractors in Union, N.J. Formerly he was with T. Pringle & Son, consulting engineers in Montreal. Mr. Visan has also been connected with E. B. Cowan, consulting engineer of Montreal.

K. J. Blakeman, M.E.I.C., has been appointed resident engineer with Angus Robertson Limited on their project at Warsak, Pakistan.

Mr. Blakeman was formerly assistant to the generation construction engineer at the Ontario Hydro Construction Division in Toronto.

Gordon M. Letson, M.E.I.C., has been named president of Letson & Burpee Limited in Vancouver, B.C. He has been general manager and a director of the company since 1924. He succeeds **Major General H. F. G. Letson,** M.E.I.C., who will continue active association with the company as a director and an advisory officer.

John Dudley Goode, Jr.E.I.C., has joined Quebec Iron and Titanium in Sorel, Que. Mr. Goode has been with Canadian Johns-Manville Company Ltd. in Asbestos, Que., since 1948, lastly as underground maintenance superintendent.

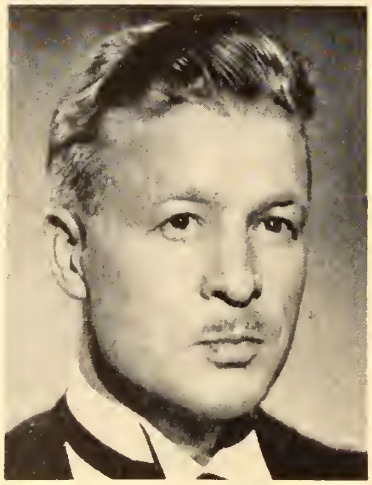
He graduated in 1947 from McGill University with a bachelor's degree in mechanical engineering. During the summer months of his university course he was with Dominion Engineering Works in Lachine, Que.

Thomas Alexander Ewing, Jr.E.I.C., is now with R. M. Way and Company, consulting engineers in Toronto. He was previously associated with Canadian Comstock Company Ltd. in Toronto as control engineer.

Mr. Ewing graduated from the University of Toronto in 1947 with a mechanical engineering degree and then joined Provincial Paper Limited in Mille Roches, Ont., as mill engineer. From 1949 to 1951 he was associated with the City of Toronto as waterworks engineer, and then spent a year with S. A. Armstrong Ltd. in Toronto as estimating engineer. He joined Canadian Comstock Ltd. in 1952 as mechanical construction engineer.

Prescott T. Duff, Jr.E.I.C., has been awarded the Teagle Foundation Scholarship to do post-graduate study in industrial management at the Massachusetts Institute of Technology in Boston.

Mr. Duff graduated in 1949 from Nova Scotia Technical College with a bachelor's degree in mining engineering. He joined the Transit & Storage Company in Wayne, Mich., as a student engineer in 1950 and in 1953 became pipe line engineer with Imperial Oil Limited in Toronto.



H. M. Whittles, Jr. E.I.C.

H. M. Whittles, Jr.E.I.C., who is in charge of mine records and reports for the International Nickel Company at their engineering office at Copper Cliff, Ont., is the secretary-treasurer of the Sudbury Branch of the Engineering Institute.

Mr. Whittles is a native of Wilkie, Sask., and received his general education there. In 1938 he moved to Sudbury, Ont., and joined the International Nickel Company where he was engaged for four years at Creighton Mine.

During the Second World War he served with the Royal Canadian Air Force as flying officer and was awarded the Distinguished Flying Cross. Returning to Canada in 1945, he entered the University of Alberta and graduated in 1949 with a B.Sc. degree in mining engineering.

After graduation Mr. Whittles returned to the International Nickel Company and worked at Garson Mine for three years engaged on mine survey and stope layout, subsequently being transferred to his present position with the company.

Mr. Whittles joined the Engineering Institute in 1948 as a Student and transferred to Junior in 1950.

C. R. Whitehead, Jr.E.I.C., has joined the Wabasso Cotton Company in Three Rivers, Que.

A mechanical engineering graduate of McGill University in 1949, Mr. Whitehead has also been with Woods Manufacturing Company Ltd. as assistant manager in Welland, Ont.

W. H. Hohn, Jr.E.I.C., has been named manager of the switchgear sales department of Canadian Westinghouse Company Ltd. in Hamilton, Ont.

Mr. Hohn joined Westinghouse in 1949 as a student engineer following his graduation from the University of Manitoba in electrical engineering.

He became a switchgear assemblies specialist in 1952 and later the same year was named supervisor of estimating and pricing for the sales department. He became supervisor of metalclad switchgear sales in 1953.

H. R. Schaeffer, Jr.E.I.C., has moved to New York City and is now associated with the Lummus Company in that city. He was previously in Montreal with Brett & Ouellette, consulting engineers.

Mr. Schaeffer graduated from the Technical University of Vienna in 1949, and has also been connected with Wiggs, Walford, Frost & Lindsay, consulting engineers in Montreal.

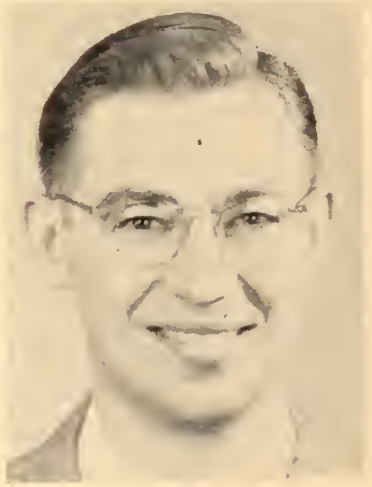
Edward George Capling, Jr.E.I.C., is now with the Industrial Development Bank in Montreal. He was formerly with Canadian Johns-Manville in Asbestos, Que., as financial analyst and finance manager, having joined that company in 1951.

Mr. Capling graduated in 1949 from McGill University in mechanical engineering and became associated with the Hydro-Electric Power Commission of Ontario as assistant equipment engineer that same year. In 1950 he was named chief engineer and production manager of Aero Tool Works Limited in Toronto, at the same time he was also associated with Corman Engineering on sub-contract work for A. V. Roe (Canada) Ltd. in Toronto.

During the Second World War he served with the Royal Canadian Air Force.

William Allan Brown, Jr.E.I.C., has been named design engineer with Falconbridge Nickel Mines Ltd. in Falconbridge, Ont. He was formerly a design engineer with the Ford Motor Company of Canada in Windsor, Ont.

Mr. Brown graduated in 1949 from McGill University with a bachelor's degree in civil engineering. Immediately after graduation he joined the Dominion Bridge Company in Lachine, Que., as a draughtsman.



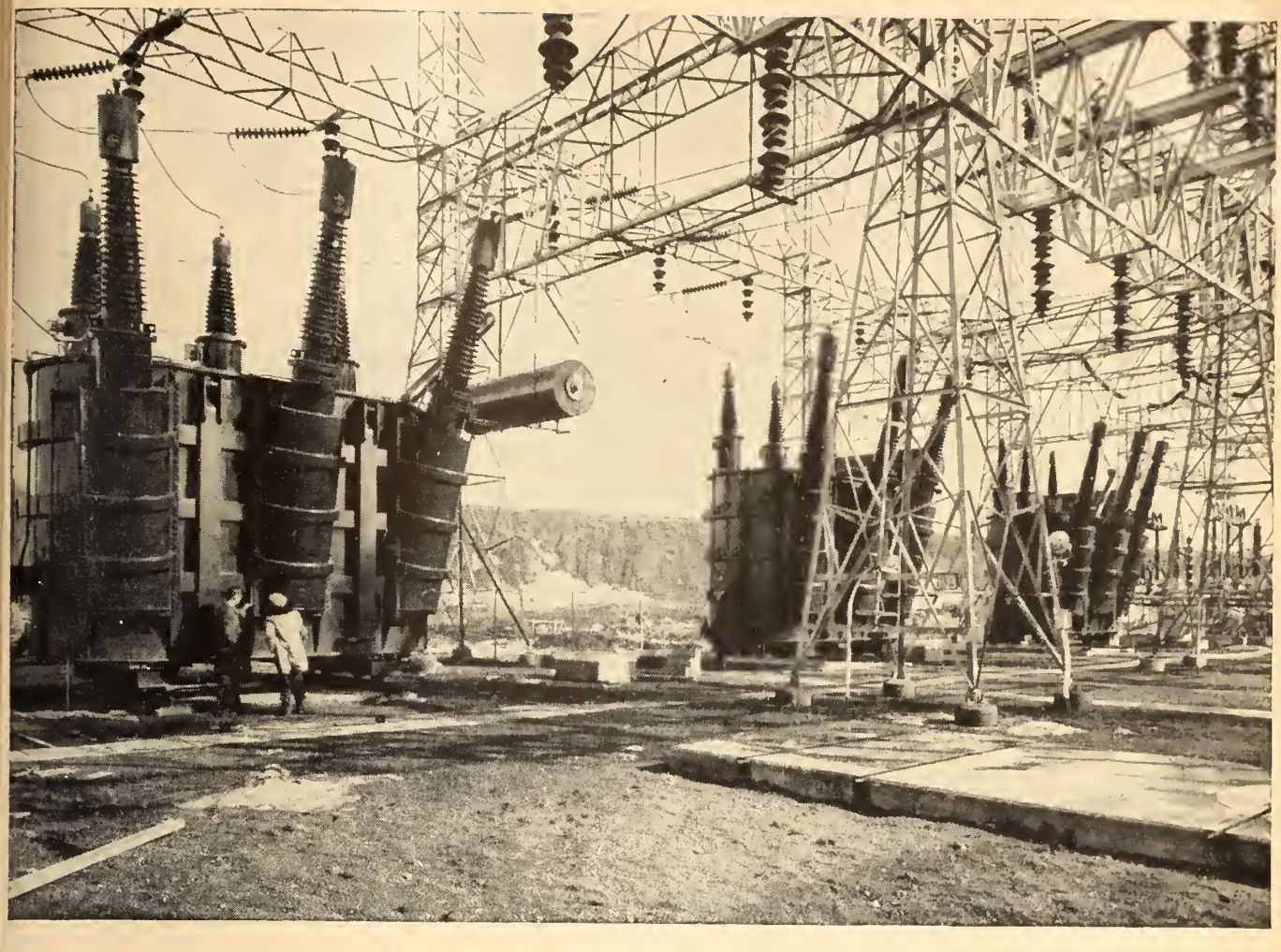
W. A. Brown, Jr. E.I.C.

E. R. Carruthers, Jr.E.I.C., has taken a position as development engineer with the J. M. Research Center in Manville, N.J.

He was previously in Montreal as chief engineer with Asbestonos Corporation Ltd., St. Lambert, Que.

Mr. Carruthers graduated from McGill University in 1949 with a bachelor's degree in chemical engineering.

Robert C. Wannop, Jr.E.I.C., is now associated with F. W. Urry, consulting structural engineer of Vancouver, B.C. He was formerly with the Dominion Bridge Company in Vancouver, B.C.



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• Personals

Mr. Wannop graduated in 1950 in civil engineering from the University of British Columbia and has also been with Swan, Rhodes & Wooster, consulting engineers in Vancouver.

Joseph Y. McCarther, JR.E.I.C., has joined Orenda Engines Limited in Malton, Ont., and is working in the mechanical development division.

A 1950 graduate of Nova Scotia Technical College in mechanical engineering, he was previously a mechanical engineer with A. V. Roe (Canada) Ltd. in Toronto, working on gas turbine engine development.

F. G. Holyrod, JR.E.I.C., is now associated with the Warnock-Hersey Company in Montreal. He was previously design engineer with the Foundation of Canada Engineering Corporation, also in Montreal.

Mr. Holyrod graduated in 1950 from the University of Manchester and has also been field engineer for the C. D. Howe Company in Montreal.

George Kerby Petrunia, JR.E.I.C., has become associated with Dow Chemical of Canada as safety engineer at their Sarnia, Ont., plant.

R. A. Auger, Jr. E.I.C.

A 1950 graduate of the University of British Columbia in chemical engineering, Mr. Petrunia has been with the R.C.O.C. since graduation. Lastly he has been administrative, training and accounting officer with the first ordnance company of the R.C.O.C. in the field.

R. A. Auger, JR.E.I.C., has been appointed manager of tank lining and cement production for B. F. Goodrich Canada Ltd. in Kitchener, Ont.

Mr. Auger graduated in 1950 from the University of Toronto with a degree in physics and engineering and that same year became associated with B. F. Goodrich as industrial engineer.

A. D. MacLeod, JR.E.I.C., has joined the Ottawa Hydro-Electric Commission in Ottawa. He has been with the Nova Scotia Light and Power Company at Dartmouth, N.S.

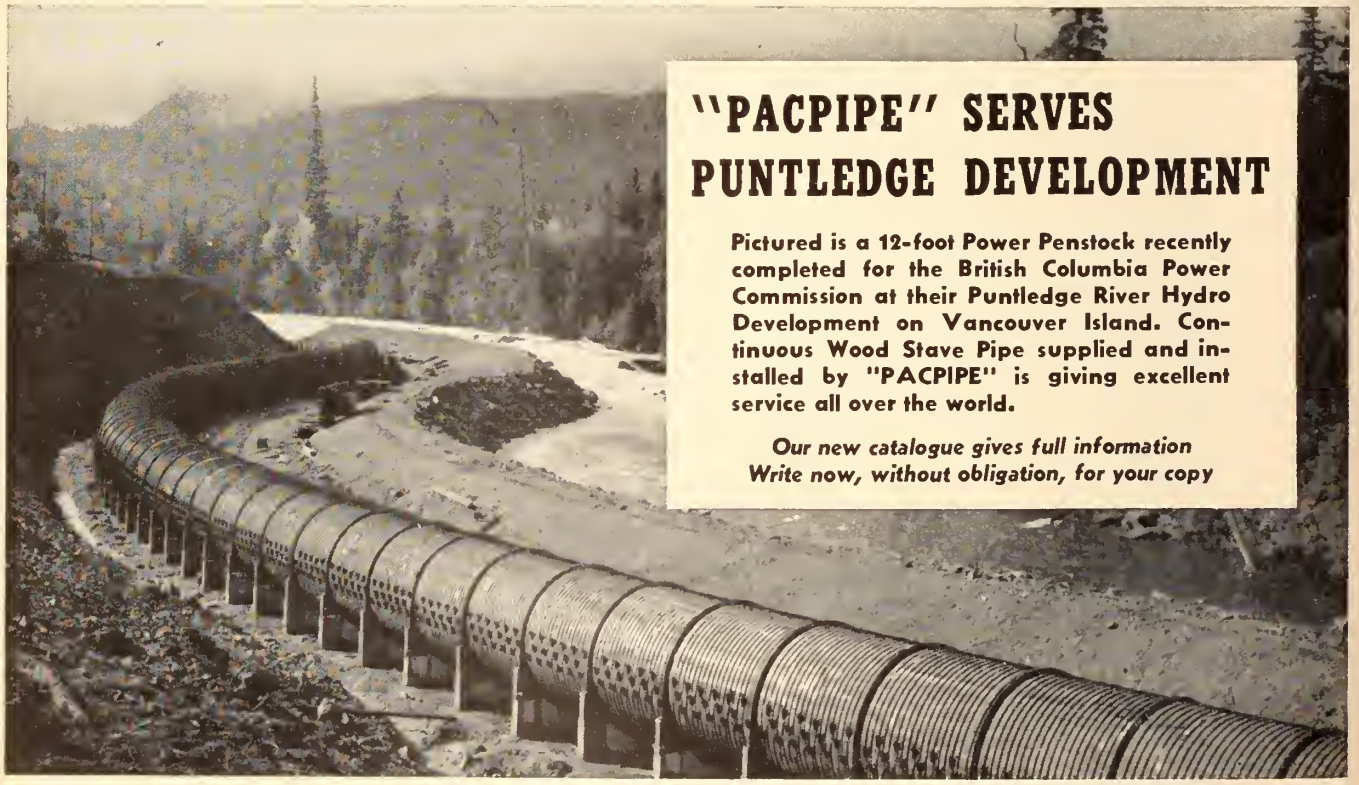
Mr. MacLeod graduated in 1950 from Nova Scotia Technical College with a bachelor's degree in electrical engineering.

J. Steudel, JR.E.I.C., has joined the firm of W. M. Armstrong & Partners, consulting engineers in Regina, Sask.

Mr. Steudel, a 1950 graduate of the Munich Institute of Technology, was formerly with Dominion Construction Company Ltd. in Edmonton, Alta., engaged on reinforced concrete design work.

J. B. Morrow, JR.E.I.C., has joined the Engineering Service Company in Halifax, N.S. He was previously with the Stewart-Warner Corporation of Canada in Belleville, Ont., as mechanical engineer.

Mr. Morrow graduated in 1950 from Nova Scotia Technical College in mechanical engineering and has also been with Canadian Westinghouse Company Ltd.



Twenty years under the sun

RUBBER-JACKETED CABLE *(left)*, NEOPRENE *(right)*. Unretouched close-ups show condition of jackets after 20 years' exposure.

—and NEOPRENE cable jacket is still in good condition!

In January 1935, two samples of cable, one with an ordinary rubber jacket, the other with a jacket of neoprene, were placed in an outdoor proving ground. After 20 years of continuous exposure to sun and weather, the natural rubber jacket is badly deteriorated and cracked. The neoprene jacket, on the other hand, is still lively, tough, and as free from cracks as it was two decades ago.

The samples shown here are bent in an arc to put stress on the jackets. This is a standard method of test to show the results of oxidation . . . one of the major causes of failure in rubber materials exposed to sunlight and weathering. Neoprene's inherent resistance to oxidation has made it the outstanding choice for jacket material on wire and cable.

Long-term tests like this prove you can depend on neoprene to give superior protection throughout an extra-long service life. Neoprene resists deteriorating influences no ordinary resilient material could stand. So when you buy wire or cable, make sure it's made to stay on the job . . . make sure it's jacketed with neoprene, Du Pont's chemical rubber.

Remember, of all resilient materials, only neoprene has *balanced resistance* to:

- Sunlight and weathering
- Oils, solvents, most chemicals
- Electrolytic attack
- Heat
- Corrosive atmospheres
- Flex cracking
- Abrasion, cutting, chipping
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*Firm*_____ *Type of Bus.*_____

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• Personals

John Joseph Bleau, JR.E.I.C., has joined the Aluminum Company of Canada at Arvida, Que., as project engineer on mechanical maintenance. Mr. Bleau was previously office manager of the Linde Air Products Company, a division of Union Carbide Canada Ltd. in Montreal, having been previously engineering representative for that company.

Mr. Bleau graduated in 1950 from McGill University with a mechanical engineering degree.

Paul Irving Woodruff, JR.E.I.C., has joined Trans-Canada Air Lines in Dorval, Que., as a flight test engineer. He formerly held the same position with Canadair Limited in Montreal.

Mr. Woodruff is an aeronautical engineering graduate of the University of Toronto, class of 1951, and had been with Canadair since that time.

D. Robin Stewart, JR.E.I.C., has joined the Moir Construction Company at St. Catharines, Ont.

Mr. Stewart was previously with the R. E. Stewart Constructioin Corporation in Sherbrooke, Que.

He graduated in 1951 from McGill University with a B.Eng. degree in civil engineering.

Ronald A. Gunst, JR.E.I.C., has been named assistant to the chief engineer of finishing works at Steel Company of Canada Ltd. in Hamilton, Ont.

A 1951 civil engineering graduate of Queen's University, Mr. Gunst was formerly plant engineer with Building Products Limited, also in Hamilton.

James Stewart Kennedy, JR.E.I.C., is now assistant professor of applied mechanics at the University of Alberta in Edmonton.

Mr. Kennedy graduated in 1951 with a B.Sc. degree in civil engineering from the University of Alberta and in 1953 received his master's degree from that university.

Until his recent appointment Mr. Kennedy has been at Stanford University in California.

G. C. Simpson, JR.E.I.C., has joined the firm of Douglas Bremner Construction Ltd. in Montreal as supervisor. He was formerly with Cecil Carpenter Company Ltd. in Montreal, also as supervisor.

Mr. Simpson graduated from McGill University in 1951 with a B.Eng. degree in electrical engineering and was an engineering assistant for Canadian Industries Limited in Kingston, Ont., for a time after graduation.

C. V. Flanagan, JR.E.I.C., has taken a position with the Dunlop Rubber Company in Toronto as development engineer. He was previously with the technical service staff of Goodyear Tire & Rubber Company of Canada Ltd. in Bowmanville, Ont.

Mr. Flanagan graduated in 1951 from the University of Toronto with a B.A.Sc. degree.

William Gordon Henchey, JR.E.I.C., is now with Alexander Murray and Company Ltd. in Montreal.

Mr. Henchey graduated from McGill University in 1951 with a chemical engineering degree and has been associated with Atlas Asbestos Company Ltd. in Montreal as branch technical sales representative.

K. L. Pinder, JR.E.I.C., has returned to Canada after spending two years in England on an Athlone Fellowship, and is now with the Shell Oil Company in Calgary, Alta., as mechanical engineer. He also spent eight months in Germany with Kodak A.-G. in their Stuttgart factory.

Mr. Pinder received his B.Eng. degree in chemical engineering from McGill University in 1951 and his master's degree the following year.

W. J. Martenson, JR.E.I.C., has joined Knight Service Limited in Drayton Valley, Alta. He was formerly with the Schlumber Well Surveying Corporation in Edmonton, Alta.

Mr. Martenson graduated from the

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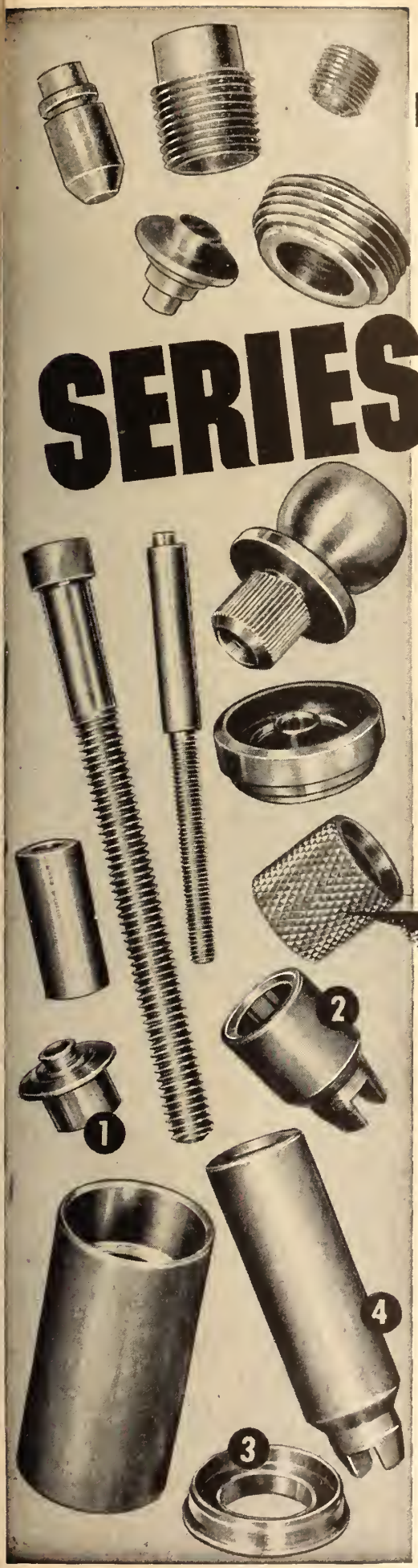

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1. **Valve Cage,** produced in 1¼" Acme six spindle machine, with rough form, spot drill, finish form drill, counter bore, drill and ream, finish form and cut off. Time, 6.93 seconds.

Report — "When 11/16" round Stelco 1213 was used, got longer drill life, improved finish."

2. **Socket,** produced in 1¼" Acme six spindle machine, with centre drill, rough form drill, ream and finish form, and cut-off. Time, 5.34 seconds. Milled on Milwaukee Miller in 2.09 seconds.

Report — "Stelco 1213 machined very good. Finish obtained was excellent. Rated it equivalent to best material received."

3. **Cylinder End,** produced in 1 ¼" Acme six spindle machine, with rough form and drill, finish form front diameter, drill and trepan, ream and shave finish form, and cut-off. Time, 8.52 seconds.

Report — "Stelco 1213 entirely satisfactory. Excellent machining steel."

4. **Pivot Nut,** requiring centre drill, rough form, drill, ream and finish form, tap and cut-off. Time, 11.79 seconds. Milled in Milwaukee Miller in 2.11 seconds.

Report — "Using Stelco 1213, longer tool life was experienced and finish was improved."

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• Personals

University of Saskatchewan in 1952 with a B.Eng. degree in mechanical engineering.

Terrence T. Kiernan, JR.E.I.C., is presently employed as an office engineer in the foundation department of the Donald R. Warren Company in Los Angeles, California.

Mr. Kiernan is a 1952 civil engineering graduate of McGill University, and has previously been with Champlain Oil Products in Montreal as a maintenance engineer.

R. J. F. Sherk, JR.E.I.C., has become associated with Spartan Air Services Ltd. in Toronto.

A chemical engineering graduate of the University of Toronto, class of 1952, Mr. Sherk had been with Nichols Chemical Company Ltd. in Toronto since his graduation.

R. Giovannetti, JR.E.I.C., has been transferred to the maintenance engineering department of the Ford Motor Company of Canada as a design engineer. He was formerly layout engineer for the company.

He graduated in 1952 in mechanical engineering from Nova Scotia Technical College, and has also been with Canadian Industries Limited in Windsor, Ont., as assistant maintenance engineer.

B. W. Allen, JR.E.I.C., has been transferred from London, Ont., to the Halifax branch of the Federal Department of Public Works, harbours and rivers branch.

Mr. Allen has been in government service since his graduation in 1952 from Queen's University in civil engineering.

Harvard B. Kolm, JR.E.I.C., is with the aeronautical division of the Minneapolis Honeywell Regulator Company in Minneapolis, Minn., working on autopilot control systems.

Mr. Kolm graduated from Nova Scotia Technical College in 1953 with a bachelor's degree in mechanical engineering and then went on the teaching staff of the mechanical engineering department of the Massachusetts Institute of Technology. He received his M.Sc. degree from M.I.T. last June and then joined Minneapolis Honeywell in Minneapolis.

John H. Chauvin, JR.E.I.C., has now joined Montreal Engineering Company Ltd. as a mechanical design engineer in Montreal. He was formerly with G. J. Hamilton Limited in Vancouver, B.C., as machine shop manager and plant engineer.

He is a 1953 mechanical engineering graduate of McGill University.

Wm. L. McNamara, S.E.I.C., is now an engineer-in-training with Avro Aircraft Limited at Malton, Ont.

He graduated last spring from the University of New Brunswick in mechanical engineering.

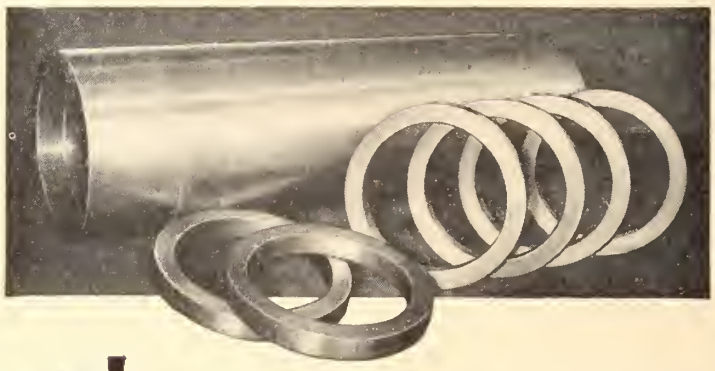
Marcel P. Lafreniere, S.E.I.C., is now professor of mathematics at the engineering school of the University of Sherbrooke.

He received his B.A.Sc. degree in civil engineering from the Ecole Polytechnique last year.

W. N. Isberg, S.E.I.C., has joined MacDonald Bros. Aircraft Company Ltd. in Winnipeg, Man., as assistant project engineer.

He graduated from Queen's University this year with a B.Sc. degree in mechanical engineering.

KENNEDY CAN CAST IT



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Within six months from the start of construction of the new Canadian Petrofina refinery near Montreal, the marketing facilities were put into operation. During the second half of 1955 this modern 20,000 bbl. per day refinery goes on-stream. The Canadian Petrofina refinery is unique in bringing together, for the first time, a combination of vacuum distillation and fluid coking with five catalytic processes, namely, cracking, reforming, hydrodesulfurization, polymerization and alkylation. A large portion of the actual refinery construction and engineering and all of the impressive off-site facilities were the responsibility of Kellogg.

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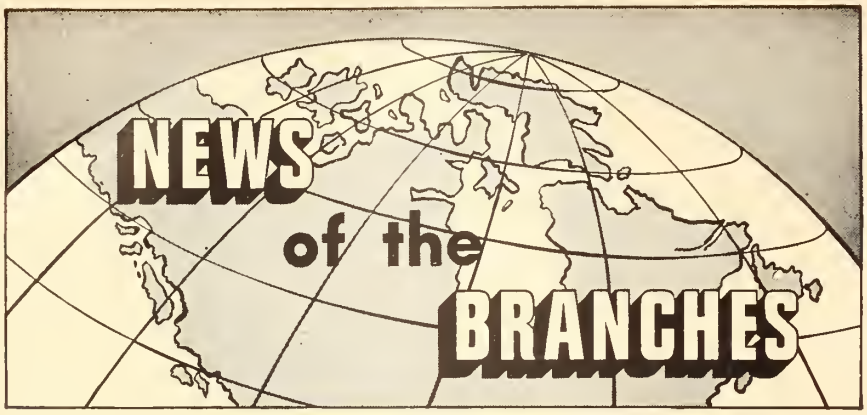

Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Belleville

J. A. Grant, M.E.I.C.,
Secretary-Treasurer

Canada Cement Plant Tour

The Belleville Branch of the Engineering Institute of Canada held its first meeting of the 1955-56 season on October 17. This meeting took the form of a tour of the Canada Cement Plant at Point Anne. Approximately 50 members and guests attended.

A. O. Drysdale, the superintendent of the plant, welcomed the members and guests and gave short talks on plant operation prior to and subsequent to the tour.

Refreshments were served through the courtesy of the Canada Cement Company. The tour proved to be a very worthwhile project and was very much enjoyed by those present.

Eastern Townships

J.-P. Champagne, Jr.E.I.C.,
Secretary-Treasurer

Asbestos Fibre Mine Visit

The Eastern Townships Branch visited Saturday, October 8, 1955, the site of a future asbestos fibre mine, in the Black Lake area, some 135 miles northeast of Montreal. Considerable preliminary work must be undertaken there by the Lake Asbestos of Quebec, Limited before the mine can be put into operation, in the course of which some $30,000,000 will be expended.

Because most of the ore body is under the lake and because of the prevailing rock formations, it was thought that it would be uneconomical to mine the ore from underground. Excessively large pillars would have to be left to provide support and after careful estimates, it was considered more economical to handle from the surface even at the expense of draining Black Lake.

Work on Mine in Progress

Work was consequently started a few months ago. A dredge is now in operation, chewing up the lake bed at the rate of 30 cubic yards a minute. Here are some statistics on the equipment, operated by Construction Aggregates: cutter head motor, 800 h.p.; pump motor: 6,000 hp. at 6,600 volts (one on the dredge and two as boosters along the pipeline); diameter of pipeline: 32 in.; length of pipeline: 3½ miles; pump capacity: 50,000 g.p.m. at 300 ft. head; impeller diameter: 84 in.; quantity of overburden to remove: 25,000,000 cu. yd.

After pumping, the water is allowed to settle after which it is returned to the lake to be used again. This is necessary because the supply of water from the watershed is not enough to make up.

Flood Precautions

Normally the lake acts as an ample reservoir into which the drainage area finds an outlet at times of heavy downpour. This will not be possible after the lake is drained. New means of storage had to be found if floods were to be avoided, and a bypass provided to detour the incoming water into the discharging river. Dams are now being erected which will allow the water to back up and flood a limited area on each side of the river. One and a half miles of paved road, which was to be in the flooded area, has been relocated. Would-be-flooded land has been bought from the riverside owners and part of the diversionary ditch has been dug out.

This visit was thoroughly appreciated by the Eastern Townships engineers who could not help but feel the impressive scope of the project.

Fredericton

O. I. Logue, M.E.I.C.,
Secretary-Treasurer

N. E. Donahoe, Jr.E.I.C.,
Branch News Editor

U.S. Air Base Tour

On Sunday, October 2, 1955, the members of the Fredericton Branch and their wives were guests at the Loring Air Base in Limestone, Maine. More than a hundred visitors were present for the occasion.

After luncheon which was served at the Officers' Club, the guests were taken on a tour of the base. The tour included the inspection of a B-36 bomber as well as a new five million dollar cantilever hangar.

The visitors were welcomed by Col. Schroeder of the U.S. Eng. Corp., who is in charge of construction at the base. The members of his staff acted as guides for the tour.

Hamilton

A. F. Barnard, Jr.E.I.C.,
Secretary-Treasurer

K. R. Crean, Jr.E.I.C.,
Branch News Editor

W. B. Redfern Discusses Sewage Survey

Members of the Hamilton Branch met at McMaster University on October 20, under the chairmanship of F. E. Milne. The topic dealt with was the sewage survey for the city of Hamilton, and the guest speaker was W. B. Redfern.

Mr. Redfern is senior member of the firm of Proctor, Redfern and Laughlin, consulting engineers who recently reported to the city of Hamilton on problems relative to sewage and sewage treatment, for an anticipated population of half a million in the city and surrounding districts.

Area of the City

The present area of Hamilton is 26.3 square miles, and Mr. Redfern stated that reports presented are based on the needs of a city with a population of half

Eastern Townships engineers visit the site of the future asbestos fibre mine in the Black Lake area. In the group are E. W. Gagan, chief engineer of Lake Asbestos of Quebec, Ltd., G. M. Dick, J.-P. Champagne and Archie Mitchell.

TECHNICAL INFORMATION

CONCERNING CHARACTERISTICS AND UTILIZATION OF DOUGLAS FIR PLYWOOD

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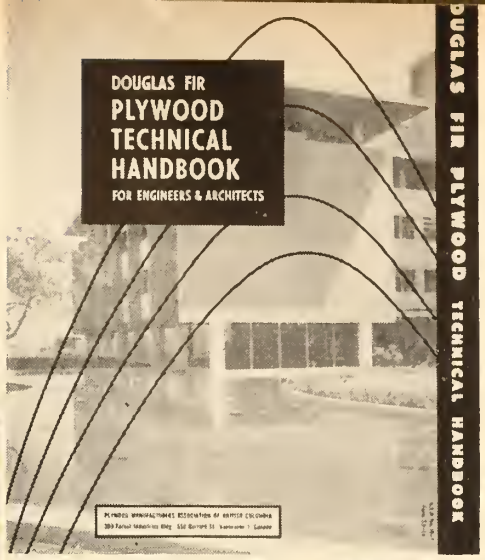
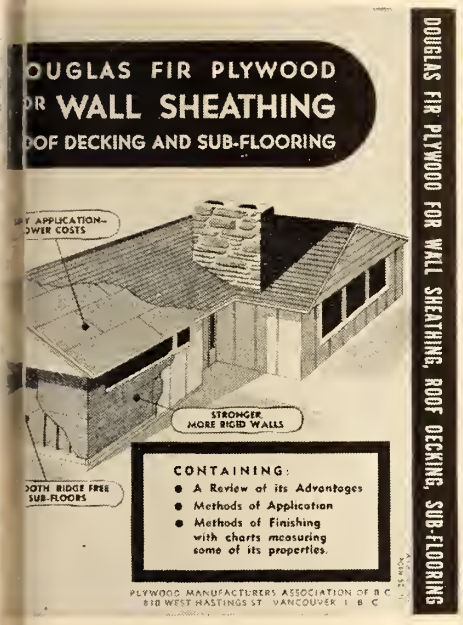
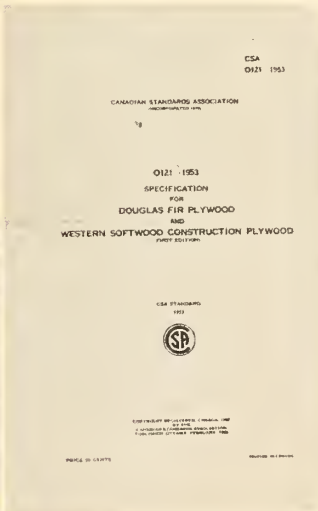


DOUGLAS FIR PLYWOOD TECHNICAL HANDBDOK: a 48 page book containing detailed examinations of plywood design fundamentals; design of built up beams with plywood webs, stress analysis of stressed skin panels with plywood covers and illustrated with charts and diagrams.

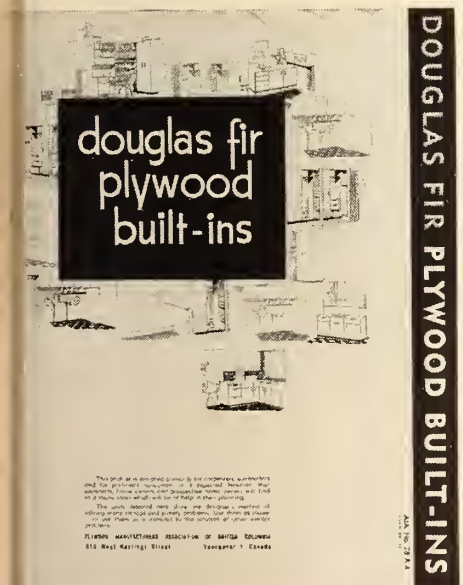
DOUGLAS FIR PLYWOOD SHEATHING FDLDER: an 8 page illustrated booklet completely describing advantages and methods of application of Douglas fir plywood for wall sheathing, roof decking and sub-flooring. Available in French.



OOUGLAS FIR PLYWOOD MANUAL: a 32 page general outline of the properties, manufacture and uses of Douglas fir plywood. Indexed for handy reference and illustrated with photos and drawings showing recommended application. Available in French.



SPECIFICATIONS for DDUGLAS FIR PLYWDDD & WESTERN SDFTWOOD CDNSTRUCTION PLYWDOD: issued by Canadian Standards Assn., this 16 page booklet deals in text and illustration with standard specifications and requirements for Douglas fir plywood and Western softwood construction plywood and is intended to serve as a reliable standards guide.



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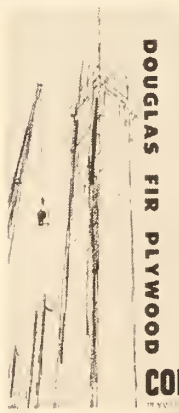

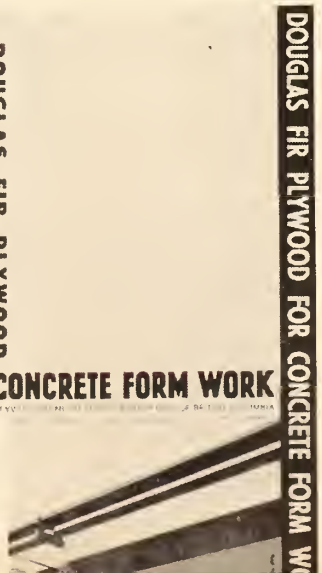

DOUGLAS FIR PLYWOOD FOR CONCRETE FORM WORK: an illustrated 24 page reference manual dealing comprehensively with Douglas fir plywood used in concrete form construction. It covers concrete forms from small house foundations to bridge and dam constructinn.

• Branch News

a million and an area of 46.0 square miles.

The area encompassed by the plan would include part of the township of Saltfleet, the township of Barton, and a section of the township of Ancaster. The estimated distribution of population over the area would be seventeen persons per acre, allowing room for parks, shopping centres, amusement areas, and industrial sites.

Present Sewage System

Sewers now installed in Hamilton are of the one-pipe system, combining storm water and sanitary sewage. At the time of construction this system was economical, as it was designed to carry rainfall during storms, and the sewage was discharged, without treatment, into Hamilton harbour.

In 1925 intercepter sewers were installed along the waterfront, to take dry weather flow of sanitary sewage from the combined sewer, discharging it into a screen and grit removal plant on Depew Street, and then into the harbour without further treatment. During heavy rain storm, water dilutes with the sanitary sewage and the two are discharged directly into the harbour. The dilution effect of the water in the harbour minimizes any harmful effect this combined flow might otherwise have.

Proposed Future System

The province will eventually require complete treatment of sewage—primary settlement of solids and secondary treatment using some type of aeration to provide satisfactory effluent. The system proposed by Proctor, Redfern and Laughlin for the future larger area consists of a two-pipe system, one to handle storm sewage and the second to handle completely treated sanitary sewage.

A report was submitted to the city of Hamilton on October 12, 1954, recommending that the city proceed with construction in the near future of sanitary and storm sewers in the west mountain area, at an estimated cost of 3,500,000 dollars. A report submitted January 8, 1955, proposes construction of a sewage treatment plant for the entire city on property owned by the city near Red Hill creek.

Estimated cost of the primary treatment plant is $7,280,000. Complete treatment is estimated at $13,385,000. It would be necessary to construct a large sewer near the West Hamilton creek, at an estimated cost of $800,000.

The capacity of the system would ultimately be 100 million Imperial gallons per day.

A cost analysis was submitted, comparing the one-plant and a two-plant system, and Mr. Redfern indicated that a single plant would be more economical.

Donald Redfern, son of the speaker and a member of the same engineering firm, gave a diagramatical representation of the flow pattern through a typical activated sludge treatment plant. Gordon Proctor, of the same firm, outlined (using slides) the storm and sanitary sewage areas and the future system described in the report.

W. B. Redfern concluded by pointing out that the report depends upon the growth of the City of Hamilton and the surrounding territory. He stated that he believed that the estimated half million population by 1988 was a conservative one, for if Hamilton expands as rapidly as other areas in Ontario that population figure could be reached within 15 years.

Kitchener

JOHN R. RUNGE, M.E.I.C.,
Secretary-Treasurer
J. L. FAIR, M.E.I.C.,
Branch News Editor

Field Trip in Galt

The first technical meeting of the season, following the annual get-acquainted social event was a field trip to two neighbouring but contrasting types of industry in Galt.

The tour began at the Royal Metal Mfg. Co. Ltd., manufacturers of metal furniture and continued across the street at Babcock-Wilcox & Goldie-McCulloch Ltd., boiler manufacturers.

Metal Furniture Manufacture

The furniture operation provided interesting examples of the rapid fabrication of tubular steel sections into the many varied shapes required for durable attractive merchandise. The operations were notable by use of special tools and

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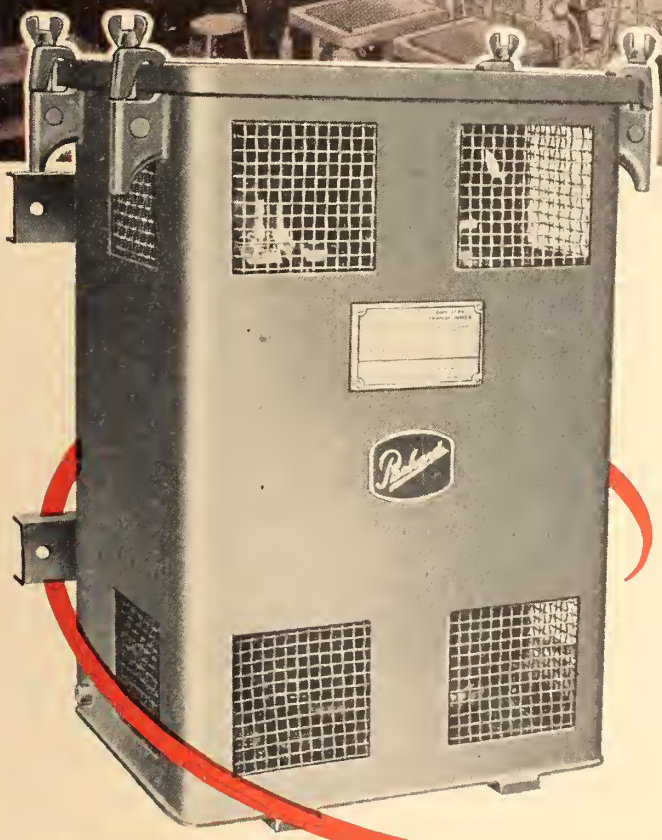

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• Branch News

jigs and highly-developed metal joining techniques designed for rapid production.

Metal parts are finished by electroplating procedures or by a chemical spray treatment followed by electrostatic spray application of paint. Chemical treatment as well as painting and baking are conveyorized for speed and control of quality. The woodworking assembly and upholstery sections were also visited and demonstrated the many arts behind the chairs in your breakfast room or the executive's office.

Boiler Manufacture

The operations in the boiler plant afforded a glimpse of another phase of Canada's growth. The party viewed units ranging in size from automatic equipment suited for a very small factory to giants for a pulp and paper industry. Points of special interest were the facilities for welding and stress-relieving of heavy sections; the radiographic and ultrasonic techniques for inspection of welded joints to meet requirements of the boiler code; and physical testing equipment to control material going into the boilers. The components being fabricated for field erection and the boilers being erected in the shop gave the visitors a picture of the realities behind the statistics of Canadian industry.

After the tour light refreshments were served in the plant cafeteria and the chairman, Mr. Sanders, thanked our hosts for their courtesy in arranging the tours.

Montreal

R. J. Harvey, M.E.I.C.,
Secretary-Treasurer

M. Benoit, M.E.I.C.,
Publicity Chairman

Centralization and Decentralization

On October 6, 1955 W. N. Hall, M.E.I.C., vice president, Dominion Tar and Chemical Company, addressed the Montreal Branch, Management Section, on the subject of "Centralization and Decentralization."

Mr. Hall's subject was appropriate to an audience with business management interests. His talk was well delivered, proved interesting and later in the evening stimulated lively discussion. He introduced his subject by defining its scope—the pros and cons of centralized versus decentralized management particularly in a firm engaged in diverse manufacturing activities. After enumerating some of the advantages and disadvantages of both systems, Mr. Hall asserted that he generally favoured decentralized systems. He then proceeded to illustrate his arguments, drawing upon a large fund of personal experience in the field of management, and concluded the evening by answering many pertinent questions from the audience. The 35 members who braved the inclement weather to attend this meeting were indeed well rewarded.

The meeting was sponsored by G. H. Hoganson, research engineer, C.N.R., who also acted as chairman. L. E. Mitchell, special project engineer, C.N.R. thanked the speaker.

Snow Removal in Montreal and Its Technical Problems

On October 20, J. V. Arpin, deputy director of the department of roads of the City of Montreal addressed the Montreal Branch on the subject "Snow Removal in Montreal and its Technical Problems".

Mr. Arpin opened his discussion with a description of the organization of the roads department. He stated that it was composed essentially of two divisions—the equipment division and the operations division. The equipment division, which is under the direction of the equipment control engineer, is responsible for the maintenance of all snow-removal equipment; the transforming of equipment from summer to winter operation which usually begins in August; the purchasing of new equipment, and the renting of temporary equipment from local contractors when the city's own facilities cannot cope with the work caused by a heavy storm or blizzard. The operations division is in charge of all snow-removal operations in the streets and the transportation of the snow to dumping areas. For most effective control, the city is divided into four districts, each under the administration of a district engineer. The districts are, in turn, divided into a total of 43 sections, each of which is run by a foreman. Each district has a garage for its equipment and each of these garages has a foreman from the equipment division who maintains control over all vehicles at the garage. This foreman can arrange transfer of equipment to and from his district so that the number of serviceable vehicles in each district is always in proportion to the work load in that district.

The speaker then described the method of employing workers, stating that employees were of two kinds, permanent and auxiliary. A permanent employee is one who has worked at least 225 days, and is retained during periods when there is little or no work. The problem of maintaining the correct number of chauffeurs, who are permanent employees, was also discussed. After a heavy storm, there are usually too few, and long hours and expensive overtime are necessary, while during periods when there is no snow, there are too many of them, and they have to be employed at other forms of work.

The following figures provided by Mr. Arpin are of considerable interest: 50,000 tons of sand, 20,000 tons of salt, and 10,000 tons of cinders are used annually on the city's streets, and the area maintained by the roads department is about 50 square miles, consisting of approximately 800 miles of pavement and 1,500 miles of sidewalk. During the last few years, the purchase price of new equipment has amounted to $850,000 per year, and snow clearing costs have risen from $1.8 million in 1952-53 to a projected $5 million for this season. Although these costs appear to be high, Mr. Arpin assured the audience that they are less than the average figure for cities of comparable street mileage.

The city receives four reports from the Dorval meteorological station every 24 hours and when a heavy snowfall appears to be imminent, the roads department prepares for action. In the event that a fall does take place, the manner of ridding the city of snow is as follows: The downtown area or central district is first completely cleared by using all the equipment belonging to that district and a large amount is brought in from the other three districts. The main arteries of the remainder of the city are then made passable by the equipment belonging to each of these districts, and finally, the remaining streets are cleared as soon as possible.

Following the address which featured the showing of slides of much of the equipment used by the roads department, an interesting film describing the department's activities was shown.

The meeting was sponsored by the Civil Section. J. C. Brodeur was in charge of meeting arrangements and acted as chairman. L. L. Goddard thanked the speaker on behalf of the audience.

Plant Tour

On Nov. 1, 1955 the Mechanical Section of the Montreal Branch sponsored a plant tour of the Northern Electric Company's communication equipment division at 1261 Shearer St., Pt. St. Charles.

Dinner was served to 89 members in the company cafeteria. Then a tour of the plant was undertaken in groups of about eight, with company representatives acting as guides.

The tour covered a wide range of activities. Large machine shop areas, tool rooms, die casting and plastic moulding sections were shown first, where the enormous quantities of intricate parts required are punched, cut, shaped, stamped or moulded. In addition, here many of the 3,500 machine tools, and 4,000 punches and dies required are built or maintained. Experimental departments were shown in which new equipment was being developed or new manufacturing techniques investigated. Later, members were taken through assembly line areas, where relays, switches, wire and cable were being formed into intricate central office equipment, including the newest crossbar types to be used in continental dialing systems, as well as other lines assembling subscriber equipment, the smaller component parts used in the home or office telephone. Extensive and elaborate test equipment necessary to ensure proper functioning of completed units was demonstrated as well.

After the tour, coffee was served in the cafeteria, while a brief description of the plant and its purpose was given by J. R. Houghton, superintendent of manufacturing methods. The building, eight stories high, has 1,000,000 square feet of floor space, and about 7,000 persons are employed in the building. It was stressed that this is a highly engineered industry, with a great deal of mechanical processing, to produce the precise, finely detailed, long-life equipment supplied to the telephone systems across Canada. Some 400 engineers and technicians are employed in these operations.

R. C. Smythe, superintendent of the works service department, outlined the tremendous problems involved in the organization, operation and maintenance of such a large plant. These problems range all the way from a shipping and receiving department, handling 8,000,000 lb. of materials per month, to a cafeteria handling 1,400 meals at noon hours. Planning and scheduling of operations is of the utmost importance to keep as-

• Branch News

sembly lines flowing properly, to ensure that all components arrive where and as scheduled.

A brief question period followed. The thanks of the members for a very interesting and informative tour, and excellent meal accommodation, was expressed by Mr. Stevens of Drummond McCall and Company.

Meeting arrangements were by D. A. Leger and the meeting chairman was R. M. Freeman.

Niagara Peninsula

G. E. Williamson, Jr.E.I.C.,
Secretary-Treasurer

Eugene Canby, Jr.E.I.C.,
Branch News Editor

Provincial Engineering Ltd. Tour

Twenty-five members were present for the plant tour of the Tower Division of Provincial Engineering Ltd., in Niagara Falls, Ont. and the meeting.

Ground was broken for the galvanizing plant in July 1954 and for the tower plant in December 1954. The first production run of towers was begun in April 1955. As of October 1955, 6,000 tons of towers have been shipped.

Tower Types

Towers range in size from semi-standard 75 ft. hydro line towers to special 350 ft. towers for television and microwave telephone service. Bids for contracts are worked out by each prospective supplier. Usually the company doing the closest design work gets the contract because, due to efficient design and fabrication procedures, their tower actually costs less to build.

Plant Design

The plant is designed for a straight through flow of material beginning with outside stock storage serviced by overhead cranes. Material is first cut to length; then the part number is stamped on. Punching operations are either performed on a multiple punch set-up (three independent presses on slide rails which can be set up for different pieces) or a Palasky spacing machine.

Shot Blasting Operation

Next the fabricated bars are cleaned in a shot blasting machine prior to galvanizing. The shot blasting operation, for most applications, is cheaper and does a better job than acid pickling. Since some of the larger pieces cannot be handled by the shot blasting machine, they must be pickled. The acid bath is kept hot by line steam. Dumping of the acid is necessary every one to two weeks.

The galvanizing sequence from shot-blasted material is as follows: a water rinse, and then a dip in the flux tank; next, the actual galvanizing dip; and a final water quench.

Every three weeks the clear liquor is pumped from the flux tank, the sludge removed, and the liquor pumped back in.

Largest Galvanizing Kettle

The galvanizing kettle is the largest in North America and the only one of its kind in existence. It is 30 ft. long, 5 ft. wide and 4 ft. deep and contains 125 tons of zinc. The pot consists of an inner and outer kettle. A bath of molten lead separates the two pots and serves to prevent any local overheating of the inner pot. Heat is supplied by 32 gas burners which keep the zinc between 840 deg. F. and 850 deg. F. The thickness of the zinc coating depends upon the speed with which the material is drawn from molten zinc. A thicker coating is obtained by removing the work rapidly because the zinc does not have sufficient time to drain back into the bath.

After quenching some of the heavy welded sections are distorted and must be straightened. Next is the final inspection and the last operation is preparing the tower for shipment.

After the plant tour the members were guests of Provincial Engineering at the Niagara Falls Club.

Tour Is Explained

Pete Paskay introduced Mr. Barnum the plant manager of the tower division. Mr. Barnum is a graduate of the University of Michigan and just previous to coming to his present job headed up the tower division of the Canadian

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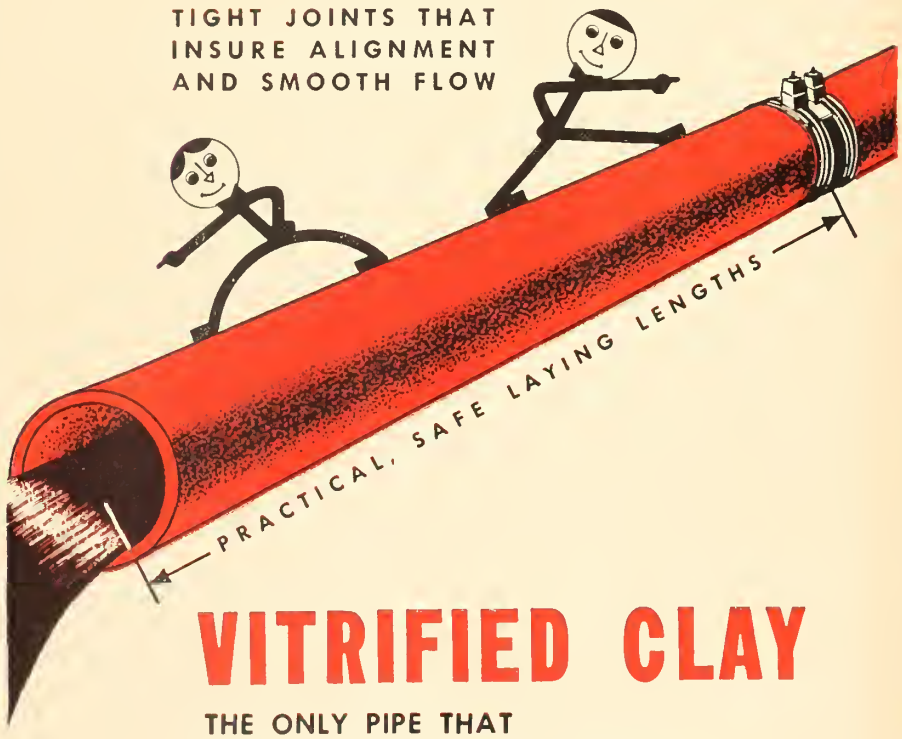

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Bridge Company. Mr. Barnum gave an address on what had been seen and introduced to the group Henry De Solla, works manager, and Lief Larson, plant superintendent.

The speaker was thanked by Paul Buss and the meeting was adjourned.

Ottawa

GORDON A. SUTHERLAND, M.E.I.C.,
Secretary-Treasurer

CARL B. CRAWFORD, JR.E.I.C.,
Branch News Editor

The President's Visit

The Branch was honoured by a visit of the president, Dr. R. E. Heartz, and Mrs. Heartz on October 4 and 5, 1955. The president was accompanied by Dr. L. Austin Wright, general secretary, and Mrs. Wright.

During the evening of October 4, a special Management Committee meeting was held with the president and the general secretary. Several items of Institute policy were discussed and the program planned for the following day was outlined.

During the morning of October 5, the president and the Branch chairman, R. F. Legget, together with the chairman of the Junior Section, A. H. Graves, visited the University of Ottawa and Carleton College and spoke to the student body.

At noon the president held a reception for the special guests who were attending the luncheon meeting honouring the memory of Lieutenant-Colonel John By. The luncheon, which was addressed by Mayor Charlotte Whitton, was a colourful affair, well attended by members of the Branch. Following the luncheon the guests adjourned to the site of the Colonel By Memorial for the official unveiling of this memorial. Details of the luncheon and unveiling ceremony are contained in the October issue of the *Journal*.

The president's reception for the Ottawa branch at the R.C.A.F. mess. Left to right, Dr. L. Austin Wright, general secretary; Mrs. R. E. Heartz; Robert F. Legget, chairman, Ottawa branch; Mrs. Wright; and Dr. Heartz.

In the evening, following a dinner for the president with members of the Management Committee and their wives, the president's reception for the Branch was held at the Gloucester Street mess of the R.C.A.F.

In a brief talk to members of the Branch the president drew attention to the shortage of engineers in Canada. He deplored the employment of engineers in positions which could adequately be served by technicians. He stressed the importance of a high standard in engineering education and suggested that university entrance requirements should exclude students who might better be trained as technicians. In this connection he urged the extension of facilities for training of the much needed technicians.

During the evening members of the Branch had an opportunity to meet personally with Dr. and Mrs. Heartz and Dr. and Mrs. Wright. The reception was well attended and brought to a close the 1955 presidential visit to the Ottawa Branch.

At the president's reception for the Ottawa branch. Left to right, Mrs. A. H. Graves, R. J. Balfour, Mrs. W. R. Honeywell, Mrs. James Boucher and James Boucher.

Modern Quality Control

To provide a program of meetings which can be attended by engineers who are unable to attend the luncheon meetings, the Branch Management Committee is initiating a series of evening dinner meetings. The first of these meetings was addressed on October 24 by Simon Collier, director of quality control of Johns-Manville Corporation, New York.

Mr. Collier explained that quality control is really the effort of a company to ensure that the quality of their product will meet the standards set by the customer. He pointed out that the need of quality control was made more necessary by modern mass production methods due to the lack of individually skilled workmanship on the assembly lines. He also indicated that buyers are becoming more quality conscious.

Statistical Analyses and Motion Pictures

The speaker described the use of statistical analyses and motion pictures to eliminate the element of "guess" in the quality of a product. The statistical analysis of rejected items often indicates the source of trouble in the manufacturing process. Movies have also been found to be most helpful in this regard and they are invaluable in illustrating production errors, which are not self-evident, to employees. Many organizations now use movies to assist in training new employees, a program which may have great effect on final quality control. Mr. Collier illustrated his point by showing a film on quality control.

The speaker was introduced by R. F. Legget, chairman of the Ottawa Branch, who also expressed appreciation at the large turn-out of members to this first of a series of evening meetings.

The Pollution Problem

Dr. A. E. Berry, director of the sanitary engineering division of the Ontario Department of Health, addressed on September 22 the first fall meeting of the Branch on the popular topic of river pollution. Dr. Berry stated that Ottawa is the largest city in Ontario

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• Branch News

that still dumps its sewage into water that neighbouring municipalities use for their water supply.

Dr. Berry pointed out that the attitude of the public is beginning to change in favour of sewage treatment. As a result of this changing attitude, two provincial government committees are now studying the problem of pollution of both water and air. He indicated that in the last 40 years the major pollution problems had changed from domestic to industrial problems.

In the last decade Ontario has built 86 new sewage disposal plants. This is equivalent to the number of plants which existed in the province up to 1945. Of all the sewage disposal plants in Canada, 55 per cent are operated in Ontario and 75 per cent of the "complete treatment" plants are operated in this province. In 1941 the provincial Department of Health began construction of plants worth $1,000,000. In 1954 the Department began construction worth $88,000,000.

Treatment Plants Are Studied

Dr. Berry observed that the pollution problem in Ontario is still bad. There are 70 municipalities, including Ottawa, which do not treat their sewage. Many of these municipalities are now studying disposal problems and contemplating the construction of treatment plants.

Dr. Berry estimated that an adequate sewage treatment plant together with the necessary sewage collection system would cost Ottawa about $17,000,000. However, he noted that this could be had for a cost of 15 cents per family per week.

Water pollution is the concern of the provincial Department of Health, the Pollution Control Board and the International Joint Commission. Provincial legislation is now being considered which could compel municipalities to treat sewage before disposal.

The speaker was introduced by R. F. Legget, the chairman of the Ottawa Branch.

Vancouver Island

CDR. P. F. FAIRFULL, M.E.I.C.,
Secretary-Treasurer

Welded Ship Construction

On Friday, October 21 the Vancouver Island Branch held a joint meeting with the Victoria Branch of the Association of Professional Engineers, B.C. with a total of 40 in attendance.

The guest speaker, R. D. Barer, Pacific Naval Laboratory, spoke on the problems of welded ship construction.

Problem of Failure

His paper summarized the results of the considerable research undertaken by the American and British committees set up to deal with the problem of failure of welded ships. The results of this research were shown to have considerable bearing on brittle failures other than ships, such as bridges, pressure vessels and vehicles, any of which may be subject to certain stress conditions at low temperatures.

The importance of "notches", whether from design, accidental damage, or poor workmanship was emphasized. The methods used to minimize trouble since World War II were discussed. These included changes in composition of ship plate, elimination of "notches" by design, and radiographic inspection on welds.

Inspection of Welds

The particular area with which P.N.L. is especially familiar, the inspections of welds to ensure soundness, was given detailed treatment. This was excellently explained by carefully prepared slides. Examples of defects were shown as they appeared on radiographs and, where possible, as actual sections cut through the defective area.

Radiography Precautions

As with most industrial practices, radiography requires conscientious attention to personnel safety. The precautions taken to ensure that operators of the equipment and workmen in the area are subject to negligible radiation were outlined.

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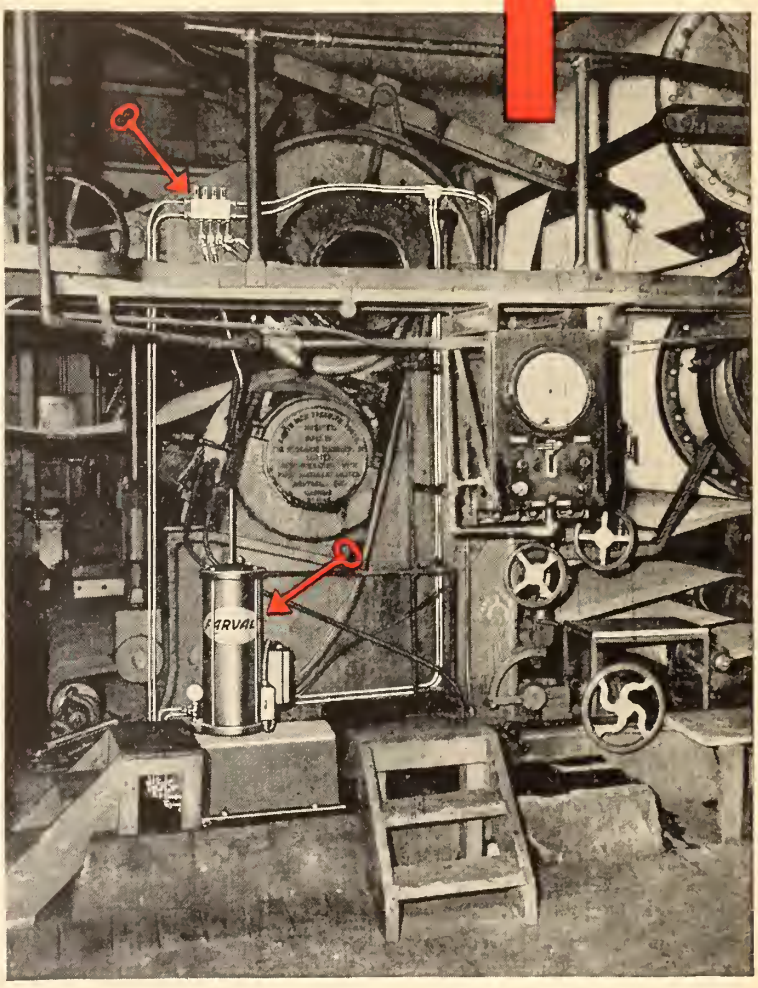

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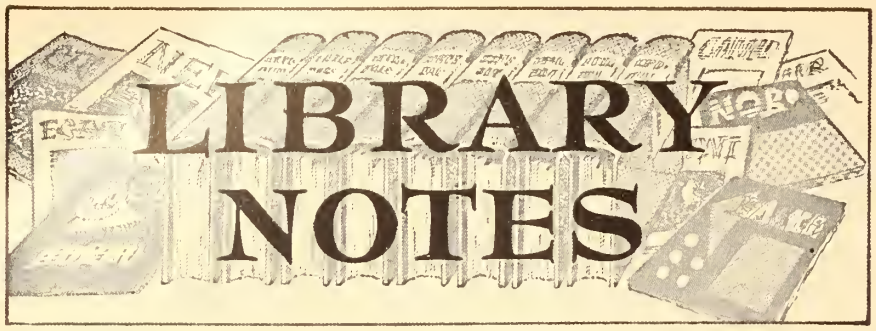

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Metals reference book. C. J. Smithells, ed. Toronto, Butterworth, 1955. 2 vols., $12.50 each vol.

This two volume reference work contains a comprehensive summary of a wide range of physical, mechanical, and electrical data relating to metallurgy and metal physics. The material is arranged in tabular form wherever possible, with brief monographs when the information could not be adequately presented otherwise.

For this new edition, the information has been thoroughly revised, and new values have been included where they had become available. The sections on crystal chemistry, diffusion in metals, thermochemical data and welding have been largely re-written, and new sections have been added on elastic properties, damping capacity, friction, etc. Other topics covered include atomic nuclei, X-ray crystallography, crystal chemistry, diffusion in metals, radiating properties of metals, mechanical properties of metals, etc.

Although the type used in the tables and on the diagrams is necessarily small, it is more legible than might be expected. Bibliographical references are included at the end of each section, and there has been a substantial increase in their number in this edition.

A detailed index increases the value of this very useful book which should find its way onto the reference shelf of many technical libraries, and of scientists and engineers working in the fields it covers. S.C.

BOOK NOTES*

Prepared by the Library
The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Atomic radiation detection and measurement. H. S. Renne. Indianapolis, Sams, 1955. 198 pp., illus., $3.00 (U.S.)

The ten chapters in this book are divided into three sections, the first of which covers nuclear theory, atomic reactions, and radiation and its effects. The next section describes the instruments used to detect and measure atomic radiation, Geiger counters, dosimeters, etc., while the last three chapters discuss some of the applications of nuclear science.

Appendices include a list of products and instruments and their manufacturers, a brief glossary, and a list of books for further reading.

The automatic factory—what does it mean? London, Institution of production engineers, 1955. 228 pp., illus., 25/-.

With the word Automation so much in evidence these days, it is interesting to read these papers presented at a conference held in England by the Institution of Production Engineers last June.

Various aspects of the automatic factory are considered; the technical and human problems; the management's problems; the place of the engineer; the automatic chemical factory; computer-controlled machine tools, etc.

The papers were all given by British experts on the subject, and there are illustrations of the equipment described in many of them. There is also a description of the various types of automatic equipment displayed at the Convention, together with the manufacturer's name.

Bearing lubrication analysis. R. R. Slaymaker. New York, Wiley, 1955. 108 pp., illus., $5.00.

This book, written primarily for engineering students whose major interest is machine design, and others not already familiar with the subject, deals with sleeve bearings.

Actual cases studied have been included, and many numerical examples used. Chapter headings include: viscosity and other properties of oil; hydrodynamic journal bearings; examples of sleeve bearing design; and boundary conditions, the coefficient of friction, and oilless bearings.

There are many illustrations, and references are appended to each chapter.

***Building, planning and design standards, for architects, engineers, designers, consultants, building committees, draftsmen and students.** H. R. Sleeper. New York, Wiley, 1955. 331 p., illus., $12.00.

This book presents specific data on over twenty building types to supplement the more general data given in the author's **Architectural graphic standards.** Information is provided for making comprehensive programs, schematic drawings and preliminary drawings, and for estimating areas and cubes. Diagrams showing spatial relationships and area requirements are generally given for each type of building, typical plans are often shown; and details, furniture, fixtures, and general data are included. A separate section is devoted to mechanical equipment for bulidings.

Design of prestressed concrete structures. T. Y. Lin. New York, Wiley, 1955. 456 pp., illus., $11.50.

The author states in his preface that the design of prestressed-concrete structures is not as complicated as most engineers presume. In this book he presents the basic principles and methods of design, in addition to giving information on materials, economic factors and other problems connected with prestressed construction.

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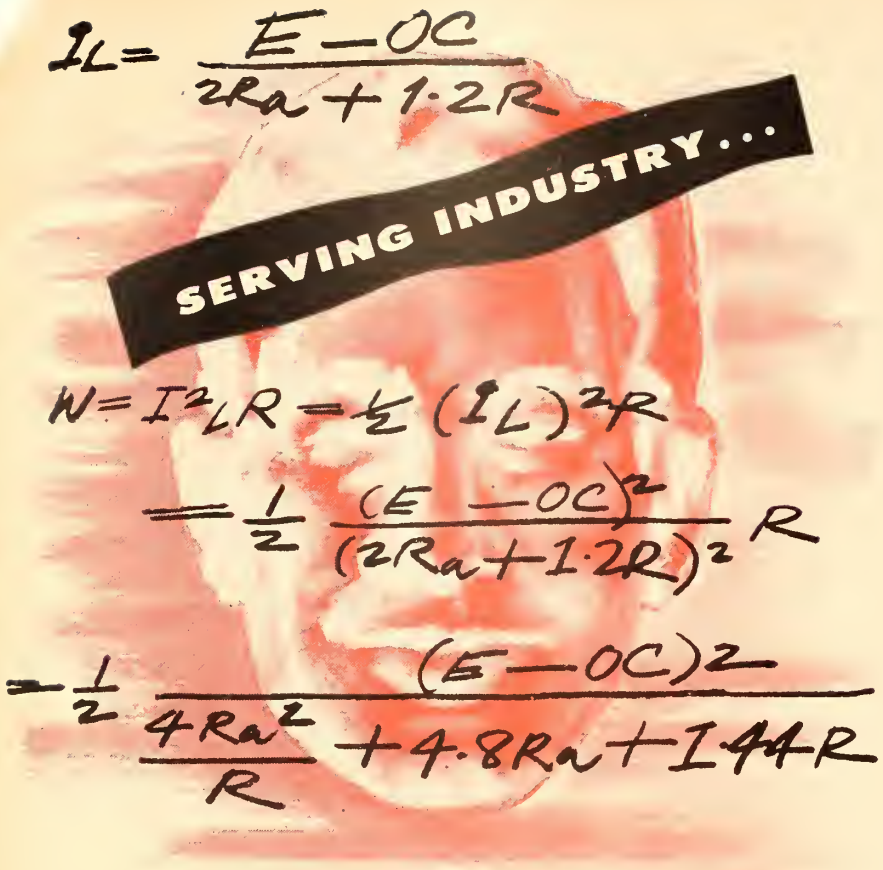

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He covers such topics as end anchorages, loss of prestress, shear, beams, slabs, circular prestressing, etc.

References are given at the end of each chapter, and some of the illustrations are taken from 1955 publications. One of the appendices outlines briefly the design data for various prestressing systems.

***Electromagnetic principles of the dynamo.** E. B. Moullin. Toronto, Oxford University Press, 1955. 367 pp., illus., $7.50.

This companion volume to the author's **Principles of electromagnetism** approaches the subject as a training in logical thought not as a manual of dynamo design. It aims at a thorough theoretical grounding which will encourage the student to take a critical view of the principles involved. Although chiefly concerned with d-c machines, much of the treatment is equally applicable to a-c machines and a supplementary chapter deals with features peculiar to them.

***Electro-technology: basic theory and circuit calculations for electrical engineers.** M. G. Say. New York. Philosophical Library, 1955. 167 pp., illus., $6.00 (U.S.).

This book presents in concentrated form the electro-technical basis of the phenomena which are important in light and heavy electrical engineering. An introductory section deals with conduction and with magnetic and electric field effects. The second part gives a complete guide to the handling of circuit problems. A feature of the book is the collection of network theorems for all types of circuits and networks.

Fertility from town wastes. J. C. Wylie. Toronto, British Book Service, 1955. 224 pp., illus., $5.00.

The author, the engineer for Dumfries County Council, presents in this book an account of a search for a solution to the problem of the disposal of sewage sludge in his county.

He discusses the principles governing waste collection, the treatment and disposal of sewage, and domestic refuse. In the section on the conservation of organic wastes the author describes the general methods to be followed in composting, and the practice used in Dumfriesshire.

He shows how the return of organic wastes to the soil not only improves the fertility of the soil but removes unsightly dumps from the countryside.

***Fundamentals of friction and lubrication in engineering.** Chicago, American society of lubrication engineers, 1954. 196 pp., $3.50.

The twelve papers presented in this first ASLE National Symposium cover many aspects from historical and general surveys of the hydrodynamics of lubrication to specialized treatments of various bearing types, the constitution of lubricants, friction problems, and wear. Bibliographies are included with most of the papers.

***Handbook of industrial engineering and management.** W. G. Ireson and

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E. L. Grant, eds. New York, Prentice-Hall, 1955. 1203 pp., $16.00 (U.S.).

In addition to covering the traditional subjects such as time study, plant layout, etc., this new handbook contains sections on engineering economy, budgeting, standardization, safety engineering, industrial hygiene, quality control, industrial statistics, and operations re-research. Intended both as reference manual and text, the treatment stresses general principles and the best current practice, and should prove very valuable to industrial engineers, students and those concerned with any form of management.

Industrial fermentations, volume 2. L. A. Underkofler and R. J. Hickey, eds. New York, Chemical publishing, 1954. 578 pp., illus., $12.00 (U.S.).

Like its companion volume, volume two of this comprehensive work is made up of papers contributed by a group of specialists drawn from industry, the teaching field and government bodies.

Topics discussed include ketogenic fermentation processes; production of riboflavin by fermentation; penicillin fermentation; broad-spectrum, polypeptide, and other antibiotics; and fermentation of cucumbers, sauerkraut and olives. There is a chapter on the important subject of cultural variation and one on fermentations in waste treatment.

There are flow diagrams, tables, etc., and each of the fourteen chapters has a bibliography.

In all, this summarizes much work in this ever-growing and important field.

Industrial furnaces, vol. 2, 3rd ed., W. Trinks. New York, Wiley, 1955. 358 pp., illus., $10.00.

Volume two of this well-known treatise is devoted primarily to practice and is intended especially to aid in the selection, installation, and operation of furnaces. The text covers fuels and sources of heat energy, combustion devices and heating elements, control of furnace temperature and atmosphere, and comparison of fuels and types of furnaces. Much of the book has been rewritten, and much new information has been added, including a chapter on safety measures.

The inspection and testing of metals. Institution of metallurgists. London, The Institution, 1955. 119 pp., illus., pa., 15/6.

This publication contains the lectures delivered at the refresher course held by the Institution in 1954. In all, five illustrated lectures were given by experts in the field.

The titles of the papers are as follows: The inspection of metals in service; Inspection in the steel industry; Inspection of non-ferrous metals; The assessments of methods of destructive and non-destructive testing; and Batch testing and sampling of metals.

This work should be a valuable addition to the book collection of those interested in metals.

An introduction to the theory of aeroelasticity. Y. C. Fung. New York, Wiley, 1955. 490 pp., diagrs., $10.50.

Intended primarily as a textbook, this work will also prove very useful to designers and flutter engineers, covering as it does various aspects of aeroelastic problems. The study of areoelasticity started in the 1920's, and part of the theory has now reached the stage where a general treatment is possible.

The larger part of the book is devoted to a study of aeroelastic problems, including flutter, transient loads and buffeting. The fundamentals of oscillating airfoil theory are covered in four chapters which also contain a brief summary of the results of experiments.

An outstanding feature of the book is the list of references at the end of each chapter. Although the author states the bibliography is incomplete, it includes both book and periodical articles which are accessible to the general reader, and covers material published up to and including 1954. For later items, the reader is advised to consult Applied Mechanics Reviews.

Principles of helicopter engineering. Jacob Shapiro. London, Temple, 1955. 433 pp., diagrs., 55/-.

The author of this book is an engineer-

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ing consultant in the field of helicopter engineering and equipment, and at one time was Research Engineer with Sir Frank Whittle's firm, Power Jets Limited. In this work he provides a complete survey of current knowledge of the field which will prove most useful to designers, engineers, and students interested in this growing phase of aviation.

Both theory and practice are covered. although little space has been given to details of aeronautics which are much the same for helicopters as for conventional aeroplanes.

The six chapters deal with such topics as rotating wings in steady flight, dynamics of the rotor, mechanics of helicopter flight, helicopter projects and rotocraft components and assemblies. Wherever possible the author has given examples of practical, and actual, designs to illustrate his remarks.

In writing the book Mr. Shapiro has drawn on the work of others, and on his own experience. A list of references is included, as is a glossary of terms and notations used in helicopter engineering.

Radio tube vade-mecum, 1955. 12th ed. J. A. Gijsen, ed. Antwerp, P. H. Brans, 1955. 381 pp.

The latest edition of this world renowned reference work on radio tubes needs little introduction. The most current, normal operational data are supplied for the types of valves included, which are tabulated in numerical and alphabetical order. The list of abbreviations is on separate cards which facilitates use of the manual.

Techniques de construction des usines a carbure de calcium, ferro-alliages et chlore. Giuseppe Zuliani. Paris, Publications minières et métallurgiques, 1955. 214 pp., illus., pa., 1400 fr.

The author, a specialist in the field, here reviews methods utilizing the electric furnace to obtain electrochemical and electrometallurgical products which are of such importance today.

The work is divided into four parts. These main sections deal with calcium carbide and its derivatives; electrical furnaces and auxiliary installations; ferroalloys; and electrolytic phenomena. Each part is divided into various topics. For example, grouped under the title Ferroalloys are the following discussions: ferroalloys in general; the metallurgy of silica; the metallurgy of manganese, electrotheric and synthetic melts; special ferroalloys, and silicon carbide (carborundum).

The book is well illustrated, there is a two page bibliography, but no elaborate table of contents or index.

The technology of cement and concrete. Volume 1, Concrete materials. R. F. Blanks and H. L. Kennedy. New York, Wiley, 1955. 422 pp., illus., $11.00.

In this first volume the authors discuss the materials used in making concrete, and their qualities. The second volume will consider the properties and uses of concrete.

Particular emphasis is placed on portland cement, but pozzolanic and other hydraulic cements are also covered.

The sections on concrete aggregates cover such topics as their geology and petrography, processing and effect.

The book is well-illustrated, and reference is made to applicable A.S.T.M. Standards. Many references are given at the end of each chapter, and, although developed originally from post-graduate courses in cement and concrete technology, the book should prove very useful to all users of concrete—engineers, contractors and technicians.

Vector and tensor analysis. Nathaniel Coburn. Toronto, Macmillan, 1955. 341 pp., $7.00.

This textbook has grown from lecture notes used by the author in his courses at the University of Michigan. It covers vector and tensor analysis, showing their value in studying other topics such as rigid body dynamics, differential geometry, etc.

Vector analysis is treated by use of directed line segments, and the theory of both it and tensors is given before any applications are made to specific subjects. The author has incorporated many problems into the text, and has included a bibliography on the subject.

Worked examples in engineering thermodynamics. H. J. Smith and J. W. Harris. London, Macdonald, 1955. 495 pp., diagrs., 35/-.

The problems presented in this volume are taken from the papers of the University of London degree examinations, the Associate Membership examinations of the professional institutions and the Higher National Diploma and Certificate examinations.

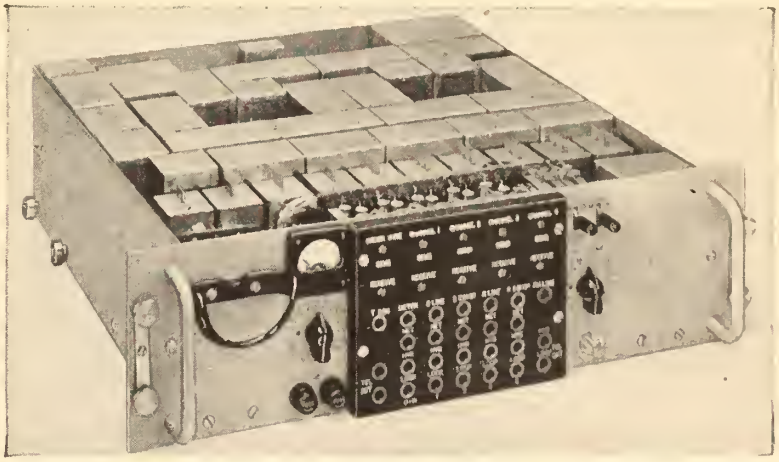
The questions are divided into twenty sections, and cover such topics as steam, steam raising plants, compressors, gas turbines and refrigeration.

The solutions given to the problems are those which would be given in an examination, so that the methods used are not fully explained. This collection should prove useful to many students.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Acta polytechnica:

No. 166—Synthetic methods for interruption tests on circuit-breakers, by H. B. Thorén. No. 167—A new formula for particle size distribution of products produced by comminution, by Jonas Svensson. No. 168—Further investigations into iterated sine- and cosine-integrals and their amplitude functions with reference to antenna theory, by Erik Hallén. No. 169—On the transverse strength of tankers, by Erik Steneroth. No. 170—Uber die Thermische Zersetzung von Kalziumsulfat bei Niedrigen Temperaturen, by J. A. Hedvall, S. Nordengren and B. Liljegren. No. 171—On the break-down of thixotropic materials, by S. E. Dahlgren. No. 172—Automatic noise-factor meter, by Henry Wallman. No. 173—The refractoriness of some types of quartz and quartzite. 2, by Folke Sandford and



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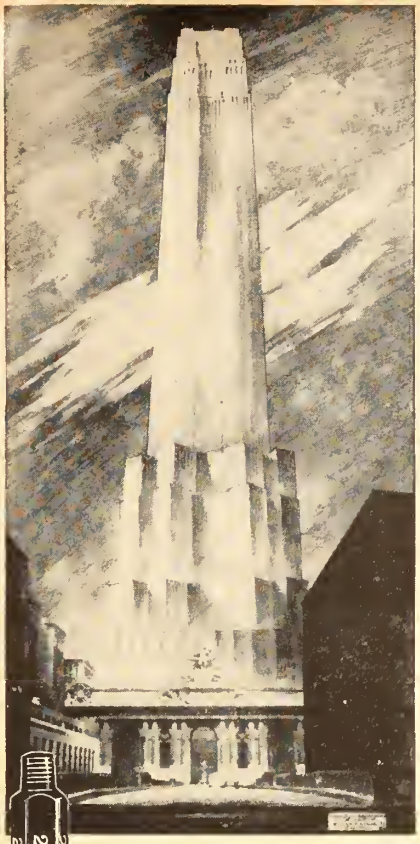

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Stig Fransson. No. 174—Investigation and calculation of the remaining tensile strength in wire ropes with broken wires, by Wilhelm Davidsson. No. 175—Dynamic forces in cranes, by J. Gotzlinger and S. Johnsson.

Atomic Energy of Canada Limited:
Atomic energy in Canada, 1955.

British electrical and allied industries research association. Technical reports:

No. E/T59—Trend in early insulating oil specifications, by E. A. Evans. No. G/T296—Effect of arcing on the air flow through the nozzle of a gas blast circuit breaker (summarizing report) by A. A. Hudson. No. L/T287—Electrode processes in spark discharges, by R. Craig. No. L/T322—Plasma oscillations and energy loss of charged particles in solids, by H. Frolich and H. Pelzer. No. Z/T92—Investigation of deterioration of moulded carbon resistors: First report, by H. F. Church and J. J. Walsh. No. Z/T95—The performance of insulated carbon-resin film resistors, by F. G. Rivers.

Canada. National research council:
National building code of Canada (1953) Appendix 4.1.B—Fire endurance of elements of structure.

Canadian Kodak Co., Limited:
How to organize and operate photographic service departments. 50 cents.

Central mortgage and housing corporation. Publications:
C.M.8—Building standards (excluding apartment buildings) May, 1955.

Kansas. University. Engineering and architecture bulletins:
No. 33—A study of stepped concrete footings, by C. M. Crosier.

Manufacturing Chemists' Association, Inc.
Chemical statistics handbook, 1955.

Quebec. Department of mines:
The mining industry of the Province of Quebec in 1953.

Underwriters' laboratories of Canada. Information bulletins:
No. C19—Purchase specifications for 2½ in. double-jacketed rubber-lined fire hose.

STANDARDS REVIEWED

British standards, British standards institution, 2 Park Street, London, W.1. British standards are available from the Canadian standards association, National research building, Ottawa.

B.S. 525: 1955—Fibre cores for wire ropes. 3/-.

First published in December, 1933, this standard has recently been revised in the light of newer technical information.

It covers a range of fibre cores of manila, phormium tenax, sisal, hemp and jute, suitable for wire ropes ⅛ in. to 4 in. circumference for cranes, lifts and hoists, shipping, oil-wells and collieries. The limits of application and grade of fibre are stated, and sizes are given. Requirements for preservation and lubrication are specified, chemical and physical properties are stated, and tests are described.

B.S. 2629: 1955 — Pallets for materials handling, suitable for transport by road and rail. 5/-.

The object of this work is to standardize a series of pallet sizes and capacities which are acceptable to transport organizations and convenient for transport and storage within individual organizations, so that palletized unit loads may be moved from manufacturer to consumer with a minimum of handling and by means of as wide a range as possible of handling equipment. Six sizes, giving an opportunity of wide application, have been specified.

B.S. 2630: 1955—Projection welding of low carbon steel sheet and strip. 2/6.

One of the process standards in the comprehensive series for the resistance welding of steel, this particular standard specifies the general requirements for the projection welding of low carbon steel sheet and strip.

The design of dies, electrodes and inserts is covered, in addition to methods of testing and welding procedure. Recommendations for the types of welding machines to be used are also given.

Canadian standards, Canadian standards association, National research building, Ottawa, Canada.

C.S.A. B51 - 1955—Canadian regulations for the construction and inspection of boiler and pressure vessels (Fourth edition) 50 cents.

"It should be understood that the Regulations contained herein are recommended standards only and do not have the force of law until adopted officially by the various provinces, also that the provinces, even though having adopted them, should be consulted as to the extent of such adoption, as the standards may have been adopted with exemptions or with additional requirements."

"The Regulations are intended mainly to fulfill two purposes. First, to provide for the safe design, construction, installation, operation and repair of boilers, pressure vessels and related equipment and second, to promote uniform requirements among the provinces."—Preface.

C.S.A. B71 - 1955 — Specification for small solid rivets (7/16-inch nominal diameter and smaller) (Second edition) $1.00.

The chief changes from the 1942 edition of this standard are:

1. New sizes, mainly 1/16- and 13/32-inch diameters have been added, and tolerances on head height and diameter have been increased.
2. Tinners', coopers', and belt rivets show changes throughout, to increase head diameters on small sizes, to widen tolerances and to add new sizes.
3. Aluminum has been added to the metals scheduled for non-ferrous rivets though this specification does not apply to aluminum rivets intended for aircraft use.

Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS WANTED

CHEMICAL ENGINEER, M.E.I.C., age 35, married, ten years experience in research, development, control and production in the pulp and paper industry. Seeks senior supervisory or administrative position. Complete resume upon request. File No. 660-W.

EXECUTIVE ENGINEER, M.E.I.C., P.Eng. (Quebec) B.Sc. Queen's with electrical and mechanical background and strong management and administrative experience desires change and seeks a senior and challenging appointment where his abilities can be fully used. Married with three children and speaks and writes French. Full details of past experience and positions will be furnished to serious inquirers upon request. File No. 937-W.

GRADUATE ENGINEER, B.Sc. (C.E.) cum laude, 10 years experience selling heavy machinery, gears, speed reducers, steel and bronze castings to heavy industry, including shipyards, machinery builders, cement industry, steel fabricators and paper mills. Prior to this, wide experience in the production, inspection, maintenance engineering and time and methods study, phases of industry. The position desired would be in top level sales work, in sales management, or in management. It would offer ability and initiative, scope for advancement. File No. 2500-W.

GRADUATE ENGINEER, 1945, age 33, bilingual, diversified industrial experience combined with sales engineering in various fields such as process control instruments, coals and petroleum fuels. Excellent knowledge of fuel marketing and extensive experience in many aspects of fuel utilization: heating, combustion, smoke abatement, steam plant engineering and related equipment. Seeks technical position of senior responsibility in sales, service, purchasing, management. Montreal area preferred. File No. 2554-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.) N.S.T.C. graduate 1950, 27 years old, single. Two years pulp and paper mill design and layout, one year diesel locomotive maintenance, 18 months railway car building and heavy repairs. Desires responsible position where qualifications and experience can be utilized. Available on reasonable notice to present employer. File No. 3271-W.

MUNICIPAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), Queen's (Civil) 1949, age 33, single, with 6½ years municipal experience including 2½ years as Town Engineer in Ontario town of 8000 population, seeks an opening in municipal or allied field with future and responsibility. Available in 1956 on one month's notice to present employer. Anywhere in Canada. File No. 4012-W.

SALES ENGINEER, P.Eng., Alberta 1950, age 31, desires employment as sales representative working out of Hamilton. Willing to sell any industrial or construction product. Five years experience in sales and engineering with industrial electrical manufacturing firm. Have both factory and district experience (2 years Montreal). 3 years with Navy petty officer in radio and radar, married, family, resident of Hamilton. File No. 4213-W.

CIVIL ENGINEER, Jr.E.I.C., Sask. 1949, married, age 27. Desirous of employment in Alberta. Experience chiefly in the field of heavy industrial equipment. Would like sales, plant engineering, application engineering. Presently located in Montreal. File No. 4517-W.

MECHANICAL AND INDUSTRIAL ENGINEER, McGill graduate, age 46, M.E.I.C., P.E.Q. and P.E.O., married. 21 years, news print and fine paper experience, in repairs, maintenance and all phases of plant engineering. Desires change outside of Quebec. Available short notice. File No. 4540-W.

ELECTRICAL ENGINEER, B.A.Sc. 1945, P.Eng., M.E.I.C., age 31, married with family, C.G.E. test course, presently employed. Excellent technical and practical background combined with administrative experience including 7 years complete charge of electrical engineering, design, construction, operation and mainteuance of large papermill and hydro electric stations including water control, transmission, relaying, and distribution. Other experience includes substation, illumination design and sales. Desires position in Canada or elsewhere with heavy industrial, power or consulting company where experience will be an asset. File No. 4725-W.

MECHANICAL-ELECTRICAL ENGINEER, with B.Sc. in electrical engineering, M.E.I.C., P.Eng., and Associate Member A.I.E.E. with seven years experience desires supervisory or management level position with an industrial organization. Experience includes one year mnaufacturer's test course, one and one half years sales engineer and four and one half years as co-ordinating engineer on large scale projects co-ordinating design, drawings, shop contact, engineering tests and field applications. Have completed executive evaluation tests and results are available to prospective employer. Travel not objectionable and will locate anywhere in Canada or the Eastern United States. File No. 4759-W.

MECHANICAL ENGINEER, P.Eng. (Ont.), Jr. E.I.C., B.Eng. 1954, McGill University, age 24, married, experience in sales, manufacturing methods and maintenance. Desires work of definite mechanical nature, either sales or/and engineering. Hamilton area preferred with moderate travel acceptable. File No. 4785-W.

YOUNG MANUFACTURING EXECUTIVE electrical engineer, M.S., P.Eng., M.E.I.C., A.M.I.E.E., A.M.A.I.F.E., early thirties, experienced manufacture switchgear and control gear, successively development engineer, chief engineer, manager. Seeks excutive position (not ncessarily electrical) with scope and good future prospects. Location open. File No. 4786-W.

MINING ENGINEER. Specialized also in soil mechanics, wide experience drilling, prospecting, development, production; in coal, salt, quarries, oil and formerly full professor Mining Engineering, Technical Assistance Administration (U.N.) expert. Fluent English and French, Spanish, Portuguese. Married age 45 years. Desires position where any former experience may be best utilized. Available immediately. File No. 4791-W.

MECHANICAL AND INDUSTRIAL ENGINEER, P.Eng. (Que.), Jr.E.I.C., graduate B.Eng. McGill 1951. 27 years old, married with two children, 4 years experience in fields of plant engineering, plant layout, process engineering, production control in various junior administrative positions with a medium-sized company in the manufacture of light precision machine parts. Extensive extra-curricular study in the fields of business administration, accounting and auditing. Desire responsible position as deputy to general manager or in industrial engineering and production control where initiative and top performance will lead to increases in responsibility and incentive. Willing to travel and will locate anywhere in Canada or northeastern United States. Canadian citizen, available upon three months notice. Substantiating data available on request. File No. 4792-W.

ELECTRICAL ENGINEER, B.Sc., E.E., 1953, age 24, single, Jr.E.I.C., 2 years in England on Athlone Fellowship, experience with large manufacturer of power equipment, several months experience in switchgear and relay applications departments, desires employment with future leading to position of responsibility in Canada or abroad. Please reply to File No. 4794-W.

CHEMICAL ENGINEER, M.E.I.C., married, age 47, 16 years experience in oil industry, 3 years experience in Canada as chemist analyst for ferrous and non-ferrous alloys. Economic studies, business and sales experience. Speaking fluently French and Italian. Interested in a position where capabilities will be fully utilized. Location and size of company is not important. Available on 15 days notice to present employer. File No. 4797-W.

MECHANICAL ENGINEER, Jr.E.I.C., age 30, five years practical experience in power plant, chemical plant, and refinery design and construction. Desires position in P.Q., preferably Montreal area. File No. 4798-W.

ELECTRICAL ENGINEER, B.A., B.A.Sc., Laval University 1954. Presently on a two year training course in England with a world wide company, specializing in hydro-electric. Undergraduate experience in the power field, experienced traveller. Married, 24, bilingual. Seeking interesting position with consultant firm or power company. Location open. File No. 4799-W.

GRADUATE ENGINEER, M.E.I.C., U. of T. 1922, chemical, civil, mechanical. Available Oct. 15, now resident Toronto. Immediate employment is desired anywhere, where there is prospect of permanence and some future ahead. Experience: tool designer, mechanical and architectural draftsman, structural steel and reinforced concrete detailer, pressure vessel detailer (over 10 years). Hold high school teaching certificate. have technical school and university teaching experience (12 years). Particular interest includes: chemical plant, oil refinery. steam plant, structural steel fabrication plant, associate or partner in consulting practice. Transportation expense advance is requested where interview is required prior to engagement. File No. 4800-W.

POWER ENGINEER. Born U.K. B.Sc. (Eng.) 1947, P.Eng. Works trained—2 years experience electrical distribution—3 years transmission design and construction—3 years power house design and construction. Last two years spent in Canada with consulting engineers as resident electrical engineer on 80,000 H.P. hydro electric project and as a design engineer. Seeks responsible post with management prospects or as senior development engineer. Preferred location Montreal. File No. 4803-V.

MECHANICAL ENGINEER, member A.S.M.E., 43, married. 3 children. Registered State of Minnesota. B. Eng., McGill, Canadian citizen now resident in U.S. desires to return to Canada. 5 years service in R.C.A.F. as aeronautical engineer officer. 10 years experience design and development. Past 5 years as a senior engineer in engineering research and development department of large U.S. firm engaged in development and construction of special machines for civil, military and atomic installations. Capable of handling projects from conception through prototype testing. Reason for change U.S. security clearance being withdrawn from aliens. File No. 4808-W.

GRADUATE MECHANICAL ENGINEER (McGill), age 34, 7 years of design and draughting experience in hydraulic turbine design, process and steam piping, plant layout, sheet metal work and materials handling seeks draughting or design work nights and/or on weekends. Also translation of German scientific papers into English. File No. 4809-W.

MECHANICAL ENGINEER, Jr.E.I.C., age 31, McGill, 1948, past experience includes 2½ years plant engineer of substantial manufacturing and relocation operation involving multiple projects. 4½ years country wide sales of power plant and paper equipment of diversive nature. Affiliation in either plant engineering or sales desired. Canada or U.S. References and details available. File No. 4810-W.

MECHANICAL ENGINEER, M.E.I.C., age 39, married. Fifteen years valuable experience in designing, estimating, selling and project engineering in the machinery and plate industry. Desires position in the Montreal area with reliable firm and good future. Presently employed, but available upon reasonable notice. File No. 4814-W.

MECHANICAL ENGINEER, P.Eng., M.E.I.C., A.M.I.Mech.E., First class B.O.T. Steam & Diesel certificate. 32 years old, married, no children. Desires responsible position in mechanical or marine engineering fields. Experience consists of five-year workshop apprenticeship, seven years as marine engineer officer and one year surveyor to international classification society in United Kingdom. Canadian experience includes one year experimental thermodynamics, two years in charge engineering department large insurance company. Available on reasonable notice to present employer. File No. 4815-W.

CIVIL ENGINEER, Jr.E.I.C. (U.N.B. 1950), married. Age 29. Experience construction and maintenance. 5 years experience with large transportation company. Familiar sewage and drainage problems. Interested in municipal engineering or contracting. Fluently bilingual. Available on two weeks notice, for work in Quebec or Ontario. Expected salary open for discussion. File No. 4818-W.

MECHANICAL ENGINEER, Jr.E.I.C., 1952 B.Eng., married, age 34. Completed training course with large manufacturer of electrical equipment. Presently employed; experience includes cost reduction and product improvement work as manufacturing engineer on switchgear equipment, induction and synchronous motors. Varied experience in sales and field engineering. Capable public speaker. Desires sales or product engineers' position demanding initiative and with opportunity for advancement. Preferred location in Ontario or Maritime Provinces. File No. 4820-W.

CHEMICAL ENGINEER, Jr.E.I.C., B.Eng., McGill, 1952, A.I.Ch.E., Jr.E.I.C., C.I.C., P.Eng., age 28, married, desires a more responsible position. Experience in development work in chemical plant and paper mill. Also administrative experience as production supervisor in a chemical plant. Presently employed in Quebec, however would consider employment anywhere in production supervision or development. File No. 4832-W.

CREATIVE ENGINEER, supervisory and management background in chemical and process metallurgy fields, and with sound engineering understanding. B.A.Sc. (Toronto), M.Sc. (Queen's), and A.H.I. business course. M.E.I.C., age 34. Can contribute in plant management, operational analysis or technical administration. File No. 4833-W.

HYDRAULIC ENGINEER, M.E.I.C., Junior member A.S.C.E., graduate B.Sc. (C.E.) Man. 1948, M.Sc. Utah State 1955, married, 31, two children, returning to Canada desires employment in hydraulic design or related fields, 6½ years experience in drainage, irrigation and highways. File No. 4834-W.

SITUATIONS VACANT

CHEMICAL

ENGINEER REQUIRED FOR PROJECT engineering work by petroleum contractors in the Toronto area. Applicants should have minimum 3 to 5 years experience in petroleum or chemical industry with knowledge of equipment selection and coordination of engineering purchasing and construction. Salary open. File No. 5407-V.

CHEMICAL ENGINEER required by newsprint mill in P.Q. A graduate chemical engineer from recognized university with some experience in the pulp and paper industry is required for the technical department. Work will consist of technical investigations of various plant operations, improved process control and paper quality. Excellent opportunity for rapid advancement. Salary dependent on experience and ability. House available. Initial letter to include full resume of experience. File No. 5453-V.

ALUMINUM COMPANY OF CANADA LTD. has openings for graduate engineers particularly in the fields of chemical engineering and extractive metallurgy. For production or development in their plants in the Saguenay district, Quebec and Kitimat, British Columbia. File No. 5467-V.

RECENT GRADUATE CHEMICAL ENGINEER REQUIRED by paper company in Province of Quebec. Interviews arranged in Montreal. File No. 5484-V.

CHEMICAL ENGINEERS and chemists required for process control and research work in a New Brunswick company's pulp mills. Apply giving full particulars and salary expected. File No. 5495-V.

CHEMICAL ENGINEER with 4 to 5 years experience required for new chemical plant to be located near Montreal by large and well known industrial concern. Excellent opportunity for a young man wishing to get in on the ground floor of a new and substantial chemical operation. Salary open. File No. 5498-V.

CHEMICAL ENGINEER required by chemical and polyethylene plant 75 miles from Toronto. Prefer recent graduate with 1 to 3 years experience. Must have qualifications for production supervisory position. Good possibilities for advancement in a growing industry. Apply File No. 5503-V.

CIVIL

SENIOR PROJECT ENGINEER required by young municipal engineering firm to supervise both design and construction of complete water supply and sewage disposal systems. Qualifications thirty to forty years with applicable experience in Canada. Please reply giving full details of academic training, professional experience, references and salary requirements. File No. 5332-V.

CIVIL OR MECHANICAL ENGINEER with design and field experience in industrial building construction, with knowledge of machine foundations, building alterations, etc. This person should have 5-10 years experience and be 32-40 years of age. This is a permanent position with a large nationally known company with head office in Montreal. When replying, please give a short summary of qualifications, experience and approximate salary desired. File No. 5505-V.

YOUNG ENGINEER or architect required for young construction firm, specializing more in sewer work and excavation but also doing building construction. Salary to start $400 per month. Must have at least two years experience and not over 35 years of age. Apply stating age, graduation, experience, and references to File No. 5373-V.

RECENT GRADUATE CIVIL engineer required in the track section of the office of the chief engineer of a major railway company in Montreal. File No. 5377-V.

CIVIL ENGINEER preferably not over 35 years of age required by structural steel firm in Montreal, to act as sales man for roof deck and wall panel construction. Salary open. Please reply to File No. 5393-V.

GRADUATE CIVIL ENGINEERS required by well known engineering and construction company for specialized work in the field of soil mechanics and foundation engineering. Post graduate studies in soil mechanics and structures desirable but not essential. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

SOILS ENGINEERS required by well known engineering and construction company. Must be graduate civil engineers, preferably with post graduate studies in soil mechanics and foundation engineering. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

ENGINEERING GEOLOGIST required by well known company specializing in the field of soil mechanics, foundation engineering and geotechnical processes. Must have post graduate studies in Pleistocene and be interested in the application of geologic aspects to civil engineering works. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

A PRESIDENT IS REQUIRED immediately by a Montreal firm, thoroughly experienced in the contracting industry, especially in the management and public relations industry. Successful candidate should be a man of ability and vision. Preferred age 35-45; must be a civil engineering graduate. Salary in five figures plus bonus. File No. 5417-V.

PROJECT ENGINEER, excellent opening for the right man, with a well established engineering firm in Montreal specializing in the hydro electric field, this is a senior position. Applicant should be a graduate with 15-20 years experience in the design, preparation of plans and specifications, reports and estimates for the civil engineering aspects of hydro electric power developments. He will be required to take charge of a designing group as project engineer. The position is of a permanent nature and entails the usual pension, group insurance and other benefits. The salary will be commensurate with the capabilities, educational background and experience of the applicant. The applicant should be prepared to furnish references as to his qualifications and experience. All applications will be acknowledged. File No. 5431-V.

CIVIL ENGINEER with good knowledge of building construction and costing by general contractor in the Kingston, Ontario area. Salary open. File No. 5434-V.

STRUCTURAL ENGINEER with some experience in steel or reinforced concrete. Age to 35. Applicants must be willing to headquarter in Minneapolis, Minnesota with some travel in both the U.S. and Canada. Position offers permanence and opportunity for advancement. Reply giving complete information regarding personal history, education and experience. File No. 5436-V.

CONSTRUCTION ENGINEER for company located in Western Canada. Age range 40-50. Must be well experienced in asphalt paving, soils, road work, concrete structures, gravel plants. Must be able to operate as general superintendent. Excellent salary and possibility of participating in company profits. File No. 5437-V.

STRUCTURAL STEEL DESIGN and detail engineers required by a progressive pulp, paper and converting company. The location is in Eastern Canada. Excellent residential, educational and recreational facilities are available. Applications will be treated with strictest confidence. Send complete resume and salary expected to File No. 5439-V.

SANITARY ENGINEER wanted for department of Health, Newfoundland. Applicant must have a degree in civil engineering and/either a certificate in Public Health Engineering or be willing to take a year's training in public health on a bursary supplied by the Department. Enquiries re salary and conditions of employment to be directed to File No. 5442-V.

ASSISTANT CIVIL ENGINEER required by an established public utility supervisory consulting organization, age 30-45, minimum 5 years experience on structural steel, reinforced concrete and foundation design of steam electric power plants. Location N.Y. Some travel field future. Reply stating age, education, experience, personal particulars, minimum salary expected. File No. 5449-V.

CIVIL ENGINEER, recent graduate, required as assistant to City engineer. Experience in asphalt paving desirable but not essential. Salary dependent on experience. Applications close January 15, 1956. Additional information will be supplied, upon request. Apply to city engineer's office, City Hall, Swift Current, Sask. File No. 5469-V.

CIVIL ENGINEER required by construction company located in Maritime Province. Applicant should have building construction experience and would be required to completely organize and supervise all phases of the office work and carry out liaison with the superintendent and all sub traders in the field. A speaking knowledge of French would be helpful but not essential. Position offers permanency and a good opportunity for an engineer with building construction background who would like to go to Maritimes and take complete charge of a growing construction company. File No. 5470-V.

CANADA

ENGINEERING OPPORTUNITIES

Civil Service of Canada

CIVIL ENGINEERS

Civil Engineering Graduates are required for oppointments in various fields including:

- Structural Design.
- Hydraulics.
- Hydrometrics.
- Public Health Engineering.
- Highway Construction.
- General Engineering.
- Surveying.

There are vacancies at Ottawa and other centres across Canada.

ELECTRICAL ENGINEERS

Over 50 positions are available to Electrical Engineers involving the design and development of:

- Communications equipment.
- Electrical machinery.
- Lighting and distribution systems.
- Electranic equipment.

Appointments will be made at Ottawa and other centres.

QUALIFICATIONS—The bosic requirement is university graduation in engineering or applied science.

SALARY—Initial salaries vary depending upon positions and range up to $6,800 per annum.

PATENT EXAMINERS

30 Graduate Engineers are required for employment ot Ottawo as Potent Examiners in the following fields:

- Mechanical Engineering.
- Electricol Engineering.
- Chemicol Engineering.

Training in potent law and regulations os well os the procedure for handling patent applicotions is provided.

MECHANICAL ENGINEERS

A number of Mechanicol Engineering graduates ore needed at Ottawa and other centres for positions involving the design ond installation of:

- Heoting, ventilating ond refrigerating equipment.
- Diesel, gas, steam reciprocoting machinery.
- Pumping equipment.
- Gas and steam turbines.
- Electricol equipment control systems.
- And others.

RESEARCH OFFICERS

Graduates in Metallurgical, Mechanical, Chemical and Mining Engineering are required at Ottawa, Chalk River and other centres for:

- Fundamental and opplied research in physical metallurgy.
- Extractive metallurgy.
- Coal mining studies.
- Industrial minerals investigations.

Ample opportunity provided in these posts to present and publish technical popers.

These positions offer opportunities for personal development and advancement as well as good working hours, generous provisions for vacation and sick leave, an excellent pension plan, low-cost term insurance and a group hospital-medical insurance plan.

For details on positions available, write to the CIVIL SERVICE COMMISSION, OTTAWA, specifying the type of employment in which you are interested.

UNIVERSITY TEACHERS WANTED

Nova Scotia Technical College desires applications for positions of Lecturers and Assistant Professors in

Chemical Engineering

Civil Engineering

Electrical Engineering

Mechanical Engineering

Metallurgical Engineering

Salary Ranges—
Lecturer—$3720 to $4200.

Assistant Professor—
$4380 to $5100.

with superannuation and hospital insurance.

First appointment will depend upon qualifications and experience. Opportunities for advancement to higher ranks in an expanding institution. Some positions available January 1st, 1956. All must be filled by September 1st, 1956.

Research and Professional employment encouraged.

Apply to The President, Nova Scotia Technical College, P.O. Box 1000, Halifax, Nova Scotia.

SEVERAL POSITIONS AVAILABLE for graduates in engineering or architecture, preferably in city planning for the City of Ottawa, Department of Planning and Works. Duties will consist of general planning studies with particular reference to zoning and land subdivision. Salaries to be negotiated. File No. 5471-V.

ENGINEERS REQUIRED BY the Saskatchewan Department of Agricultfure. Salary range $337. to $409. per month. Requirements, University graduation in engineering with some professional or sub-professional experience. Civil or agricultural engineers are preferred Duties: project engineers for irrigation, drainage and flood control work to do preliminary investigation, and supervise the operation and maintenance program. The work is under the general direction of a district engineer. Benefits: 3 weeks holidays and 3 weeks sick leave per year; generous pension plan. These positions offer an excellent opportunity to obtain on the job training in this specialized field. File No. 5472-V.

CIVIL ENGINEER required to act as engineering assistant in the City Engineer's office, London, Ontario. The starting salary is $3,604.00 increasing $200.00 per year to $5,088.00. File No. 5474-V.

DESIGN ENGINEERS wanted by a rapidly expanding firm specializing in prestressed and precast concrete throughout Canada. Several years experience in reinforced concrete is required. Positions offer salary, participation in company's hospitalization and pension plans. File No. 5477-V.

ESTIMATOR EXPERIENCED IN industrial buildings, bridges and heavy construction required by expanding firm operating throughout Canada. Position offers salary participation in company's hospitalization and pension plans. Applicants should give full details, including age, education and background, experience, marital status, salary requirements. File No. 5477-V.

SALES ENGINEER for promotion and sales in professional field with background in structures and construction required by firm specializing in prestressed and precast concrete throughout Canada. Position offers salary and commission, participation In company's hospitalization and pension plans. Applicants should give full details including age, education and background, experience, marital status, salary requirements. File No. 5477-V.

PLANNING ASSISTANT (Architect) required by the City of Vancouver to perform civic design and general planning duties. Degree in architecture; must be eligible for professional registration in B.C. Some planning experience desirable. Salary $353. to $424.00 per month. Apply to Personnel Director, City Hall, 453 W. 12 Avenue, Vancouver 10, B.C., not later than January 5, 1956. Quote Competition No. 0-300. File No. 5479-V.

TRAINEE PLANNING ASSISTANT required by the City of Vancouver. To be trained to perform a variety of municipal planning work with emphasis on highway locational duties and related traffic problems. Degree in Civil engineering with allied experience. Must be eligible for professional registration in B.C. Salary $353.00 to $424.00 per month. Apply to Personnel Director, City Hall, 453 W. 12 Avenue, Vancouver 10, B.C., not later than January 5, 1956. Quote Competition No. 0-299. File No. 5479-V.

FOREST AND CIVIL ENGINEERS required by established consultants with headquarters in Western Canada. Qualifications: 2 to 8 years experience, able and willing to assume responsibility for and be capable of managing projects which include timber management, forest surveys, aporaisals and evaluations, logging inspection, design and supervision of construction, etc. Salaries: commensurate with experience and qualifications. Advancement: excellent opportunity exists for advancement in a rapidly expanding organization. Please submit full details of qualifications, experience, references, etc. File No. 5480-V.

APPLICATIONS ARE DESIRED from graduate civil engineers for the position of assistant engineer with the city of Guelph, Ontario. This position in the City Engincer's office offers a variety of work in a steadily growing city of 33.000 population. The engineering department plans, designs and supervises all work of the sewer, water, road and garbage departments. Building inspection and the planning department are also operated through the engineering office and the opportunity of experience through association and work with these departments is available. Some experience or association with municipal or similar work is desirable but not essential. The salary range is from $4600.00 to $5500.00 per year depending on ability and experience and a recent graduate intending to make a career of municipal work is preferred. File No. 5481-V.

WANTED FIELD ENGINEERS with 2 to 8 years experience in major civil engineering and structural work, to work on varied projects in Eastern Canada from Montreal office. Must be accurate instrument men and for senior positions capable of supervising contractors' work. Some knowledge of piling and dock work a decided advantage. Minimum of several years work for right man. Application sent to File No. 5483-V.

CONSTRUCTION ENGINEER wanted to fill position of projects manager for large general contractor located in Nova Scotia. Experience should include housing development and general construction. Applicant must have had field experience and be able to take charge of estimating. This is a senior position with excellent income opportunities. Reply stating age, education, experience and salary required to File No. 5496-V.

CONSULTING ENGINEER has opening for structural engineer with minimum 10 years experience in commercial work. An associateship will be offered to a suitable man. All replies treated confidentially. File No. 5501-V.

GRADUATE ENGINEER required by major oil company for sales engineering positions in Montreal and surrounding territory. Involves broad training in all petroleum products and their application in industry. Experienced and bilingual engineer preferred between 25-30 years of age. File No. 5504-V.

GRADUATE CIVIL ENGINEERS for field work, required by international engineering and construction company specializing in petroleum and chemical fields. Preferably experienced in concrete foundations; erection structural steel; detailing, fabrication and erection of piping. Non-experienced applicants will be considered. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5512-V.

ELECTRICAL

GRADUATE ELECTRICAL ENGINEER, required as assistant engineer in rural department of power company in Alberta. Location in Edmonton. Duties involve design and estimation of single phase farm power lines with related engineering. Salary commensurate with qualifications. Excellent employee benefits provide pension, group life, sickness and accident coverage. File No. 5359-V.

TWO JUNIOR ELECTRICAL or engineering physicists for work in our research and development departments. The work involves research and development work in various special antennae and related components. Location Ontario. File No. 5374-V.

ELECTRICAL MANUFACTURING ENGINEER with experience in the design and manufacture of air break switch gear required for chief engineers position with Western manufacturer. Should be capable of leading a development program in a newly equipped lab on low voltage air break switchgear and circuit breakers up to 15 kv. Salary open. Replies from applicants with all or part of the required experience will be treated in strict confidence, and should contain full details of experience, age, and educational background. File No. 5395-V.

COMMUNICATIONS DEPARTMENT OF LARGE transportation company in Montreal has immediate openings for electrical engineering graduates specializing in or with experience in communications as assistant engineers in the transmission and equipment groups. Work involves application and special engineering of all types of carrier, telephone, telegraph program network transmission, television and broadband microwave systems. Offers wide range of experience in communications field. Headquarters Montreal, with field engineering throughout system. All replies will be held in strict confidence and will be acknowledged. File No. 5403-V.

ELECTRICAL ENGINEER WITH experience in design of electrical installation, including communications for industrial and commercial buildings. Minimum five years experience since graduation. Firm of consulting engineers in Toronto. File No. 5411-V.

ELECTRONIC ENGINEER required with several years experience in design and construction of experimental equipment. Knowledge of magnetic amplifiers essential. Capable of independent work on servo-mechanisms for aircraft application. Manufacturer of aircraft engine fuel systems located in Toronto. Apply with full details as to age, date of graduation, experience and approximate salary required. File No. 5412-V.

ELECTRICAL ENGINEER required as assistant in rotating machinery department handling special induction motors, alternators and generators. Should be capable of handling quotations, orders and general correspondence. Location Montreal. File No. 5432-V.

The General Atomics Division of CANADAIR LIMITED MONTREAL

invites application from

ENGINEERS

This newly organized nuclear division has openings for engineering designers with layout, design and development experience in the following categories:

MECHANICAL EQUIPMENT
HYDRAULIC SYSTEMS, INCLUDING PUMPS
TANKS, VALVES, PIPES and HEAT EXCHANGERS
PLANT LAYOUT
PROCESS INSTRUMENTATION SYSTEMS
ELECTRICAL or ELECTRONICS CIRCUITRY
NUCLEAR REACTORS

Here is a splendid opportunity to get in on the ground floor of a new and expanding field with a well established company.

Please send details of education and experience to:

DR. A. C. JOHNSON
Canadair Limited
P.O. Box 6087
Montreal, Quebec

ENGINEERS

NATIONAL RESEARCH COUNCIL CANADA

Requires

HONOUR GRADUATES AND POSTGRADUATES

In

AERONAUTICAL ENGINEERING

CHEMICAL ENGINEERING
CIVIL ENGINEERING
ELECTRICAL ENGINEERING
ELECTRONICS
ENGINEERING PHYSICS
MECHANICAL ENGINEERING

For RESEARCH and DEVELOPMENT work at OTTAWA

Applications or enquiries are invited from recent high-ranking university graduates, particularly honour graduates from Canadian universities. Write to:

Employment Officer
National Research Council
Sussex Drive
Ottawa 2, Ontario

ELECTRICAL ENGINEER required as assistant in motor department handling standard induction motors. Should be capable of handling quotations, orders and general correspondence. Location Montreal. File No. 5432-V.

ELECTRICAL ENGINEER as assistant in transformer department. Should be capable of handling quotations, orders and general correspondence. Location, Montreal. File No. 5432-V.

APPLICATIONS ARE INVITED FROM electronic development engineers with experience in the intermediate frequency field, for advanced development work associated with I.F. circuits and systems for new techniques in pulse and doppler radar. The position, which is permanent and pensionable, is at the company's main plant at Rugby, England. Qualifications: university degree and at least two years experience in I.F. or related circuit developments. Applications, stating age and giving details of qualifications, should be made in the first instance to File No. 5446-V.

MICROWAVE DEVELOPMENT ENGINEER. Applications are invited for the position of development engineer at the company's main plant, Rugby, England. The position is permanent and pensionable, and concerns long-term development of the latest techniques in microwave systems of unusual complexity. Ample opportunities are afforded for original work. Qualifications: university degree in electrical engineering or physics, and at least two years practical experience in microwave systems and/or components development. Applications stating age and giving details of qualifications should be made in the first instance to File No. 5446-V.

OPPORTUNITIES FOR ELECTRICAL ENGINEERS and engineering physicists with the Defence Research Board at Valcartier, Quebec; Ottawa, Ontario; Dartmouth, Nova Scotia. The challenging program, which offers excellent chance for advancement, includes research on missile control systems, servomechanisms, temperature and vibration problems, fire control systems, instrumentation, low frequency and high frequency propagation, radio communication circuits, radar, microwave techniques, and underwater acoustics. Applications are invited from university graduates (or the equivalent) who are Canadian citizens or British subjects. Initial salaries range from $3,750.00 to $6,000.00 depending on qualifications and experience. Modern laboratory facilities and generous employment benefits available. File No. 5447-V.

ELECTRICAL ENGINEER required by Potash Company in Saskatchewan. Must be qualified to lay out and supervise installation and maintenance of power distribution system for an industrial plant and mine. A knowledge of control systems, switchgear, relaying and heavy motors is desired. Position involves supervision of electrical and mechanical installation and offers a varied and interesting position in an expanding company. File No. 5448-V.

ELECTRICAL ENGINEER GRADUATE, two to five years experience protective relay work with electric utility. Permanent position long established supervisory-consulting organization headquarters New York. Some travel Latin America. Salary commensurate with experience. Reply stating age, education, experience, personal particulars, and minimum salary expected. File No. 5449-V.

ELECTRICAL ENGINEER, graduate, two to five years experience, protective relay work with electric utility. Permanent position, long-established supervisory consulting organization. Headquarters New York. Some travel Latin America. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5450-V.

YOUNG ELECTRICAL ENGINEER, power option, recent graduate or man with one or two years experience. Good opportunity. Permanent position with long-established electric utility in Costa Rica. Knowledge Spanish necessary. Reply stating age, education, experience, personal particulars, and minimum salary expected. File No. 5451-V.

GRADUATE ELECTRICAL ENGINEER, required to assist in preparation of plans, specifications and estimates of electrical systems for offices, shops and buildings designed in chief architect's department Trans-Canada Air Lines, Montreal. Preference given to applicants having two or more years general experience in the electrical branch of construction work and interested in being closely associated with architectural work. Permanent position with full employee benefits. File No. 5452-V.

SENIOR POWER TRANSFORMER design engineer. Good opening for aggressive man unafraid of responsibility and with existing or potential ability to handle up to the largest ratings. Well established firm with excellent technical facilities. Salary open and commensurate with experience and ability. Our employees know of this advertisement. All replies will be treated as confidential. File No. 5461-V.

SYNCHRONOUS MOTOR DESIGN ENGINEER, capable of all types of synchronous motor and generator design, and with experience in the design of hydro alternators, up to 10,000 KVA. Salary commensurate with experience and ability. Our employees know of this advertisement. All replies will be treated as confidential. File No. 5482-V.

TEST LABORATORY SUPERVISOR required by electrical appliance manufacturer in London, Ontario. Must have some industrial chemistry experience and supervisory potential if not experience. File No. 5489-V.

ELECTRICAL ENGINEER with 4 to 6 years experience. Duties include co-ordination of mine electrical installations, preparing plans, drawings and cost estimates of new installations and alterations to existing installations, surveys for substations and power lines as well as technical direction to electrical foreman and staff. Location, Atikokan, Ontario. Salary dependent on experience. File No. 5494-V.

PURCHASING AGENT. CHIEF PURCHASING agent required for manufacturer of large electrical apparatus, situated in the Niagara Peninsula. Duties consist of supervising and performing purchasing functions, including procurement and expediting of all raw materials, purchase parts, equipment, tools and supplies. File No. 5499-V.

ELECTRICAL ENGINEER — senior engineer required by major consulting firm located in Vancouver, B.C. Experience in pulp and paper mill power system development, in-

MECHANICAL DESIGN ENGINEERS

The Research Division of Ferranti Electric Limited requires engineers experienced in the design and development of precise mechanisms, equipment mountings and enclosures as related to electronic computers and similar devices.

Applicant should be capable of supervising a development group and should be qualified engineers or holders of British Higher National Certificates.

For appointment call Mr. E. H. Mann, RO 2-3661 or write to:—

Ferranti Electric Ltd.
Industry Street,
TORONTO 15, ONTARIO

stallation, and operation required. Excellent opportunity for man with proper qualifications. Group benefits available. In reply please state experience, salary expected and availability. File No. 5510-V.

MECHANICAL

MECHANICAL ENGINEER with 3 to 5 years experience in the design and construction of materials handling equipment. Working knowledge of electricity and the strength of structures helpful. Position offers good salary and opportunity for advancement with full employee benefits. Location Niagara Peninsula. File No. 5322-V.

MECHANICAL SALES ENGINEERING and application engineering positions in new and growing company making electrical, industrial control apparatus in S.W. Ontario. Prefer electrical mechanical or engineering and business 1955 grads. File No. 5388-V.

A WELL KNOWN MACHINERY manufacturer requires a mechanical sales engineer to contact large industries in the Province of Quebec. Established clientele assuring substantial income for qualified man. Some knowledge of French desirable. This is in addition to the existing staff who are aware of this vacancy. If you believe you are the man for this position please send complete details of qualifications and past experience which will be held in strict confidence. File No. 5389-V.

GRADUATE MECHANICAL ENGINEER for large industrial concern near Montreal required for development work and general project engineering. Permanent staff position and good prospects for promotion for young engineer with initiative and ability for original design work. Previous experience preferred but not necessary. We will pay travelling expenses for interview. Write stating personal information, experience in detail, salary required and date available. File No. 5390-V.

MECHANICAL DESIGN ENGINEER. We require an experienced professional mechanical engineer with 10 to 15 years experience in design mechanical equipment particularly cranes or materials handling machinery. Experience in design of radioactive material handling valuable. Will be required to design layout of fuel rod handling system and equipment. Please reply by letter stating experience, qualifications, etc. Location Ontario. File No. 5401-V.

PLATE AND VESSEL DESIGNER. We require an experienced professional mechanical engineer with 5 to 10 years design experience in vessels, heat exchangers or allied equipment. Will be required to work on pressure vessels and heat exchanger for the reactor, as well as plate and tube components for the reactor core. Please reply by letter stating experience, qualifications, etc. Location Ontario. File No. 5401-V.

RECENT MECHANICAL GRADUATES of Canadian universities have exceptional opportunities to train for sales of combustion control and industrial instruments. Prominent American manufacturer has organized Canadian company with general offices and assembly plant in Toronto. Canadian born engineers required. Extensive factory and field service training will be provided. File No. 5404-V.

MECHANICAL ENGINEER required by sheet metal fabricating company in Montreal, to take charge of small engineering department. Duties will include supervision of drafting and estimating standard and custom products and development of new products. Applicant should have 4 or more years applicable experience and be preferably bilingual. Starting salary minimum $6,000.00 per year. Company name Eastern Steel Products but please submit full details as to past experience, age, etc., to File No. 5416-V.

TWO GRADUATE MECHANICAL ENGINEERS wanted by manufacturer of heavy industrial machinery in Western Montreal for application engineering and sales. 1950-1955 graduates considered. Training provided. Benefits include generous life insurance, sickness and accident and pension plans. Five day week. Applicants should outline training, experience, and salary expected. File No. 5423-V.

CANADA'S MOST MODERN transformer plant requires mechanical engineer with five years experience on pressure vessel design, medium to heavy structural steel or plate design, for work on large tanks and components. Work is interesting and varied; transformer experience not necessary. Full employee benefits, pleasant working conditions in attractive Southern Ontario community. File No. 5426-V.

DESIGN ENGINEERS required for commercial vehicle design. Good opportunity with a sound future for a graduate mechanical engineer, who has had practical experience in structural design. Location Ontario. File No. 5429-V.

GRADUATE MECHANICAL ENGINEER required by a heavy industry with extensive mining and milling operations in the Eastern Townships (Quebec). Duties will include machine design, plant layout, work scheduling, etc. Preference will be given to applicant with one year's experience or recent graduates. Good opportunity, interesting and permanent position with attractive salary. Numerous employee benefits. Replies should include complete record of education, also salary expectation should be mentioned. File No. 5338-V.

MANAGER ENGINEERING DEPARTMENT required by large and long established manufacturing company in Montreal. A man with the following qualifications to fill the senior position. Graduate engineer preferably mechanical with post graduate training in business administration and industrial organization. Over 5 years experience as plant engineer or as assistant plant engineer in a large company with administrative responsibilities. Thorough knowledge of modern maintenance control and material handling methods. Age 30 to 40 years. Salary is open. File No. 5435-V.

MECHANICAL ENGINEER either recent college graduate or with some experience. Age twenty-five to thirty-five must be willing to locate in Minneapolis, Minnesota, and to travel as required by duties. Interests and/or background should be in air handling, plant layout or design. Position offers good salary, opportunity and permanence. Reply giving complete information regarding personal history, education and experience. File No. 5436-V.

WANTED MACHINE DESIGN ENGINEERS. A progressive pulp, paper and converting company has opportunities for experienced pulp and paper mill machinery designers. The location is in eastern Canada. Excellent residential, educational and recreational facilities are available. Applications will be treated with strictest confidence. Send complete resume and salary expected to File No. 5439-V.

LARGE CHEMICAL PLANT IN Edmonton area has staff openings for two mechanical engineers. (1) Required qualifications and duties as follows: qualifications B.Sc. in mechanical engineering from recognized university. Up to 5 years experience in design on field work. Ability to supervise drafting work. Duties: general engineering in chemical plant including design and layout of alterations and new installations. Supervision of drafting work. (2) Qualifications: B.Sc. in mechanical engineering from recognized university. Up to 7 years' experience in design or field work. Experience in plant maintenance work an asset. Ability to supervise clerical and drafting work. Duties: maintenance engineering, including trouble shooting of mechanical problems, responsibility for spare parts program. Assist in setting up preventive program. Mechanical design work. Please supply references, age, marital status, academic standing, experience, salary expected and date available. File No. 5440-V.

SALES ENGINEER, age 25 to 30, mechanical engineer or equivalent required by well known Canadian heavy machinery manufacturer to handle pulp and paper mining and process industry accounts; to work out of Montreal; reply in writing stating age, education, experience, etc. File No. 5441-V.

INDUSTRIAL ENGINEER. An attractive position for an ambitious man about 35 years of age has developed in our industrial engineering department. This post will involve the management of one or more of the functions of direct labour control, the development of standards and estimates, scheduling, forecasting and methods improvement. A graduate mechanical engineer with five to ten years' manufacturing experience of some responsibility would be preferred, but persons with equivalent experience will be considered. This position will provide sufficient interest, authority, and salary to attract an exceptional man. File No. 5463-V.

LARGE TRANSPORTATION COMPANY in Montreal requires mechanical engineer to work on the staff of the electrical section of the mechanical department. The duties involve steam power plant layout, including piping, and other mechanical assignments. This is an opportunity for a recent graduate to obtain experience in this line of work. File No. 5464-V.

MECHANICAL ENGINEERS and engineering trainees required by engineering department in Toronto. Responsibilities will be design, load calculations, equipment selection, estimating and survey of air conditioning and refrigeration systems in the commercial and industrial fields. Positions offer employment with one of the world leaders in this field and will give excellent opportunity after training for advancement in application, construction or sales. File No. 5486-V.

A NORTHERN ONTARIO ASBESTOS producing mine has openings for the following personnel. Mechanical graduate engineer with several years experience some of which should preferably be in construction work. The work will be diversified with opportunity for advancement. Position open immediately. File No. 5491-V.

MECHANICAL ENGINEER, exceptional future for dependable man. General plant engineer for Toronto area. Some experience in manufacturing plants for medium heavy industry. Short training period in U.S.A. to learn product and methods to eventually work on layout of new plant and supervision of installation. File No. 5493-V.

MAINTENANCE SUPERINTENDENT for large mining operation in Ontario. A graduate mechanical engineer is preferred but applicants with some technical training and with good varied practical experience will be considered. A minimum of five years' experience preferably (but not necessarily) in the maintenance of equipment such as heavy diesel trucks, power shoveis, jaw and cone crushers and screening equipment. Some machine shop experience is desirable. Age limit—50 years, good health essential. Company housing is not available but the company will assist the applicant in procuring suitable housing. Bilingual preferred, but not essential. File No. 5502-V.

RECENT GRADUATE IN MECHANICAL engineering with one or two years of experience preferably in the rubber industry. This is an

GRADUATE ENGINEER
for
GENERAL ENGINEERING WORK

On special equipment in Canadian industry. Duties may cover construction, testing and servicing of equipment. Must be free to travel, salary open. File No. 5507-V.

SENIOR ENGINEERING POSTS

With B.C. Power Commission

Opportunities are open with the B.C. Power Commission for the following positions of supervisory level, each requiring 8 to 12 years appropriate experience in hydro utility work.

CIVIL DESIGN ENGINEER experienced in structural design of dams, penstocks, hydro plants, capable of preliminary studies, investigations and reports on hydro developments and with a knowledge of soil problems.

STATION ELECTRICAL DESIGN ENGINEER experienced in electrical design of generating and switching stations, including relay and carrier applications.

CONSTRUCTION ENGINEER. Qualified in civil engineering to assist in administration organization and overall supervision of plant and line construction, with construction experience and knowledge of design problems.

Applicants should be registered professional engineers in B.C. or clearly capable of immediate registration.

ALL positions are in Victoria, B.C., and are of a permanent nature. Salaries are commensurate with capability and experience. Pension and other benefits available.

Further information on request, or application giving age, education and chronological experience may be made directly to Personnel Supervisor, B.C. Power Commission, Box 500, Victoria, B.C.

excellent administrative opportunity for a young man to supervise product development program in rubber, plastics and coated fabrics fields. This company has a comprehensive pension and welfare plan fully paid. Full details of experience and qualifications should be sent to the attention of File No. 5506-V.

MECHANICAL ENGINEERS required by major consulting firm in Vancouver, B.C., for design and layout of pulp and paper mills; conveyors and materials handling systems. Positions of supervisory nature available, to men with proper qualifications. Experience in pulp and paper mill construction or operation desirable, but not essential. Group benefits available. In reply please state experience, salary expected, availability. File No. 5511-V.

MISCELLANEOUS

RESEARCH HYDRAULIC ENGINEER required for research team studying the forces involved in pulpwood holding grounds at both model and full scale. Requirements: master's degree in hydraulics engineering, good academic record and ability to work with woods personnel in the field. Apply by resume to File No. 5361-V.

MINING OR CHEMICAL ENGINEER having design and detail experience in ore handling or chemical plant equipment is required by a large Kingston manufacturing company. Reply giving complete information on personal history, education and experience. File No. 5372-V.

PROJECT AND CONSTRUCTION ENGINEER. Graduate in civil or mechanical engineering with furnace design experience in building structure, material handling equipment, structural and machine design. Supervisory ability in draughting. Experience in smelting operation or construction would be an asset. Fluent English is essential. File No. 5378-V.

INSTRUMENTATION ENGINEER to design measuring and control systems for chemical and metallurgical processes. Work includes preparation of flowsheets, wiring and piping diagrams, layout and detail drawings, detailed instrument specifications, cost estimates. Location Western Canada. Salary open. File No. 5391-V.

PHYSICAL METALLURGIST to undertake both fundamental and applied research on nonferrous metals primarily lead and zinc and their alloys. Salary dependent upon qualifications and experience. Location Southern B.C. File No. 5391-V.

SALES ENGINEER for the Province of N.S. to represent national manufacturer of fabricated steel products, for the construction industry. Preference will be given to applicants from Nova Scotia or graduates of N.S. universities, between the ages of 23-36 years. The successful candidate for this opening will be associated with a staff of engineers and will have the opportunity of advancing to the executive level. Initial letter should outline complete background and availability for interview. File No. 5405-V.

DESIGN ENGINEER, young graduate with several years product engineering experience and writing ability, for editorial work on new magazine. Good working conditions and remuneration in keeping with ability. With first letter give education and experience, also starting salary requirements. File No. 5406-V.

YOUNG ENGINEER required for work in heating and ventilating company located in Ontario. Will be trained in the engineering, research and sales departments of the company with a view to eventual branch office work. File No. 5408-V.

A VACANCY OCCURS FOR a general works manager, at a plant located approximately 100 miles north of Toronto. Medium and heavy engineering products are manufactured by between 600 and 700 employees. The works include a steel foundry, grey iron foundry, bronze and non-ferrous metal foundry (including centrifugal castings); with pattern, machine and erecting shops. The position is such that only first class applicants will be considered who must have the qualifications of being a trained engineer, a good organizer, a pleasing personality and ability to fulfil a position of trust. The ultimate prospects for the right man are of the highest. Also salary will be commensurate to the candidates' ability and experience. File No. 5413-V.

OPPORTUNITIES FOR ENGINEERS. Mechanical, are required with at least five years' experience in designing heavy machinery and plant equipment. Mechanical, metallurgical, electrical and chemical, interested in training for production supervisory positions are wanted. Mechanical, engineering business, electrical and chemical, interested in industrial engineering are also needed. Our expanding development on the most advanced specialty steel mill equipment assures you of an excellent salary and good opportunities for promotion with Canada's foremost specialty steel mill. Contributing to your security are extra benefits such as a generous pension, hospitalization and group life insurance schemes. File No. 5414-V.

YOUNG MINING OR CIVIL ENGINEER, preferably bilingual required by mining industrial plant near Montreal. Must be also good draughtsman and be responsible for plant equipment and plant expansion. Salary in accordance wtih experience. Write stating age, marital status and experience. File No. 5419-V.

A NATIONAL ORGANIZATION in Ottawa requires an engineer; a junior with 2 to 3 years experience in electrical or civil fields. Permanent employment complete with pension plan. File No. 5420-V.

MECHANICAL OR CHEMICAL ENGINEER required by pulp and paper company located in Province of Quebec. This engineer is required for our design engineering department and should have a minimum of 5 years experience with at least 2 years in pulp mill engineering. The salary is open for discussion. File No. 5421-V.

SALES ENGINEER required for leading manufacturer of automatic controls. Duties involve application of limit switches and clutch controls to industrial equipment and the organizing and training of distributors. The applicant selected will undergo a training program in the U.S.A. after which he will be located in Montreal. All replies should state personal particulars, background and salary required. File No. 5424-V.

GRADUATE ENGINEERS FOR JUNIOR positions in the industrial engineering department of a large asbestos mine in the Eastern Townships. Applicants should be between 21 and 30 years of age, and have an engineering background. Experience in industrial engineering in heavy industry or large manufacturing enterprises preferable but not essential. Successful candidates will be given training in wage incentives and job methods. Excellent working conditions, extensive employee benefits. File No. 5427-V.

TECHNICAL PERSONNEL NEEDED FOR integrated petrochemical and synthetic fibre plant located Western Canada. 1) Senior mechanical engineer with extensive experience in materials handling equipment, both application and design. 2) Senior process engineer with extensive experience in oil refinery, chemical or allied engineering. 3) Junior mechanical engineer. Recent graduate. Experience in oil refinery, chemical plant or allied industries preferred but not essential. 4) Junior corrosion engineer mechanical, chemical or metallurgical graduate with experience or interest required for work on plant scale corrosion problems and materials specifications. 5) Textile engineer, recent graduate in textile engineering or engineering degree with equivalent training preferably with experience in synthetic yarn plant. 6) Maintenance engineer, mechanical, electrical or chemical engineer, 2-5 years' experience in maintenance department of large chemical or synthetic yarn plant or equivalent operation in large chemical or allied industry. 7) Senior piping draftsman. Experienced piping designer including specification, layout and detailing, or graduate engineer interested in piping design. Applications will be treated confidentially. Write immediately stating personal details, experience in full. Salary required and date available. File No. 5428-V.

MECHANICAL OR STRUCTURAL ENGINEER, with steel fabrication experience required to take charge of detailing office, consisting of four draughtsmen and one estimator and to consult with architects and contractors to obtain suitable fabricating contracts. A thorough knowledge of welding, welding procedures and jig design required. This is an excellent opportunity in a well established Vancouver firm, employing approximately 50 men. Maximum salary and employment benefits to right man. Reply stating age, experience and salary required. File No. 5433-V.

AGRICULTURAL SALES ENGINEER required for metropolitan Montreal and Maritime Provinces. Applicant should have university degree or equivalent in agriculture. Knowledge of French and chemistry desirable. Field of sales covers a line of agricultural chemicals to distributors in the Maritime Provinces supported by detailed sales and services work with dealers and growers; and sanitary and surfactant chemicals to industrial concerns in metropolitan Montreal. Applicant must be willing to headquarter in Montreal and be prepared to travel frequently into the Maritimes, taking up temporary residence there at a central location with his family during the active summer season. This latter provision subject to discussion. Apply by confidential letter giving details of education, experience and general background to File No. 5438-V.

AGRICULTURAL AND OR INDUSTRIAL chemical sales engineer required for Alberta and British Columbia territory. Applicant should have University degree or equivalent in agriculture or chemistry, have had three to five years sales experience in agricultural or industrial chemicals, possess strong administration interests and aptitudes and be willing to locate in Vancouver, B.C. area. File No. 5438-V.

UNIVERSITY TEACHER WANTED. The University of Saskatchewan wishes to receive applications from engineering graduates, Civil, Electrical, or Mechanical, under 35 years of age, to teach applied mechanics and allied subjects. Duties to commence January I, 1956, the salary offered is $4000.00 per year, and permanent appointment is a possibility.

Apply to the Dean of Engineering, University of Saskatchewan, Saskatoon, Sask. giving age, qualifications, experience and references. File No. 5443-V.

THE GOVERNMENT OF British Columbia requires engineers and technicians for a multi-million dollar highway program. Engineers: should have experience in highway location, design or construction. Professional registration desirable but not essential. Salaries range from $327.00-$464.00 per month depending on qualifications and experience. Benefits include compensation coverage, sick and vacation leave after one year; pension plan, statutory holidays. Opportunities for experience and advancement with a progressive program in a fast growing province. File No. 5444-V.

RECENT UNIVERSITY GRADUATE required for inspection engineering miniature electronic components and assemblies. Location Montreal. Salary up to $4620.00 depending on qualifications. Generous employee benefits. Good opportunity for advancement. File No. 5454-V.

REGISTERED PROFESSIONAL ENGINEER required for organizing and supervising inspection of materials, components and assemblies for weapons including auxiliary and ancillary equipment. Location Sorel, P.Q. Opportunity for continuing employment with advancement in due course. Salary commensurate with education and practical experience. File No. 5455-V.

LARGE CANADIAN ORGANIZATION handling quality precision instruments requires junior inspection engineer at Toronto. Only registered or graduate engineers with some experience in design production or inspection of instruments need apply. Starting salary up to $400.00 per month depending on experience. Opportunity for advancement. File No. 5456-V.

PROMINENT WEST COAST CONSULTING engineering firm requires graduate engineers with experience in the following categories: Mechanical, for design and lay-out of process plants, materials handling systems, process piping. Civil: structural design, field work, hydraulic systems. Electrical: industrial plant power systems. Please reply stating experience, salary expected and availability to File No. 5459-V.

EXCELLENT OPPORTUNITY FOR a recent Canadian University graduate 1952-1955, from either engineering physics or electrical engineering, for a sales position in the X-ray field. This position offers intensive training on X-ray equipment from six months to one year's duration and a sales engineer's position at the end of the training period. The possibility for advancement into a management position is excellent. This opportunity is located in Toronto. File No. 5460-V.

INDUSTRIAL ANALYSTS. Graduates in engineering or science wanted for large asbestos mine in Eastern Townships of Quebec. Applicants preferred who have training and/or interest in business administration or finance. Selected individuals would be trained to appraise and report upon the financial desirability of making capital and operating expenditures. Salary depends upon qualifications. Age 20-35 years preferred. Excellent living accommodations with good educational, social and recreational facilities available. Near large cities. Apply in writing, giving details of education, experience, marital status and salary desired. File No. 5462-V.

STIMULATING AND CHALLENGING positions with a future are opening up in our new and expanding research and development department in Montreal. At this time we have several responsible positions open (and others will be available during the coming months) for graduate engineers, chemists and physicists with experience in one or more of the following fields. Pressure sensitive adhesives; rubber and/or plastics; resins and coatings; textiles; cotton purification and processing, synthetic fibres, fine and specialty papers; paper containers; instrumentation. Modern well equipped lab. in our new research centre will provide excellent facilities and working conditions. Liberal benefits. Salaries commensurate with education and experience. Replies will be given all applications submitting a complete resume of personal data, educational background, work experience and recent photograph of themselves to File No. 5465-V.

APPLICATIONS ARE INVITED FROM ENGINEERS WITH MINING EXPERIENCE to act as technical representative in the sale of explosives to the mining and other industries. These positions will provide good opportunities for advancement in a new expanding organization. A knowledge of mining practices, particularly development and production, is necessary but previous sales experience is not essential. Applicants should be in their twenties or thirties. Please reply in writing giving details of education and experience to File No. 5468-V.

1954 OR 1955 ENGINEERING PHYSICS or electrical engineering graduate to work as an assistant to an advance deve'opment and/or product development engineer on colour television. To be located in Toronto. File No. 5473-V.

1953-4-5 ENGINEERING PHYSICS OR electrical engineering graduate to work as an assistant in radio advanced development, particularly on transistor circuitry. Location Toronto. File No. 5473-V.

A RECENT ENGINEERING physics or electrical engineering graduate who has a good background in radio and television theory and practical work experience in laboratory, quality control, or similar work on radio and television to fill a position of release engineer on domestic radio and television receivers. Location Toronto. File No. 5473-V.

A RECENT ENGINEERING PHYSICS or electrical engineering graduate with at least 4 years of laboratory experience as a product development engineer on domestic television receivers, to fill a position as a product development engineer on monochrome and colour television. To be located in Toronto. File No. 5473-V.

AN ENGINEERING PHYSICS OR electrical engineering graduate, who has had experience on layout, design and construction of microwave systems to fill a position as senior communications system engineer. Location Toronto. File No. 5473-V.

MONTREAL CHEMICAL FIRM requires 2 chemical engineers with at least three years' experience in the selection of chemical plant equipment and piping layouts. Two recent graduates with some experience in chemical manufacturing design or operation. Two mechanical engineers with at least three years' experience in the selection of equipment and the layout of manufacturing plants. Two recent graduates with some experience in process equipment design or operations. Applicants should be between the ages of 23 and 35 and application may be made in writing giving a brief summary of training and experience to File No. 5475-V.

SALES AND SERVICE ENGINEER for Eastern Canada to take over Montreal office of established firm specializing in the distribution and servicing of equipment for the pulp and paper industry. Liberal commission, $3600.00 annually guaranteed. Bilingual preferred with a minimum of four years experience in a pulp and paper mill. File No. 5476-V.

ENGINEER—CHEMICAL OR CIVIL preferred, to take charge of construction department for old established manufacturer. Guaranteed salary plus profit sharing plan—usual benefits available—an excellent opportunity for the right man. Some construction or maintenance experience essential. File No. 5478-V.

RECENT ENGINEERING graduate either electrical or mechanical with some electrical experience for a permanent position as plant engineer. We are manufacturers of aluminum extrusions and are at present engaged in an expansion program of plant and equipment. Applicant need not have experience but preferably good electrical background. Training period provided. Location Province of Quebec. File No. 5485-V.

UNIVERSITY TEACHERS WANTED. Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Metallurgical Engineering. Salary ranges: lecturer, $3720.00 to $4200 00. Assistant professor $4380.00 to $5100.00 with superannuation and hospital insurance. First appointment will depend upon qualifications and experience. Opportunities for advancement to higher ranks in an expanding institution. Some positions available January 1st, 1956. All must be filled by September 1st, 1956. Research and professional employment encouraged. Apply to The President, Nova Scotia Technical College, P.O. Box 1000, Halifax, Nova Scotia. File No. 5487-V.

BILINGUAL SALES ENGINEER required preferably mechanical electrical, by long established company, leader in its industry. Location Montreal. Age approximately 30 years. Sales organization with small staff offering excellent prospect for advancement. Applicants must be able to deal with owners and top executives. Remuneration commensurate with ability and experience. In reply give all details of age, marital status, education, experience. File No. 5488-V.

PHYSICIST OR METALLURGIST, recent graduate, interested in solid state physics required for work on fatigue. Work involves non-destructive testing methods. Previous experience advantageous but not essential. Excellent working conditions. Please reply to File No. 5490-V.

MINING ENGINEER, recent graduate, the work will be both in open pit and underground and will include underground caving operations. Position open January 1st, 1956. All benefits including pension plan, salary commensurate with ability. Apply stating age, salary required, education and experience to File No. 5491-V.

EQUIPMENT MANAGER required by transportation company headquarters in Whitehorse, Yukon Territory. Applicants must be graduate engineers, mechanical, mining, metallurgical or civil between the ages of 40-45 years with at least ten years experience in the selection, operation, and repair of automotive, crawler and contractor's work equipment or mechanical equipment used in open pit mining operations and motor truck transport. Business administration experience desirable but not essential. Married man preferred, housing available. State salary required and forward references and applications along with recent photo and record of salary progressions to date. Interviews will be arranged at suitable point if applicants justify.

EXCELLENT OPPORTUNITY to become established in fast growing fluid power field. Sales engineers required by large manufacturer of air and hydraulic cylinders to be located in Ontario and Quebec. Applicants should have some engineering training or background and knowledge of machine tool application. Salary, travelling expenses, plus commission. File No. 5497-V.

CHIEF OF RELAYING STUDIES. Graduate professional engineer to prepare design and specifications of relay protection for power systems with 2 million horse power generating capacity, to carry out analysis of relay operation and to supervise training of relay personnel. Should have at least 5 years' experience this class of work and be under 40 years of age. Location Brazil. File No. 5500-V.

FOUR QUALIFIED ENGINEERS

preferobly groduates in mechanicol or civil engineering from Conodian Universities, are required for a large Newsprint and Pulp mill in the Province of Newfoundlond.

Experience in the pulp and paper industry is preferred but not essentiol. Two of the positions will require engineers with five to ten yeors experience while the other two positions could be filled by recent groduotes. Preference will be given to those opplicants who, opart from engineering training, have hod some administrotive experience.

A broad outline of the work covered is briefly; design, layout, process development ond mointenance control, depending upon opplicant's experience and interest. Applications should be mode in writing to File No. 5521-V.

Report on a POWER-FULL decade

The first 10 years of jet progress in Canada is marked this month . . . a decade in Canadian creative engineering progress of high significance . . . lifting Canada to a position of eminence in the supersonic era in aviation now upon us.

December 2—The Jet Age in Canada gets underway with formation of A. V. Roe Canada Limited.

September—Design starts on the Orenda concept of jet power.

February—First test run of Orenda 1—5,800 lbs. thrust.

October—Orenda earns its wings—first flight in a service aircraft North American F86A. Over 400 contractors and suppliers recruited to provide Orenda parts and accessories.

June—Orendas make first flight in Avro CF-100. Development underway on new models—more power, less weight.

1952 September—Orenda's production plant opens . . . the assembly line rolls. Power increased in Orenda 8 at 6,355 lbs.

1953 January—Orenda 10 replaces an American engine in Canadair Sabres.

1954 March—Yet more power—over 7,000 lbs.—in two-s turbine Orenda 11 (CF-100) and Orenda 14 (Sabre 6 Both now outstanding power performers in their respective classes.

1955 December—Current Orendas deliver some 25% more powe than first Orenda for 10% less weight. Close to 3,000 Orendas in six production models now in operation throughout the free world.

and for tomorrow... Under intensive development for the supersonic era, new designs with power far in excess of any current production model.

ORENDA *ENGINES LIMITED*

MALTON, CANADA

MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

BUSINESS & INDUSTRIAL BRIEFS

A Digest of Information

received by

The Editor

Appointments and Transfers

National Carbon President.—The appointment of John S. Dewar as president, National Carbon Company, Division of Union Carbide Canada Limited

J. S. Dewar

has been announced by Ewart Greig, president, Union Carbide Canada Limited.

●

General Motors Diesel Appointments. — E. V. Rippingille, Jr., president and general manager of General Motors Diesel Limited, London, Ont., has announced the appointment of W. M. Warner as general sales manager, heading all sales activities for the company with offices at London. Also, R. J. Beath is appointed manager of locomotive sales and service with headquarters at Montreal. The appointments were effective November 1, 1955.

Spartan Air Services.—J. A. Roberts, president of Spartan Air Services Limited, announces that James E. Wells has resigned as managing director and has been appointed executive vice-president. D. W. Hayworth, former Western manager and more recently assistant general manager, has been appointed general manager.

●

Canadian Westinghouse Retirement. — Clarence W. Hookway has retired from the Canadian Westinghouse Company after 44 years with the firm. Mr. Hookway was lately associated with the district apparatus division.

●

Monsanto Canada Personnel. — Monsanto Canada Limited announce that Gerald F. Parker has been made superintendent of development and production of vinyl compounds (Oakville, Ont.); N. Reimer and A. Sherman have been appointed to the newly created positions of product sales managers (Vancouver, B.C.); and Keith B. Owens has retired as sales manager for the chemical sales department, for health reasons, after 22 years of service.

●

A.I.Ch.E. President. — Newly elected president of the American Institute of Chemical Engineers for 1956, will be Walter Gordon Whitman, conference secretary-general, United Nations International Conference on Peaceful Uses of Atomic Energy, and professor and head of the department of chemical engineering at Massachusetts Institute of Technology.

●

Rosco Metal and Roofing. — H. G. Pipher, president of Rosco Metal & Roofing Products Ltd., announces the appointments of R. W. Stevens as assistant secretary-treasurer, and D. J. Cobban as chief accountant and personnel manager.

●

Packard Electric Directors.—W. L. Hetherington, M.E.I.C., and I. Lorenzen have been appointed directors of Packard Electric Company Limited filling vacancies left by the late Arthur G. Herr, M.E.I.C., and the recent retirement of Frank Malloy.

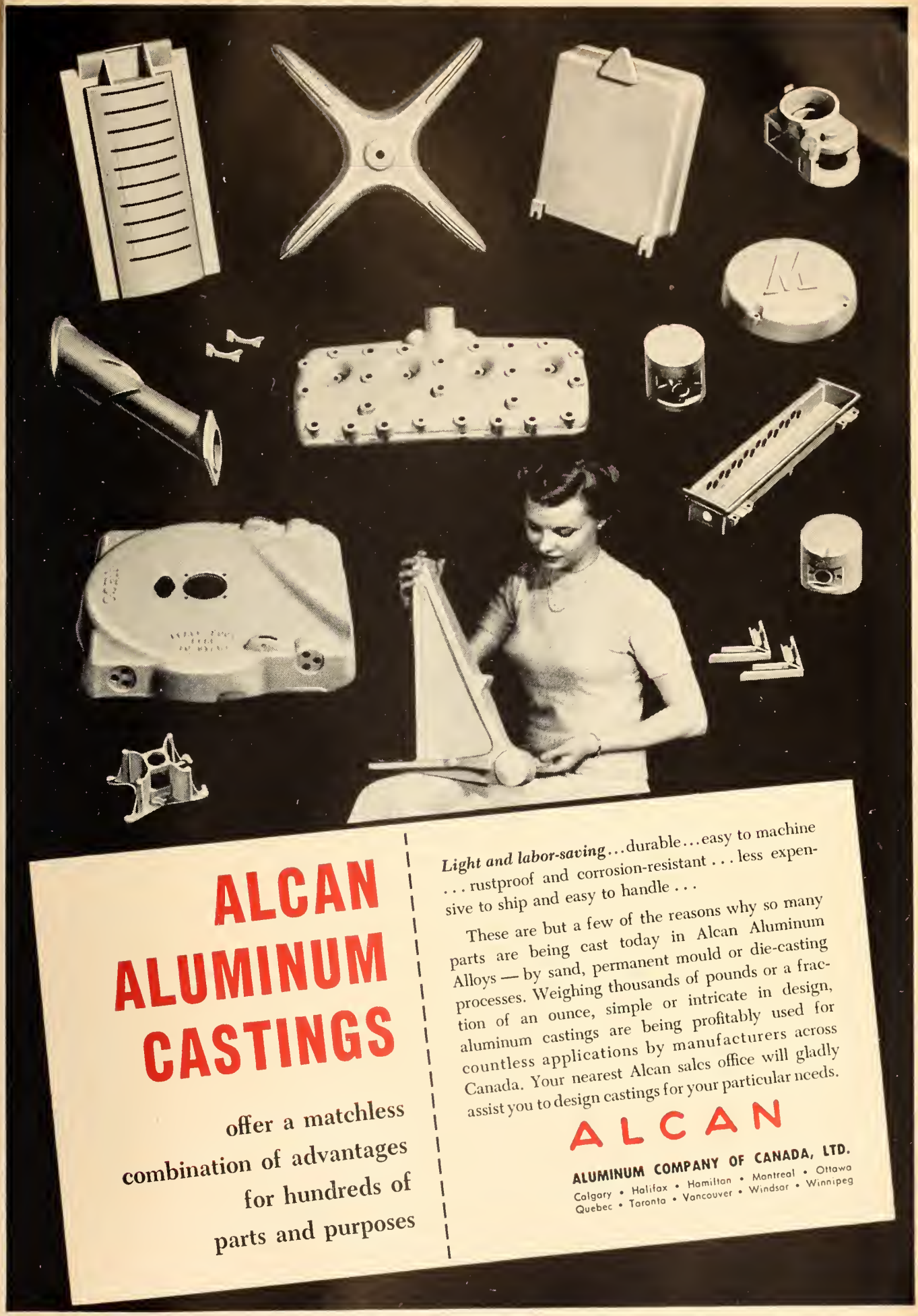
●

Trans-Canada Pipe Lines. — D. R. Pflug has been appointed vice-president and chief engineer of Trans-Canada

D. R. Pflug

Pipe Lines Limited, it has been announced by N. E. Tanner, president of Trans-Canada.

●



ALCAN ALUMINUM CASTINGS

offer a matchless combination of advantages for hundreds of parts and purposes

Light and labor-saving...durable...easy to machine ...rustproof and corrosion-resistant ... less expensive to ship and easy to handle ...

These are but a few of the reasons why so many parts are being cast today in Alcan Aluminum Alloys — by sand, permanent mould or die-casting processes. Weighing thousands of pounds or a fraction of an ounce, simple or intricate in design, aluminum castings are being profitably used for countless applications by manufacturers across Canada. Your nearest Alcan sales office will gladly assist you to design castings for your particular needs.

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Bus. and Ind. Briefs

J. E. Shirreff

At a recent meeting of the board of directors of Johnson, Matthey and Mallory Ltd., J. E. Shirreff was appointed vice-president.

•

C.G.E. Appointment.—Henry C. McGee, of Montreal, has been appointed manager of the Maritime District of the wholesale department of Canadian General Electric Company Limited. Mr. McGee suceeds R. N. Fournier, M.E.I.C., who goes to Winnipeg as manager of the wholesale departments' mid-West district.

•

Siporex Limited.—This wholly-owned subsidiary of Dominion Tar & Chemical Company Limited announces the appointment of G N. Moseley, of Montreal, as general sales manager.

•

Trane Appointment.—Jack H. Buttery, works manager, Trane Company of Canada, Limited, announces the recent appointment of Fred B. Symmes as assistant works manager.

•

C. A. Dunham Appointment.—A. J. Dickey, president of C. A. Dunham Company Limited announces that Richard M. Mitchell has been elected executive vice-president and assistant general manager of the company.

•

R. M. Mitchell

Henry C. McGee

• • •

New Equipment and Developments

New Petroleum Laboratory.—Alchem Limited, Burlington, Ontario, announce the opening of a new petroleum laboratory designed to provide specialized services to the producers, refiners and consumers of petroleum and petroleum products in Canada. These services include evaluation of distillate fuels, selection of petroleum treatments, special chemical and physical analyses on storage tank sludges and the testing of refinery fluids. The facilities of the petroleum laboratory will be used principally for testing and development and for product control.

•

B.S.A. Tools Limited, Toronto, Ontario, has recently been appointed representatives of two American companies: Horton Chuck Company, Windsor Locks, Conn.; and Hanson-Whitney Company, Hartford 2, Conn.

•

C-I-L Distributing Centre.—The construction of a $300,000 distributing centre to service the Maritimes area, is being undertaken in Halifax, N.S., by Canadian Industries (1954) Limited. General contractor is MacDonald Construction Co. Ltd.; architect is J. Philip Dumaresq also of Halifax. The distributing centre will house the Maritime district sales offices of the C-I-L agricultural chemicals, ammunition, explosives and chemicals divisions, and the paints and "Fabrikoid" divisions.

•

Largest Machinery Trailer.—What is believed to be the largest capacity machinery trailer ever built in Canada has been completed and shipped by Truck Engineering Limited, of Woodstock, Ontario. Weighing 78,500 pounds, this trailer has a payload capacity of

SUB-SURFACE EXPLORATION
Soil Sampling ⁘ Foundation Testing
Core Drilling ⁘ Grouting

FOR EXAMPLE:

INDUSTRIAL PLANTS

Kitimat Dock, Plant & Townsite — Job 51-73
Aluminum Co. of Canada
B. C. International Engineering

The huge aluminum plant with its docking facilities for deep sea vessels and townsite for 50,000 people has required many months of soil sampling and foundation testing. Our crews successfully completed the first phase of this work during the years 1951-1954 inclusive and are at present testing the site for the additional pot-lines, which will form an integral part of the recently announced expansion program.

WE DRIVE INTO THE EARTH

BOYLES BROS
DRILLING COMPANY LTD.,
VANCOUVER, CANADA

Modern Equipment and Experienced Crews
at MONCTON, NORANDA, KIRKLAND LAKE,
PORT ARTHUR, EDMONTON and VANCOUVER

DOW CORNING *first in* SILICONES

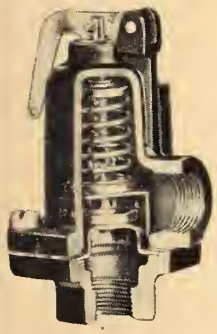
Silicone News

FOR DESIGN ENGINEERS

Dependable Valve Operation Assured With Silastic Seals

Relief valves for hot water must: open accurately at set pressure; close, drip-tight, at the slightest reduction from that pressure; give long reliable service. That's a difficult order but with heat-stable Silastic*, McDonnell & Miller, Inc. of Chicago have engineered such maximum dependablity into their new No. 230 series of pressure relief valves.

Because it has excellent resistance to moisture and to compression set at high temperatures, Silastic is ideal for sealing these devices. In the words of McDonnell & Miller, "the compressibility of Silastic provides good closure, its high temperature stability guards against deterioration, and Silastic resists adhesion, thus providing dependable operation." *No. 59*



1955 CHEMICAL ENGINEERING AWARD WON BY DOW CORNING CORPORATION

New York—An 84-man committee of senior chemical engineering educators, headed by Professor Walter G. Whitman, director of the chemical engineering department, Massachusetts Institute of Technology, has selected Dow Corning Corporation winner of the 1955 Award for Chemical Engineering Achievement sponsored by Chemical Engineering magazine.

Silicone products most widely used, are indexed by type of application, in the 1955 Reference Guide to Daw Corning Silicane Products. A brief but camprehensive 8-page summary is given af the praperties and applicatians. With increasing effart devated ta praduct impravement and cast reductian, such a reference guide ta this remarkably stable group af engineering materials becames increasingly important to design engineers. *No. 62*

Silicone Insulation Eliminates Need For TEFC Motors in Tidelands Oil Operations; Saves $3,000 per Unit

In the dark ages before silicone insulation was developed, it was standard practice to specify TEFC motors in outdoor installations where excessive moisture, weathering or corrosive chemicals limit service life. Now progressive engineers are finding that open-type motors insulated with Dow Corning Silicones are equally effective and substantially less expensive.

A typical example of good modern practice is the silicone insulated compressor motor operating on one of the California Company's fixed oil well platforms in the Gulf of Mexico. Built by Electric Machinery Mfg. Co., Minneapolis, this 300 hp, 900 rpm induction motor is exposed to the most severe weather the Gulf can produce. Installed 10 months ago, the unit is in excellent operating condition.

The windings of this "Sil-Clad" motor are insulated with Dow Corning silicone resins, silicone resin-impregnated components, and a tape made with Silastic*, Dow Corning's silicone rubber. Outer protection is provided by a steel housing with a baffled ventilating system that prevents dust, moisture and chemicals from lodging in the motor. The housing and motor frame are coated inside and out with a silicone based paint formulated by Midland Industrial Finishes Co.

According to Electric Machinery, this "Sil-Clad" motor is more reliable and more resistant to corrosion than conventional Class A or B totally enclosed, fan cooled motors of the same rating. And it cost $3000 less than a comparable TEFC motor built with ordinary insulating materials. Lower initial costs combined with greater reliability and lower maintenance costs account for the rapidly increasing market for such motors. *No. 60*

*T.M. REG. U.S. PAT. OFF.

New Silicone-Glass Insulators Meet Class H Specifications, Are Stronger, Easier to Use

Production methods developed by Silicone Insulation, Inc., New York City, reduce the cost of molding one-piece silicone-glass laminated coil bobbins and other Class H components. Users save assembly costs.

In the bobbins, glass cloth impregnated with Dow Corning 2104 silicone resin flares out from the cores into flanges providing completely unified structures that are easy to handle for quick assembly, and exceptionally strong in proportion to their wall thickness. Tolerances may be held as low as ± .001".

Neither brittle nor flexible, these one-piece laminated Class H bobbins show no tendency to break at the joints, crumble or delaminate. Already in use by several leading manufacturers of high temperature transformers, relays, solenoids and controls, they are available in a wide range of sizes and dimensions, and may have as many as six integral flanges.

Price-wise, silicone-glass laminated bobbins compare favorably with conventional Class H assemblies. Low mold costs permit production runs of as few as one hundred parts. *No. 61*

Design Edition 15

DOW CORNING SILICONES LTD. - Dept. EJ-2
Tippet Rd., Downsview, Metropolitan Toronto, Ont.

Please send me 59 60 61 62

NAME _____

TITLE _____

COMPANY _____

STREET _____

CITY _____ PROVINCE _____

DOW CORNING SILICONES LTD., Tippet Road, Downsview, Metropolitan Toronto, Ontario

Bus. and Ind. Briefs

220,000 pounds and was ordered by the Aluminum Company of Canada Limited for their operation at Kitimat, B.C. Its main job will be the moving of a 110 ton transformer. Special railway tracks have been laid down on the 11½ foot wide deck to handle this load, as well as two other transformers of lighter weight. Special alloy steel beams form the main frame; sixteen heavy duty nylon tires bear the load on the rear end, and altogether thirty-four tires are used in the train of truck-tractor, dolly, and trailer.

●

New Service Available.—"Slide-honing" or speed barrel finishing, is made available through the formation of Tumbling Sales and Service, in Hamilton, Ont. Facilities are provided for custom tumbling work, also experimental tumbling and slide honing, which has been developed from tumbling, and combines regular tumbling action with a slide honing action, to provided controllable finishing methods.

●

Established in Canada.—The F. E. Myers & Bro. Co. (Canada) Limited, has been established in Kitchener Ont., as a wholly-owned subsidiary of the F. E. Myers & Bro. Co., Ashland, Ohio. Officers of the new company are C. Ginn, Jr., chairman of the board; J. C. Myers, Jr., president; F. E. Myers II, vice-president and secretary; M. G. Moses, treasurer; S. C. Miller, sales manager and assistant treasurer; and J H. Schofield, assistant secretary.

●

Machinability Computer.—A new electronic machinability computer revealed by Canadian General Electric's Carboloy Section recently, is designed to solve machining problems, which normally take several hours to compute, in less than two minutes, with consistent and reasonable accuracy. For example: to determine quickly whether or not a correct set of conditions is used for machining a current job; to help arrive at a proper set of conditions for setting up a new machining operation; or to indicate the relative advantages of changing some of the present job conditions to obtain greater production. The 32-pound, self-powered analogue unit will consider 14 operational variables in machining, such as grade of carbide, speed, feed, depth of cut, tool life, alloy, material hardness.

●

Linde Plant at Fort William.—Mayor H. Badanai recently declared open the new Fort William plant of Linde Air Products Company, Division of Union Carbide Canada Limited. This new establishment brings the chain of operating Linde plants in Canada to 15—another is under construction. It will service local users of oxygen, acetylene and other industrial gases. General contractors for the Fort William plant were G. R. Houston Limited.

●

Shell Research Fellowships.—Beginning next year Canadian universities participating in Shell Oil Company of Canada's research fellowship program will each be provided with a $500 grant-in-aid. At the same time the company stated that the number of fellowships available would be increased from 7 to 8 through the addition of the University of New Brunswick. The first fellowship at U.N.B. will be awarded for the 1956-57 academic year.

●

Alaska Pine & Cellulose.—Repairs to a section of the dock structure which was damaged when the supporting beach slipped in August, 1955, are now under way. Expenditure will be in excess of $500,000. Geological studies are being made of underwater strata and plans are being drawn covering the construction of new dock and warehouse facilities to replace those demolished. Three days after the underwater landslide occurred the mill was back in full scale operation.

●

Hydraulic Starter for Diesels.—A new hydraulic starting system for diesel engines has been developed by General Motors. The unit has been tested in the field and is now available for installation on new General Motors Diesel engines or on others already in operation. The Hydrostarter is said to eliminate many replacement and maintenance costs common to conventional starters. Its efficiency is not affected by temperature, humidity or altitude. In zero temperatures the unit attains cranking speed almost instantly.

●

New Refrigeration Evaporator.—Roll-Bonded aluminum-sheet panels — made by a new process that forms almost any pattern of tubing within a single homogeneous sheet of aluminum — will be mass-produced in Canada beginning in mid-1956, according to an announcement by N. E. Russell, president of Aluminum Goods Limited. The company will spend more than $300,000 to expand existing plant facilities, to make the new product available for Canadian refrigerator manufacturers and other metal fabricators. A new rolling mill, hydraulic press and auxiliary equipment are now being installed at the company's Toronto plant. Key to the new development is a silk screen process that applies a special stop-weld "ink" to one side of an aluminum sheet in a carefully designed pattern. Another sheet is overlaid to form a sandwich and the two sheets are hot-rolled together, bonding into a single unit. No bonding occurs in the stop-weld pattern, which is later inflated into tubing by hydraulic pressure. The result is a labyrinth of passages — producible to practically any design — within a single, strong sheet of aluminum.

●

Trans-Antarctic Equipment. — Enfield Cables Limited announce that they have been chosen to supply the electric cables to be used by the Commonwealth Trans-Antarctic Expedition for receiving and transmitting radio reports; as part of the beacon installation for guiding supplying aircraft; on various meteorological instruments; in the mobile workshop for on-the-spot repairs and as an essential link in the mobile lighting systems in the various camps. All these duties will be carried out in external temperatures varying between plus 50°F. and minus 90°F. To meet such exacting conditions, Enfield have used a plastic insulation which will remain flexible and, unlike other materials, will not become brittle at sub-zero temperatures.

●

Aluminum Extrusion Plant.—Premier W. A. C. Bennett has announced that construction will begin immediately on a $500,000 aluminum extrusion plant in Richmond, the Fraser River suburb of Vancouver. The plant will be built by Pacific Coast Aluminum Limited, a new B.C. company headed by Walter C. Koerner, chairman of the board; R. R. Keay, president; and Leon J. Ladner, Q.C., director, all of Vancouver. Production is scheduled to start in May, 1956, of extruded aluminum bars and tubing.

●

New Oil Company Department. — Canadian Oil Companies, Limited, has set up its new producing department with headquarters at Calgary, Alberta, as announced by company president W. Harold Rea. J. B. Webb of Calgary was appointed department manager and will also be exploration manager. H. G. Bagnall of Calgary is operations manager, in charge of all producing and drilling operations. W. M. Luthy is development manager, responsible for development of new projects involving the company's crude oil production. Mr. Webb and Mr. Bagnall were formerly executives of the Anglo-Canadian Oil Co. Ltd. which merged recently with Canadian Oil.

●

Federal Public Works Contracts. — Works Minister Winters has announced that contracts involving expenditures totalling $7,138,800.27 were awarded by the Federal Department of Public Works during the month of October 1955. The amount for new works is $4,384,313.81; for the repair and maintenance of existing structures $2,693,422.46; and for dredging contracts, $61,064.00.

●

Premier Steel Mills Opening. — The $2,000,000 Premier Steel Mills plant, located in Strathcona, on the outskirts of Edmonton, was opened in November. The 72,000 square foot mill will have a 35,000 ton annual capacity, all produced from scrap steel. The majority of the steel will be used by Alberta's construction industry.

●

Unitary Pump Seals.—A new series of Unitary mechanical seals, designed for use on process pumps has been announced by The Garlock Packing Company of Canada Ltd., Toronto, Ont. The seals are designed for use on rotary shafts of boiler feed pumps, chemical pumps, oil refinery pumps, digestor circulating pumps and other process pumps.

●

Miniature Telemeter Receivers. — Miniaturized Metameter Telemeter receivers, which can be used in graphic panel arrangements, have been announced by The Bristol Company of Canada Limited. These receivers are

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available either as indicators or strip-chart recorders, and occupy a panel space only 5 inches square. Designed to fit into the company's Metagraphic instrument line, the indicators and recorders can be used to receive telemetered signals of any of the usual variables, such as pressure, flow, temperature, differential pressure, and such electrical measurements as voltage, current and power.

●

Joint Pipeline Project.—Arrangements for building the Northern Ontario Section of the all-Canadian pipe line to carry gas from Alberta as far east as Montreal were announced in November by the Right Hon. C. D. Howe on behalf of the Government of Canada.

The Government of Canada will recommend to Parliament the formation of a Crown Company to build and own a 675-mile section of the All-Canadian line between the Manitoba-Ontario boundary and Kapuskasing. This Northern Ontario Section will be leased to Trans-Canada Pipe Lines Limited.

The Northern Ontario Section, estimated to cost $117,633,000 initially, will be financed jointly by the Canadian and Ontario Governments. The Ontario legislature will be asked to approve participation by Ontario equal to one-third of the cost but not more than $35 million. The Parliament of Canada will be asked to authorize the Government of Canada to subscribe the balance

With this Northern Ontario Section arranged for, the underwriters are confident that Trans-Canada Pipe Lines can finance the construction of the remaining sections of the All-Canadian line. Applications are now before the United States Federal Power Commission for permission to import gas into the United States from the Trans-Canada system near Emerson, Manitoba, and Niagara Falls, Ontario, and to enable Trans-Canada to import gas from the United States near Niagara Falls to develop Eastern markets, pending the arrival of Alberta gas via the All-Canadian line.

Trans-Canada Pipe Lines have until May 1, 1956 to demonstrate to the satisfaction of the two governments that it has arranged for finances and commitments to carry through its entire construction program. This having been demonstrated, the Crown Corporation will build a 30-inch line from the Manitoba-Ontario boundary to the vicinity of Kapuskasing. At the same time, Trans-Canada will build a similar line from Winnipeg to the Ontario border, and from Kapuskasing to the Toronto area. These sections, to be completed in 1957, will connect with the lines scheduled to be built by Trans-Canada in 1956 from Alberta to Winnipeg and from Toronto to Montreal.

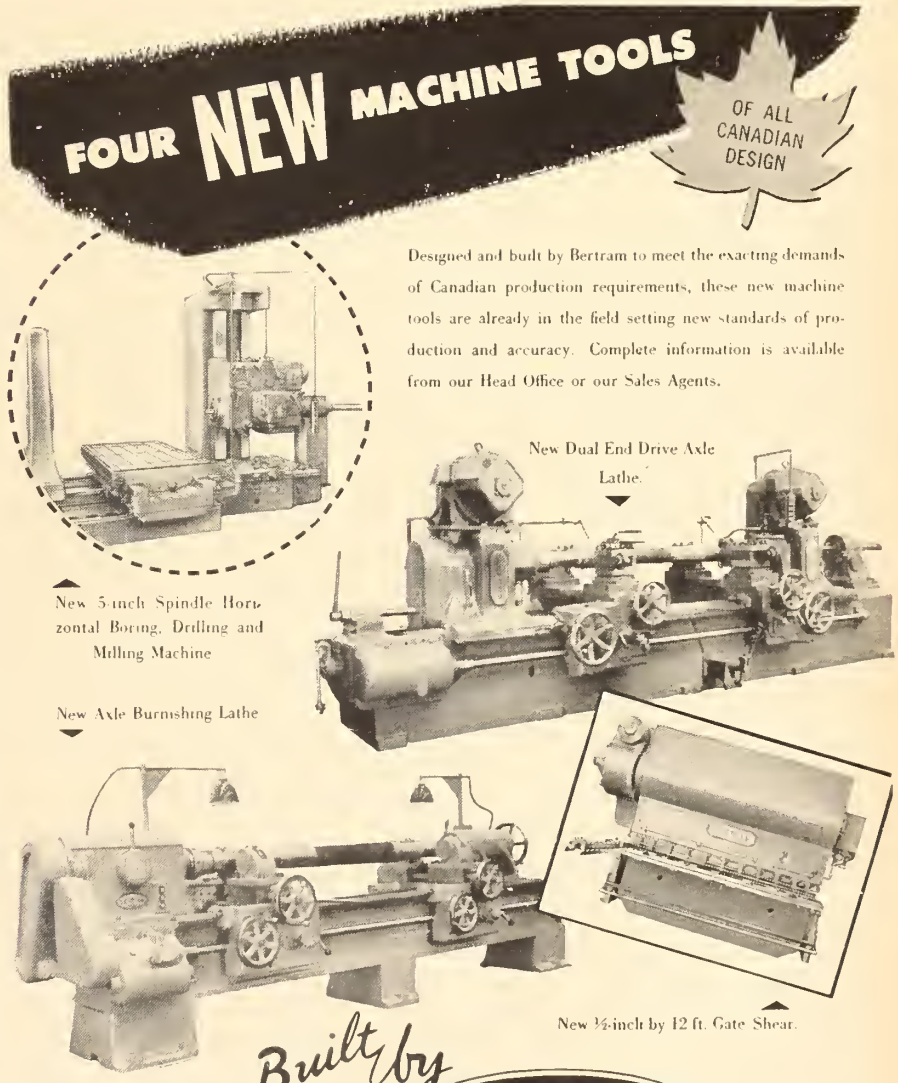
Trans-Canada undertakes to purchase the Northern Ontario Section as soon as it can arrange the necessary finances, and has an option to purchase the section at any time, provided the Crown Corporation has received an annual return of 3½ per cent on its capital during the term of the lease. The purchase price is to be the total capital cost to the Crown Corporation, minus credits to depreciation arising from rental payments, but the purchase price is not to be less than the higher of either (a) total capital cost less amortization at 3½ per cent per annum plus interest thereon compounded at 3½ per cent annually, or (b) 70 per cent of the original capital cost.

The rental payments described previously will result, as throughput grows, in payments which in due course will total more than interest plus the amortization at 3½ per cent to be credited to Trans-Canada in the purchasing price. Any such excess payments will represent a profit to the Crown Corporation or an accelerated amortization of its assets. Apart from the undertaking to purchase, it will in these circumstances become in the interest of Trans-Canada to purchase the Northern Ontario Section, since it can not otherwise receive any benefit from these excess payments. The 70 per cent floor will give a further incentive to Trans-Canada to purchase the Northern Ontario Section.

●

Ice-Free.—A way in which sections of Canada's transportation and electricity-rich waterways may be kept free of ice is being introduced this winter at the Slave Falls Dam of the City of Winnipeg Hydro-Electric System, 100 miles north of the Prairie Capital.

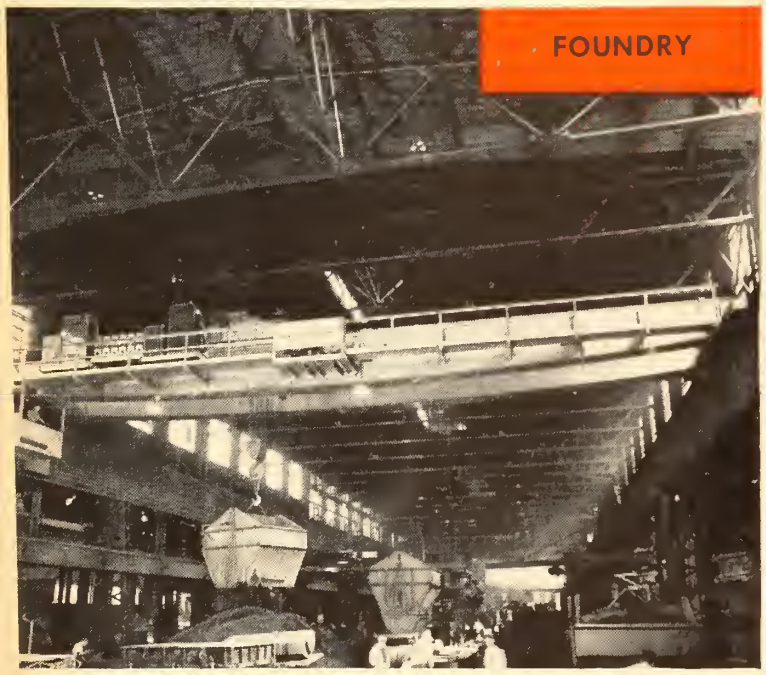
Basis of the Winnipeg method is the use of compressed air from a submerged pipeline along the 1200 foot face of the Slave Falls dam. Bubbles of air released through holes in the pipeline cause warmer water near the bottom to become lighter and rise to the surface. The result is a permanent ice-free surface, and even the removal of existing ice. The system could also be used during Canadian winters to keep open certain navigation channels, ferry routes, harbour basins, shipyards, and pulp and paper mill ponds. It has even been



SECTION OF DESIGN OFFICE

PART OF FORGE SHOP

FOUNDRY



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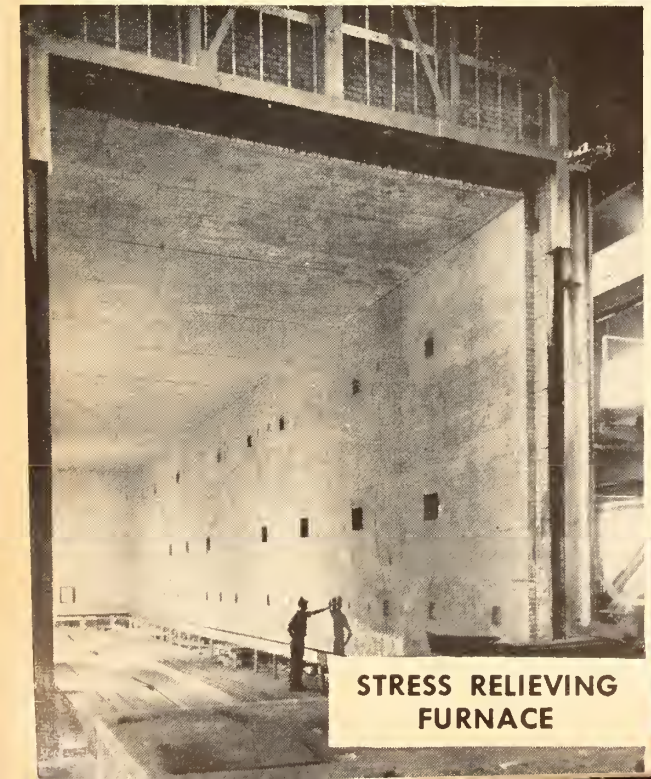

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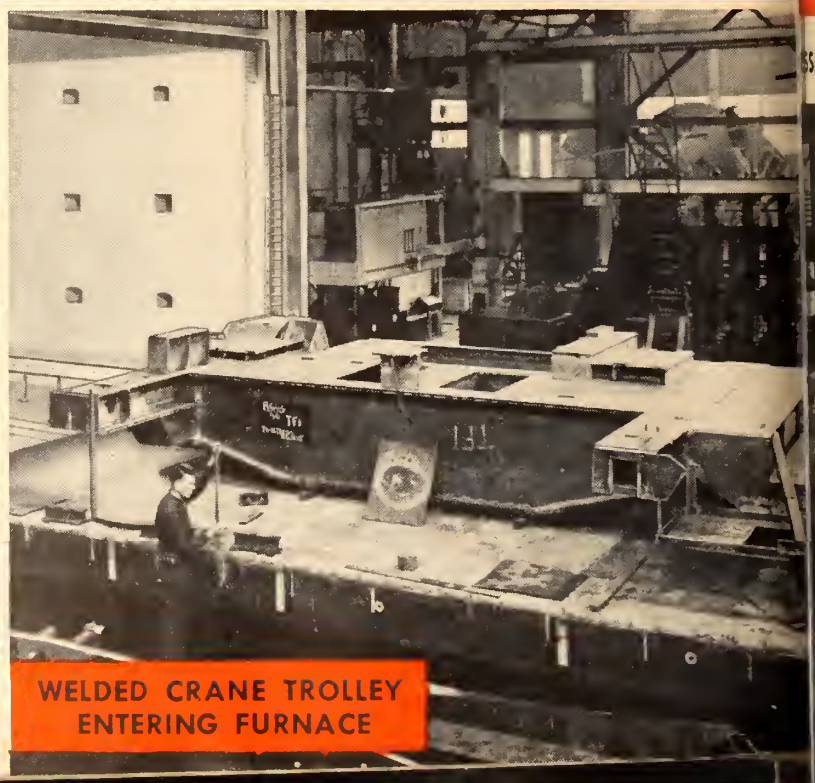
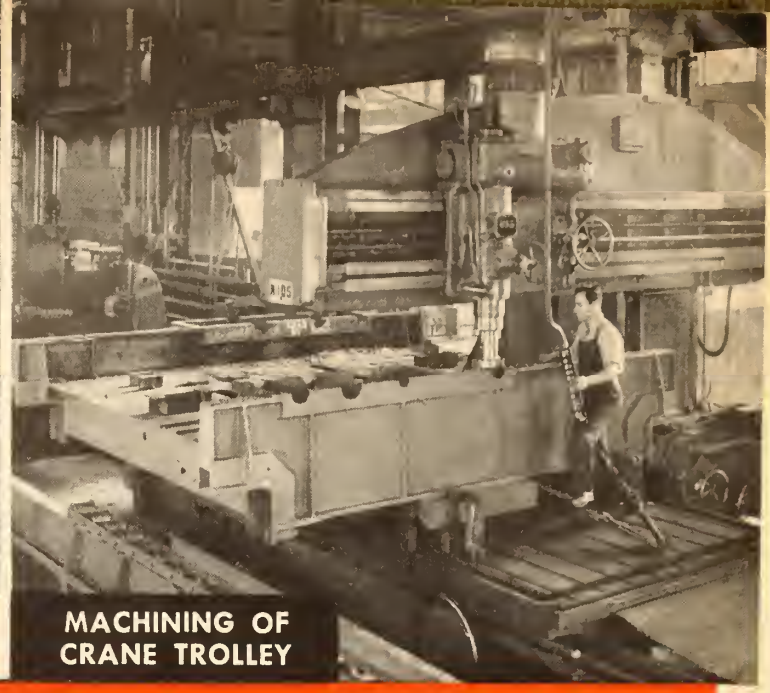


WELDED CRANE TROLLEY ENTERING FURNACE

SECTION OF MACHINE SHOP



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These plant facilities with our large and experienced design staff, enable us to provide outstanding service in the field of mechanical handling.

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OVERHEAD CRANES...ORE AND COAL UNLOADERS ...ORE AND COAL BRIDGES...PULPWOOD STACKERS...DOCK CRANES .HYDRAULIC REGULATING EQUIPMENT.. SPECIAL MACHINERY.

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used in a pond to provide comfortable ice-free conditions for swans.

The compressed air anti-freeze system has been applied successfuly in Sweden. where the climate is similar to Canada's, by the international makers of compressed air equipment, Atlas Copco, Stockholm. This organization's Canadian company worked with Winnipeg Hydro engineers on the installation of the Slave Falls bubbler system.

Until now, the principal limiting factor in ice control has been cost. Atlas Copco reports considerable savings from the compressed air system over other methods of preventing ice formation. Installation of a permanent compressed air system on the 800-yard ferry route between Adelsö and Munsö, Sweden, cost about $1600 compared to an annual outlay of about $1,000 for sawing up the route each winter.

At another installation in Sweden, a 1000-yard, 32-feet wide ferry route has been kept open for the entire winter with equipment consisting of a single plastic hose and one compressor unit with very low power consumption. The channel remained completely free of ice although temperatures dropped as low as —4°F. and ice at the shore measured 20 inches thick.

●

Research Reactor. — An industrial research reactor that will harness the atom to the needs of specific industries is being considered by a group of Canadian companies. Sponsored by the Pulp and Paper Research Institute and Isotope Products Limited, Oakville, the plan calls for participation by up to a dozen firms in the rubber, oil, chemical, metal and food industries and by the entire Canadian pulp and paper industry.

President of Isotope Products and a former Chalk River scientist who pioneered industrial use of the atom in Canada, Donald C. Brunton has announced the plan. Several firms have already agreed to participate; other companies are currently considering the proposal. The project is a unique joint effort by a group of unrelated industries to secure common benefits from atomic research.

The project, which may cost $2 million, will provide a nuclear reactor specifically designed for industrial research and industrial application of atomic energy. Preliminary study on the reactor's design will take about nine months. The reactor is likely to be operating by early 1958. Once in operation, this reactor will provide research facilities tailored to the needs of the specific industries involved. It may produce as well radio active isotopes for the participant firms.

●

Association News

(*Continued from page 1697*)

British Columbia

convenorship of Trolley Coach subcommittee.

H. R. Stirland has accepted a position with Construction Aggregates Ltd. Mr. Stirland returned from an extended vacation in Britain this spring and has since held a temporary position with the Cementation Company.

S. Palusinski, recently accepted a new position with the B.C. Engineering Company. He was formerly with J. Muirhead, electrical consultant.

F. Zielgler has left Western Bridge and Steel Fabrication to join the firm of A. B. Sanderson in Victoria.

T. F. R. Newmarch, of Powell River Co. Ltd., has been moved from Powell River where he was with the Department of Technical Services, to Vancouver where he will take over his new duties as planning assistant.

A. Cohen has taken a new position with Sandwell and Co. Ltd. He was previously with Western Consulting Ltd.

S. P. Fox, a 1952 graduate of University of British Columbia in forest engineering, is now taking further courses at the University of Toronto. He was previously working as a technical officer with the Forest Products Laboratory in Ottawa.

A. M. White recently accepted a position with the Vancouver office of Racey, MacCallum and Associates Ltd. He had been with the C. M. & S. Co. at Trail since graduation in mechanical engineering in 1949.

D. M. Story of Alaska Pine and Cellulose Ltd. is now acting field project engineer at Port Alice.

A. G. Mercer has been offered a fellowship at the University of Minnesota and intends taking a doctorate in hydraulics. He graduated in civil engineering at University of British Columbia in 1954 and has since been taking post-graduate studies at Minnesota.

R. E. Hamilton, presently with British Pacific Properties, will be leaving shortly to take up a new position with Read, Read, Jones, Christoffersen.

J. H. Parliament, of Granby Consolidated Mining, Smelting and Power Co. Ltd. has been transferred from Copper Mountain to take charge of the Granby operations at Phoenix and Lone Star properties in the Grand Forks area.

W. J. MacKenzie is presently working near Prince George as resident engineer in charge of construction of the Fraser River and Salmon River railway bridges on the northern extension of the P.G.E.R. from Prince George to the Peace River area.

H. K. Williams, formerly a Location Engineer with the Alberta Department of Highways, is now a forester with North Western Pulp and Power Ltd. at Hinton, Alta.

A. S. Nelson has accepted a position with Stolberg Construction Ltd. and will be leaving his present employer, Phillips, Barratt and Partners, on October 31.

E. W. Mountjoy, a 1955 geological graduate of University of British Columbia, is now taking post-graduate studies in geological sciences at the University of Toronto.

I. N. Jachontoff has accepted a position with Sandwell and Co. Ltd. He was formerly with Johnson-Crooks Construction Ltd. at Kitimat, B.C.

Werner Claus, who has been with the Bechtel Corporation in San Francisco, recently accepted a position with Sandwell and Co. Ltd. in Vancouver. Mr. Claus was a former resident of Vancouver and has worked for Bohna, Miller and Co. Ltd. and B.C. International Engineering.

A. C. Kenny has accepted a position with the Plywood Manufacturers' Association of B.C. and expects to leave for England in January, where he will stay as a representative of his employers. He was with Allen C. Smith and Associates formerly.

F. A. R. Willis is now with the producing department of Imperial Oil Ltd. in Regina. He used to be with the C. M. & S. Co. at Tulsequah, B.C.

I. E. Vickers has taken employment with the B.C. Power Commission in the distribution branch. He arrived in Canada from Australia last spring and since that time has been with the B.C. Electric Company in Vancouver.

E. H. Tarrant is now with the electrical department of H. A. Simons Ltd. He had previously been with Rogers Majestic Electronics.

O. T. Foss has accepted a position with A. L. Swanson and Co. in Vancouver. Previously, he was with North-West Telephone Co.

F. A. Forward, head of the department of mining and metallurgy at University of British Columbia, has distinguished himself again by winning another honour, the $1,000 McCharles prize. Announcement of the award was made by President Sidney Smith of the University of Toronto.

The prize honours Professor Forward for his work in the invention and development of a process for the recovery of uranium, copper and cobalt.

The professor returned last month from Geneva, where he was a member of the Canadian delegation to the international "Atoms for Peace" conference.

W. C. Sellens, a 1953 University of British Columbia mechanical engineering graduate has just returned to Vancouver from Montreal where he was working with Northern Electric. He is now with B.C. Telephone Co. Ltd.

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